

NTPC Limited

(A Government of India Enterprise)



GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW \pm 5 MW) EPC PACKAGE

SECTION – VI

TECHNICAL SPECIFICATION

PART - B

BIDDING DOCUMENT NO.: CS-6401-001-2

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**GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW \pm 5 MW)
EPC PACKAGE**

TECHNICAL SPECIFICATION

SECTION – VI

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PART-B
VOLUME – I
MECHANICAL

PART-B
VOLUME – I
CHAPTER – M1
ENGINE AND AUXILIARIES


CLAUSE NO.	<div style="text-align: right;">  </div> TECHNICAL REQUIREMENTS			
1.00.00	ENGINE COMPONENTS AND INTEGRAL SYSTEMS			
1.01.00	GENERAL Bidders shall offer 10 to 24 numbers of Gensets with their individual engine generator output and heat rate based on Gas analysis, provided separately in Annexure I, Volume II of Part A of this specification. The combined net plant output of all the generators shall be minimum (108 ±5 MW). The total project capacity shall be (108 ±5 MW) which shall be installed as per following schedule: 1st Year (2029) – (84 ±5) MW 2nd Year (2030) – (12 ±3) MW 3rd Year (2031) – 0 MW 4 th Year (2032) – Balance capacity to meet net plant capacity of 108 ±5 MW Out of total number of engines commissioned in 2029, maximum 2 number of identical engines shall cumulatively meet capacity of 12 ± 3 MW. Balance capacity to meet (108 ± 5 MW) shall be with identical engines complying to above installation schedule. The 2 number (maximum) of gensets meeting (12 ± 3 MW) shall be selected in such a way that transporting weight of each genset along with trailer/trolley shall not exceed 100 Tons. Note: All the supplied engines shall be compatible to fire 20 to 25% Hydrogen by volume and same shall also be demonstrated during shop test of all engines.			
1.02.00	ENGINE SYSTEM			
1.02.01	The offered engines shall be in conformance to: i) Standard: ISO 3046 ii) Quantity: 11 to 24 nos. of Engine to meet the plant capacity as specified in clause no. 1.01.00 iii) Four stroke. iv) Proven standard practice of the OEM. v) Having an embedded engine control system, controlling the combustion process individually in each cylinder. vi) RLNG as base/primary fuel. vii) Designed for continuous operation at any load between 30 -100% of power output for the fuel specified.			
1.02.02	Lubrication system: Complete and self-contained lubrication oil system for each Engine shall be provided to supply oil at required temperature and pressure to all Engine bearings. It shall be as per standard proven practice of the Engine OEM for the offered model of Gas Engine.			
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	The lubrication system shall comprise of but not be limited to following:			
	i. Wet oil sump			
	ii. Engine/Motor driven main lubricating oil pump with pressure regulating valve.			
	iii. Pre-lubricating pump with electrical motor or as per standard proven practice of OEM			
	iv. Lubricating oil cooler			
	v. Lubricating oil temperature controller.			
	vi. Lubricating oil filter, with integrated safety filter or as per standard proven practice of OEM			
	vii. Oil Mist eliminator			
	viii. Centrifugal filter or any other arrangement as per standard practice of OEM to maintain the oil parameter as desired for engine's best performance .			
	ix. Start-up / running in filters			
x. All necessary piping, valves, specialties, instrumentation and supports				
1.02.02.00	Note: All the piping, fittings, valves, Lube Oil Tanks, and complete strainers including body and element shall be of stainless steel. Further all the parts of lube oil coolers which are coming in contact of lube oil shall be of stainless steel.			
	Purification System			
	Provide permanently connected, Continuous Oil Purification system having following major equipment / features.			
	(1) Capacity and purity:			
	Oil purification system having capacity to purify 20% of total oil charge in system per hour. Purified oil shall have moisture not more than 500 PPM & max. particle size conforming to code 15/12 as per ISO 4406 or requirement of the engine manufacturer whichever is better. The above particle size and moisture content shall be demonstrated with inlet oil quality conforming to 21/18 as per ISO: 4406 and 15000 PPM moisture respectively in one pass.			
	(2) Type:			
	Centrifuge or any other type oil purification system as per engine manufacturer's standard practice. All components of the oil purification system including purifier vessel, which are coming in contact with oil shall be constructed from high grade stainless steel.			
	(3) Purification system shall have following components:			
	(i) Positive displacement feed & discharge pumps (if required), each having capacity not less than the capacity of the purification system.			
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1.02.02.01	(ii) Electric oil heater to heat oil to temperature not more than 65°C with possibility to cut heater elements in steps.			
	(4) Provision for transferring of oil from one tank to other tank including wet oil sump with or without centrifuge shall be given with necessary valve & piping arrangement.			
1.02.02.02	(5) Type test(s) to be conducted: Particle size impurities test and moisture test as detailed out in the technical specification, is to be carried out on purification system of engine.			
	Plant Lube Oil Pumps Following lube oil pumps shall be provided as per the requirements indicated: i. 2X100 % capacity pumps of min. 5 m³/hr each for Lube oil unloading from the tankers to storage tank. Necessary arrangement including unloading hose, valves etc. shall be provided with approach of oil tankers to unloading area. ii. 2X100% capacity pumps of min. 5 m³/hr each for transferring lube oil from Lube oil storage tank to the engine. iii. 2X100% capacity portable type pumps of min. 5 m³/hr each for evacuation of oil from Engines during overhaul and again transferring back the oil to Engine. All associated pipes, valves, fittings etc. shall also be supplied by the bidder.			
1.02.02.02	Lube Oil Tank (i). Following Lube oil tanks of capacity 13kL each shall be provided: <ul style="list-style-type: none">1 no. Storage tank1 no. Used/Dirty oil tank The tank shall be provided with: <ul style="list-style-type: none">2 x 100% AC motor driven vapor extraction fansLevel indicators for maximum level, minimum level and normal level.Level transmitters for remote level indication, alarm and protections.Necessary manholes with covers, platforms, railings, and access ladders.Drain points, sampling points. (ii). Lube oil tanks shall be made from suitable grade of stainless steel plates. The interiors of the tank shall be descaled and coated with a suitable paint/ oil for protection during transportation, which would dissolve with lube oil on first filling of the tank. (iii). Oil tank with top mounted equipment shall have sufficient rigidity to prevent sagging and vibration. (iv). Equipment attached to the lube oil tank shall be mounted by means of pads and all openings shall be gasketed. Further, openings on the top of the tank shall be raised at least by 25 mm. The tank top shall have adequate draining arrangement. (v). Suctions to pumps mounted on tank shall be from clean compartment of the tank. All associated pipes, valves, fittings etc. shall also be supplied by the bidder.			
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1.02.02.03	Lube Oil Coolers Cooling system for Lube oil shall be as per standard and proven practice of the Engine OEM for the offered model of Gas Engine.			
1.02.02.04	Filters and Strainers (i). For MOP/AOP/Control Oil pump (if applicable) filters, DP Indicator, DP Switch, filling line, drains/ vents fitted with suitable sight glass (as per OEM practice) and proper termination for vent/ drain lines shall be provided as per standard proven practice of the Engine OEM. (ii). All pumps in the lube oil system shall be provided with stainless steel filter/ strainer at suction (internal).			
1.02.02.05	Oil Piping and Fittings Complete piping & fittings shall be provided and following shall be ensured: a. Drain pipes have gradual slope towards oil tank. b. Pipes carrying hot lube oil are routed so as to avoid cables.			
1.02.02.06	Irrespective of the requirement of conducting the type tests under this contract, the Contractor shall submit the reports of the type tests listed in the " TYPE TEST(S) TO BE CONDUCTED " and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment same (model / type / size / rating) to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all of the specified type tests under this contract, in which case the type test charges shall not be payable for the type tests waived by the Employer.			
1.02.03	Ignition system: Ignition system shall be of: I. With individual controller to: a. Regulate fuel flow b. Regulate air/gas mixture c. Control Ignition timing d. Turning gear system, as applicable e. Starting System: By compressed air injected into the cylinders through starting air valves with protection devices or as per standard practice of OEM. f. Charge air system: g. Embedded Engine control system			
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CLAUSE NO.	<div>एनटीपीसी NTPC</div> TECHNICAL REQUIREMENTS			
1.02.04	<p>II. RLNG flow meter: Turbine type/ Coriolis type. Output data: Mass flow, Volume flow, Density, Temperature, Totalizer with local display and remote integration with DCS system.</p> <p>Air Intake and Exhaust System</p> <p>The air intake and exhaust system shall be provided with:</p> <p>(a) Air intake system:</p> <p>The offered system shall have proven service record of operation in climatological conditions similar to plant site and shall be capable of operating under most adverse site conditions, without affecting continuous operation of Engine sets and the filtration process. System shall be complete, but not limited to the following:</p> <ul style="list-style-type: none"> <li>i. Intake air Filters <li>ii. Intake air silencers – Stainless Steel <li>iii. Intake air ducting between Engine and Air filter <p>(b) Exhaust gas driven turbocharger</p> <p>(c) Charge air cooler</p> <p>(d) Rotary oil bath or Dry type charge air filter as per OEM proven practice with silencer</p> <p>(e) Exhaust gas silencer: Corten steel</p> <p>(f) Expansion bellows</p> <p>(g) Rupture discs on exhaust ducting</p> <p>(h) Necessary exhaust pipe, supports, hangers, expansion joints and insulation</p> <p>1.02.05 Starting Air System</p> <p>Type of starting air system used in Engine shall be as per standard and proven practice of the Engine OEM for the offered model of Gas Engine.</p> <p>In case of starting to be done by air, following to be followed:</p> <p>Min. 2 no. Working+1 no. Stand by starting air compressors of 60Nm³/hr, 30 bar to be provided with Air bottles and with all the piping, valves, instruments etc.</p> <p>Each Engine shall have dedicated air bottles.</p> <p>Minimum 1 No. of air bottle shall be provided for each Genset.</p> <p>The capacity of air bottle(s) for each genset shall be suitably sized for at least 3 starts of one engine at required pressure. Also, provision shall be made for interconnection of air bottles of each genset with the other.</p> <p>1.02.06 Exhaust stack</p> <p>The exhaust of each Genset shall be led through separate exhaust air ducting. The ducting shall comprise of necessary fittings, expansion joints, Reactive industrial type silencer, Rain Hoods etc. This ducting shall be routed out of the acoustic enclosure & structurally</p>			
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1.02.07	<p>supported. Vertical run of exhaust ducting shall be as per the statutory requirements of central and local pollution control board. The structural support could be common for more than one vertical run of exhaust of Gensets. The exhaust ducting and supporting structure shall be supplied and installed by the CONTRACTOR complete with all supports, hangers, hardware, expansion joints and insulation with cladding. Bending radius of pipes/ducts should be more than three times of the NB of chosen pipe.</p> <p>i) Number: one no. per engine</p> <p>ii) Height: As per MOEF&CC /CPCB/A&N administration guidelines.</p> <p>Stack Height shall be maximum of the following in meter:</p> <p>(a) $H=14Q^{0.3}$, Q= Total SO₂ emission from the plant in kg/hr.</p> <p>(b) Minimum 6m above the building where generator set is installed</p> <p>(c) 30m.</p> <p>iii) Construction: Corten Steel</p> <p>iv) Insulation and cladding as per following specifications shall be provided on exhaust ducting up to minimum height of 2 m above Engine Hall. Insulation shall be provided conforming to applicable standards and good engineering practices. Further Insulation to be provided to maintain maximum cladding surface temperature of 60°C.</p> <p>a. Insulation shall be 75 mm thick Un-bonded rock wool mattress as per IS 3690 type-2 at an application density of 64 kg/m³. Cladding shall be aluminium sheet of 20 SWG.</p> <p>b. Pipes/ducts should be painted before carrying out insulation as per applicable standards. Height of cladding shall be as per standard and confirmed by the CONTRACTOR.</p>			
	<p>Engine Cooling system</p> <p>Radiator cooled engine shall be provided. For Radiator cooled engine, the engine cooling system shall be complete, but not limited to the following:</p> <p>a) Remote Radiator type with engine/motor driven fan</p> <p>b) Frequency convertor for radiator</p> <p>c) All necessary piping, valves, specialties, instrumentation and supports</p> <p>d) Expansion tanks</p> <p>e) Circulating pump along with drive as per standard proven practise of the OEM</p>			
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	<div>f) Anti-corrosion cartridge</div> <div>g) Extra capacity to meet system degradation</div> <div>h) Preheating Unit</div> <div>i) Maintenance water tank</div>			
1.02.08	Statutory Approval <p>It shall be responsibility of the Contractor to obtain the necessary approvals of Inspection Authority/Chief Inspector of competent approving Authorities etc. on behalf of the Employer, as may be required for designing and design calculations, manufacturing and erection procedure, testing etc. as called for under the various Regulations. All such documentation submitted to statutory authorities shall also be submitted to the Employer for review. Letter of approval from such agencies/authorities shall also be submitted to the Employer for record purpose.</p>			
1.02.09	Limits of NOx Emission <p>NOx reduction shall be achieved through suitable system by the contractor to limit NOx emission value to the guaranteed conditions as specified elsewhere in the technical specifications and CPCB guidelines.</p>			
1.02.10	Noise level <p>As per standards of MoEF & CC and Central pollution Control Board (CPCB), India Refer Annexure-IA, Volume-IV, Part-A.</p>			
1.02.11	Operation and Maintenance platforms <p>Bidder shall provide access, inspection and maintenance platforms along the engine for facilitating easy access to all the components of the engine e.g., valves, nozzles, C&I instruments etc. during operation and maintenance.</p> <p>Minimum width of the platforms shall be 1500mm or as per standard proven practice of the OEM to operate and maintain the Gensets without any hindrance or difficulty.</p> <p>Interconnecting platform between different engine modules also to be provided.</p>			
1.03.00	BEARINGS <p>Bearings used in Engine shall be as per standard and proven practice of the Engine OEM for the offered model of Gas Engine.</p>			
1.04.00	SEALS <p>Seals used in Engine shall be as per standard and proven practice of the Engine OEM for the offered model of Gas Engine.</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.05.00	COUPLING Coupling for connecting Engine to generator/Alternator shall be as per standard and proven practice of the Engine OEM for the offered model of Gas Engine.			
1.06.00	TURNING GEAR SYSTEM Turning gear system shall be as per standard and proven practice of the Engine OEM for the offered model of Gas Engine.			
1.07.00	GOVERNING SYSTEM Engine governing system shall be as per standard and proven practice of the Engine OEM for the offered model of Gas Engine.			
1.08.00	Oily Water Handling System The Oily water handling system shall be complete, but not limited to the following: <div><div>i.</div><div>Oily water collection pits – 2 nos. for collection of drains from Engine Hall</div></div> <div><div>ii.</div><div>Vertical sump pumps - Min. 1W + 1S no./ per pit capable of emptying the pit in 15-20 min</div></div> <div><div>iii.</div><div>Sludge Storage Tank - 1 no. of adequate capacity (finalized during detail engineering).</div></div> <div><div>iv.</div><div>All piping, level switches, level indicators, heat tracers & insulation, if required</div></div> <div><div>v.</div><div>Sludge unloading pump unit - 1W + 1S no.</div></div>			
2.00.00	Fuel Gas System			
2.00.01	Fuel gas system of each gas engine shall be skid mounted and shall consist of following: <div><div>(i).</div><div>Last chance filter</div></div> <div><div>(ii).</div><div>Stop Valve & Control Valve shall be servo motor actuated or as per OEM standard practice.</div></div> <div><div>(iii).</div><div>Distribution piping to the gas burners</div></div> <div><div>(iv).</div><div>Flow measuring devices</div></div> <div><div>(v).</div><div>Instrumentation required for monitoring of pressure and temperature of gas.</div></div>			
2.00.02	Redundancy level and type of instrumentation in gas supply system shall be the minimum required for safe and reliable operation of the unit.			
2.00.03	Fuel gas piping downstream of the individual Absolute Filter Separator unit (not part of Gas Engine Integral System) of each gas engine shall be made of stainless steel of suitable grade.			
3.00.00	Starting System			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Engine starting system shall be of proven design and as per the standard practice of the manufacturer for the offered model.			
3.01.00	Gas Detection System for Combustible Gas & Vapors			
3.01.01	Gas detectors shall be provided at strategic locations within Engine Hall and the nearby areas. At least one sensor shall be located in close proximity to each point where leak of combustible gas or vapor is likely to occur. Gas Detection System shall consist of sensor assemblies, controllers, control power supply (with back up arrangement) and dust proof cover assembly for the sensors.			
3.01.02	Alarm and protection (Engine trip) shall be provided for gas concentration level exceeding certain set value e.g. alarm for 20% LEL and Engine trip for 60 % LEL (Lower Explosive Limit)			
3.01.03	Gas Detection System shall be designed to meet NEMA -7 requirements and suitable for Class I, Division II, Group D Area.			
3.01.04	Sensors of Gas Detection System shall be catalytic diffusion type or any other proven design with flame proof NFPA approved construction. Sensor range shall be 0 – 100 % LEL.			
3.02.00	FUEL GAS SUPPLY SYSTEM			
3.02.01	<p>Fuel gas supply system shall be capable of providing required quantity of clean, dry gas as acceptable to the Engine fuel gas quality requirements in all operating conditions including the minimum and maximum fuel consumption condition. Fuel gas supply system shall consist of following equipment/ components:</p> <ul style="list-style-type: none">(i). Emergency Stop Valve/ Shut-off valve at the inlet to isolate the station in case of emergencies (which can be operated remotely from control room).(ii). Fuel Gas Heaters, if required.(iii). Piping and Valves to make the system complete.(iv). Filtration system, if required(v). Pressure control valves, if required(vi). Gas flow meters (common to all Engines) as well as individual gas flow meter for each Gas Engine as per relevant standards.(vii). Required Electrical and C&I Equipment/ Systems.(viii). Safety Relief Valves and Gas Vents, if required(ix). All drives under this system shall be operated and monitored from Central Control Room.			
3.02.02	Gas Flow Meters			
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3.02.03	(i). For each Gas Engine, one no. of Gas Flow meter shall be provided to measure the fuel consumption by individual gas Engines. Gas flow meter common to all engines shall also be provided. Location of gas flow meter shall be as per the standard scheme for Gas Engine's integral gaseous fuel system. (ii). The type and accuracy of the Gas flow meters shall be as indicated in the relevant chapter of "Control and Instrumentation", Volume-III, Part-B, and Section VI. (iii). Design, construction, installation and operation of the Flow Meter shall be in accordance with the relevant Recommendations/ Reports from AGA/ API.			
	Piping and Valves (i). All isolation valves in gas system shall be Ball Valves of fire safe design. The trims of all ball valves, safety valves, slam shut off valves and control valves in the fuel gas system shall be made of stainless-steel material of suitable grade. (ii). Proper access and operating platforms shall be provided for the operation and maintenance of the equipment/ valves etc. (iii). Piping downstream of each of the Absolute Filter Separator unit shall be made of stainless steel of suitable grade. (iv). The Fuel Gas supply piping system shall be designed in accordance with the applicable provisions of the latest editions of ASME B 31.1 or B 31.3 and ASME B31.8. (v). Welding and stress relieving shall be as per ASME Sec.- VIII, Div. I. (vi). Hydro test pressure for piping and components of fuel gas system shall be 1.5 times the design pressure.			
3.02.04	All Electricals and Instruments in the Fuel Gas System shall be of Flame Proof/ Explosion Proof Design.			
3.02.05	All design documents of the Fuel Gas supply system shall necessarily be reviewed and vetted by the Gas Engine OEM during detailed engineering.			
4.00.00	Engine Hall EOT Cranes Quantity – 2 per Engine hall			
	(i) Rating (a) Capacity - Each EOT crane (Common for all the engines in each engine hall) capable of lifting 105% of the single heaviest equipment/components (Except Gas Engines) including lifting beam and slings etc. (as applicable) for maintenance and loading/unloading in the engine hall. However, min. 5 Tons capacity of each EOT cranes to be provided (b) Crane Span – To Suit the span of Engine Hall			
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	<p>(c) Hook level – To suit handling requirement of equipment</p> <p>(d) Top Rail Elevation – To be confirmed by vendor</p> <p>(g) Approximate maximum full load speeds</p> <p> Main Hoist 1.6m/min</p> <p> Trolley travel 4.0 m/min</p> <p> Crane travel 8.0 m/min.</p> <p>(h) Creep speed of hook – 10% of maximum Speed</p> <p>(i) Creep Speed for cross travel & Long travel - 10% of maximum speed</p> <p>(ii) Type – Electrically operated indoor travelling type</p> <p>(iii) Applicable Code</p> <p>(a) Design and duty of crane structure, main hoist, cross travel, long travel in accordance with class M5 of IS: 3177 (latest edition).</p> <p>(b) All other structure of cranes in accordance with IS-807.</p> <p>(c) Hook shank type conforming to IS 15560 (latest edition).</p> <p>(iv) Bridge structure</p> <p>(a) Vertical deflection caused by safe working load and weight of trolley in central position not to exceed 1/800 of the span.</p> <p>(b) Trolley stops of spring type to be mounted independently on bridge rails to prevent trolley from running off.</p> <p>(v) Buffer</p> <p>(a) Suitable buffer to be fitted to each end of carriage assembly and crab.</p> <p>(b) Buffers to be designed to bring the loaded crane to rest from a speed of 50% of the rated speed.</p> <p>(vi) End trucks, wheels and axles To be designed in accordance to IS: 3177 (latest edition)</p> <p>(vii) Bridge and trolley drive Mechanism</p>			
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	<p>(a) One drive at each end of bridge.</p> <p>(b) One drive for trolley drive.</p> <p>(vii) A distinct type alarm with conspicuous warning lights on either side of the crane bridge to indicate overloading of crane.</p> <p>(viii) Safe means of access shall be provided and to every place of crane where examination/maintenance of any component is involved. A platform shall extend to full length of the crane. The platform shall be made of checkered Steel plate. A double tire handrail of height 1100 mm shall be provided along the outer edge of the platform and 75mm high toe-guards shall be provided all along the platforms and wherever else required from safety consideration. The width of platform shall not be less than 800mm in width and Guard rails shall be provided on the crab side of the bridge platform.</p> <p>(ix) LADDERS: Necessary access ladders shall be provided for access on to crane bridge platform from the gantry girder level, from crane bridge platform to trolley platform and from operating floor of pump to gantry girder level.</p> <p>(x) Drums To be in accordance with IS-3177 (latest edition).</p> <p>(xi) Wire Rope</p> <p>(a) Wire rope of extra flexible plough steel and of 6/36 or 6/37 construction conforming to IS: 2266 (latest edition).</p> <p>(xii) Bearings and lubrication</p> <p>(a) The type of bearings for various parts as per IS:3177 (latest).</p> <p>(b) Bearing life not less than 10,000 working hours.</p> <p>(c) Centralized grease lubrication with hand operated grease pump for all bearings as per bidder's standard proven practice.</p> <p>(xiii) Guarding</p> <p>(a) Suitable guard to push forward or off the rail track any object placed across.</p> <p>(b) Suitable guards to live electrical wirings downshop lead.</p> <p>(c) Other guarding as per relevant standard.</p> <p>(xiv) Safety</p>			
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	<p>(a) To meet the requirements of Factories Act.</p> <p>(xv) Runway/trolley Rails and rail joints</p> <p>Rails to be as per relevant Indian Standard and joints to be butt welded by thermit welding or fusion welding.</p> <p>(xvi) Brakes</p> <p>2X 100 % Brake shall be provided for each motion. Each brake for hoisting motion, cross travel, long travel etc., shall be designed as per following:</p> <p>Brakes to be as per IS 3177. The Capacity of hoisting motion brakes to be 150% of torque transmitted to the brake drum with full load and that of cross travel and long travel to be 125% of motor rated torque before deaerating.</p> <p>(xvii) Crane shall be controlled individually for all its motions from the control pendent panel.</p> <p>(xviii) Crane shall have a permanent inscription of English on each side, readily visible from the ground level, stating the safe working loads in tonnes for the hook, year of manufacture, crane serial number and manufacturer's name.</p>			
5.00.00	<p>Factory Acceptance Test (FAT)</p> <p>Factory Acceptance Test of all the Engines and Alternators shall be attended by the owner/client.</p>			
6.00.00	<p>DOCUMENTS TO BE SUBMITTED WITH THE OFFER</p>			
6.01.00	<p>In addition to the information required as per Technical Data Sheets, Bidder's offer shall include following information/ documents for gas- Engine as minimum requirement:</p> <ul style="list-style-type: none">(i). Salient Design Features(ii). Constructional Details of the Engine – General Arrangement Drawing, Sectional Drawing, General Description and Material of Construction(iii). Scheme and Write-up for Integral Systems of the Engine(v). Technical Details and Write-up of Engine Support Systems(vi). General Operation Philosophy indicating capabilities and limitations(vii). Operation principle, NOx control capability			
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6.02.00	<p>(viii). Quality requirements for Fuel, Air and Water</p> <p>(ix). Inspection & Maintenance Guideline for Engines</p> <p>(x). Performance Curves</p> <p>Inspection & Maintenance Guideline for the Engine sets shall include following details:</p> <p>(a). Identification of major Engine part that require inspection, repairs or replacements during Scheduled Inspection.</p> <p>(b). Type of Schedule Inspections for Engine and description of activities/ jobs to be carried out during each type of Scheduled Inspection.</p> <p>(d). Design or expected life of major components</p> <p>(e). Repair and Refurbishment requirements of major equipment.</p> <p>(f). Life of Protective Coatings and TBC (Thermal Barrier Coating if provided) for all coated components.</p> <p>(g). Shutdown periods required minor inspections and major inspections.</p> <p>(h). Extent of disassembly required during each type of Inspection.</p> <p>(i). Repair/ replacement criteria for components.</p> <p>(k). Manpower (supervisory, skilled, unskilled) requirement for each type of Inspection.</p> <p>The details furnished shall be consistent with the standard established practice of the Engine model offered and the Bidder may be asked to substantiate the same.</p>			
7.00.00	<p>PRE-COMMISSIONING AND COMMISSIONING REQUIREMENTS</p> <p>Pre-commissioning and Commissioning of Engine shall be as per the standard procedure of Engine. The same shall be submitted to the Employer during detailed engineering for Information. Minimum pre-commissioning and commissioning requirements shall be as specified in following paragraphs.</p>			
7.01.00	<p>Pre-commissioning</p>			
7.01.01	<p>Some of the important Pre-commissioning activities are mentioned hereunder. However, it shall be Contractor's responsibility to draw up a detailed sequential and systematic list of checks / tests connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied under his scope. Procedure for all such checks/ tests shall be submitted to the Employer in course of detailed engineering.</p>			
7.01.02	<p>Hydraulic test for Fuel Gas system piping and other piping system as per statutory requirement shall also be carried out. All equipment/ T&P required for carrying out these hydro tests shall be arranged by the Contractor.</p>			
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7.01.03	Oil flushing of Lube oil system shall be carried out as part of pre-commissioning. Entire flushing oil requirement and other consumables along with flushing equipment shall be met by the contractor. Further, all temporary connections required for oil flushing e.g., bypass connections for bearings, temporary cooling line connections for lube oil cooler etc. shall be made by the Contractor.			
7.01.04	After completion of lube oil flushing, the complete system shall be drained and the interior of oil storage tank shall be inspected for cleanliness. The interior surfaces shall be wiped with lint free cloth. Various pipe connections shall be restored for normal operation.			
7.01.06	Fuel lines shall be cleaned by compressed air blowing after hydro test. Before charging with RLNG, the complete pipe line shall be purged by Nitrogen gas.			
7.01.07	Exhaust diffuser of Engine shall be visually inspected before the commencement of commissioning activities.			
7.02.00	Commissioning			
7.02.01	<p>Upon completion of pre-commissioning activities/ tests, the Contractor shall initiate commissioning of facilities. During commissioning, the Contractor shall carry out system checks and reliability trials on various parts / systems of the facility. The Contractor shall carry out these checks/ tests to establish that each equipment of the supply complies with the requirements stipulated and are installed in accordance with the provisions of the Technical Specifications. These tests may be conducted concurrently with those required under commissioning sequence. The Commissioning tests/ checks shall specifically include but will not be limited to carrying out necessary commissioning checks for the following:</p> <ul style="list-style-type: none">a. Operation and Functional Tests for all Integral Auxiliary Systems of the Engine (Lube oil, Turning Gear, Start-up system, Ignition System, Gaseous Fuel Systems, Air Compressor system, Fire Protection & Detection System, Engine cooling water pumps, service water pumps, potable water pumps, effluent treatment system, Electrical systems, Control and Instrument system etc.).b. Air Intake Systemc. Proper working of Interlocks & Protections of all systems.d. Electrical tests (for generator, excitation systems etc.).e. Synchronization of the Genset unit and load operation.f. Maximum Generator Capability - at 0.85 p.f.(Power factor), temperature rise limited to that applicable for class-B insulation as per IEC at 100% rated load condition.g. Performance of Emergency DG Set unit(s) at rated load.h. Vibration level and parallel operation of following equipment -<ul style="list-style-type: none">(i) Raw water transfer pumps,(ii) Engine cooling water pumps,- (iii) Service water pumps,(iv) Potable water pumps,			
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	<p>(iv) Effluent treatment system.</p> <p>i. Following shall be demonstrated at Site</p> <ul style="list-style-type: none"> Performance test of each of systems such as Hydrant, HVW Spray, MVW Spray, Inert gas extinguishing system of control room and control equipment rooms, fire detection and alarm system, Fire extinguishers and Fire monitors as per the design parameters/ standards/TAC. Parallel Operation, vibration & noise level of the fire water pumps and diesel engines. All tests as required by the TAC/ TAC accredited agency. <p>7.02.02 All interlocks and protections of Gensets shall be commissioned and proved through simulation. Employer representative shall be fully involved in all commissioning activities and all records related to control settings shall be entered in commissioning protocols.</p> <p>7.02.03 Functional test for all integral systems shall be completed in all respects during commissioning of the plant.</p> <p>7.02.04 Prior to first ignition in Engine, fire detection & protection system plant shall be commissioned and checked for safe and reliable operation.</p>			
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	<table><tr><th>Sr. no.</th><th>DESCRIPTION</th><th>Units</th><th></th></tr><tr><td>1.0</td><td colspan="3">ENGINE</td></tr><tr><td>1.1</td><td>Speed</td><td>rpm</td><td></td></tr><tr><td></td><td>Power Output (Electrical generated power)</td><td></td><td></td></tr><tr><td></td><td>a. On RLNG</td><td>kWe</td><td></td></tr><tr><td>1.2</td><td>Frequency</td><td>Hz</td><td></td></tr><tr><td>1.3</td><td>No. of Cylinders</td><td>Nos.</td><td></td></tr><tr><td>1.4</td><td>Bore size</td><td>mm</td><td></td></tr><tr><td>1.5</td><td>Swept volume per cylinder</td><td>dm³</td><td></td></tr><tr><td>1.6</td><td>No. of stroke</td><td>Nos.</td><td></td></tr><tr><td>1.7</td><td>Stroke length</td><td>mm</td><td></td></tr><tr><td>1.8</td><td>Dimensions of Genset</td><td>mm</td><td></td></tr><tr><td>1.9</td><td>Dry Mass</td><td>Tons</td><td></td></tr><tr><td>1.9a</td><td>Operating Mass</td><td>Tons</td><td></td></tr><tr><td>1.10</td><td>Coupling Type</td><td>-</td><td></td></tr><tr><td>1.11</td><td>Starting Method</td><td>-</td><td></td></tr><tr><td>1.12</td><td>Lube Oil consumption</td><td></td><td></td></tr><tr><td></td><td>a. On RLNG</td><td>g/kWhr at full load</td><td></td></tr><tr><td>1.13</td><td>Lube Oil consumption</td><td></td><td></td></tr><tr><td></td><td>a. On RLNG</td><td>Kg/hr at full load</td><td></td></tr><tr><td>1.14</td><td>Cooling</td><td></td><td></td></tr><tr><td></td><td>a. Cylinder Cooling</td><td>type</td><td></td></tr><tr><td></td><td>b. Charge Air cooling</td><td>type</td><td></td></tr><tr><td></td><td>c. 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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	1.16	Start command to full load time	minutes	
	1.17	Engine shaft driven auxiliaries	-	
	1.18	Motor Driven auxiliaries (within engine module)	-	
	1.19	NOx emission	In ppm (v/v at 15% excess) Oxygen	
	1.20	Coupling details between Engine & Generator	-	
	2.0	GENERATOR		
	2.1	Dimension	mm	
	2.2	Voltage	V	
	2.3	Mass	Tons	
	2.4	Cooling	type	
	3.0	BASE FRAME		
	3.1	Type		
	3.2	Dimension		
	3.3	Fastening/Fixing Type		
	3.4	Material		
	4.0	Gas System	Details	
	5.0	Engine Lubrication System	Details	
	6.0	Lube Oil system facility	Details	
	7.0	Compressed Air System	Details	
	8.0	Starting Air System	Details	
	9.0	Engine Cooling System	Details	
	10.0	Charge Air System	Details	
	11.0	Exhaust System	Details	
	12.0	NOx Control System	Details	

PART-B
VOLUME – I
CHAPTER – M2
LAYOUT REQUIREMENT


CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>	
1.00.00	LAYOUT REQUIREMENTS			
1.01.00.1	Broad Guidelines for General Layout Plan General layout plan including indicative/ suggestive Main Plant area for the proposed Gas Power plant is as shown in the tender drawing. It shall form the basis for further elaboration by the Bidder for the plant facilities, which are in his scope. Plant to be installed within the area allocated for the Gas Power plant. However, Bidder may optimize the space utilization from safe erection, good & safe operation and maintenance aspects.			
1.01.02.1	Bidder shall develop detailed layout for the equipment offered in the main plant block considering sequential erection & ease of operation and the same are to be clearly brought out in the bid. Further while preparing the detailed layout, planning the facilities in the Bidder's scope and deciding upon the transportation and construction/ erection strategy and functional requirements, the bidder shall ensure the following aspects:			
	a)	The area for construction/erection facilities like lay-down, pre-assembly, offices and stores is to be managed by the Bidder. In case bidder requires additional area, he shall make his own arrangement at his cost outside the plant boundary. Development of the same including security etc. for the intended use will also be his responsibility.		
	b)	Face of the buildings and facilities shall be located in such a way so as to avoid interference of building foundation with road shoulder and drain. The spacing between various buildings and facilities shall be suitably decided so as to avoid interference between their foundations.		
	c)	All the buildings and facilities shall be approachable by fire tenders.		
	d)	All statutory requirements including safe distances between various facilities as per applicable rules/acts/laws including local bye-laws shall be met.		
1.02.00	Equipment layout			
1.02.01	While developing the layout, the Bidder shall ensure following minimum requirements:			
	1.	Number of Maintenance Bays	Minimum one (1) no. on one side of each Engine-hall.	
	2.	Utility Block	Minimum 2 tier common Utility block to be provided. At 1st tier Common Control Room (CCR) and Control Equipment Room (CER) to be provided. PLC/DCS for controlling Electrical breakers shall also be kept in CCR. 2nd tier shall have provision of Inert gas room, Office space, Meeting/Conference Rooms, Store, Pantry room etc.	
	3.	Arrangement of Gensets	Transverse.	
	4.	Basement, Pits & Trenches	Regular Basement floors are not acceptable in	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<div>Engine Hall building.</div> <div>5. Minimum clear working space around the equipment</div> <div>1200 mm</div> <div>6. Minimum width of all Staircase</div> <div>1200 mm</div> <div>7. Clear Headroom at different floor Within Engine Hall & Utility Block Below pipes, ducts, structures & Cable trays etc.</div> <div>2.5m (minimum)</div>			
1.02.02	Arrangement for the removal/handling of equipment to the maintenance bay to be provided. Further, adequate space and provision for handling/removal of pumps, motors, fans, Switchgear Panels, Transformers and other equipment during maintenance shall be provided with proper approach.			
1.02.03	For the equipment located outside the Engine Hall building suitable handling arrangement shall be provided by the bidder.			
1.02.04	All handling arrangements including special arrangements like trolley, trolley drive pedestals etc. for carrying out Inspection/ maintenance of Engine, Generator/Alternator and their auxiliaries shall be provided by the bidder.			
1.02.05	Inside each Engine Hall minimum 2 nos. EOT crane is to be provided which shall be able to travel complete length of Engine hall and passage way envisaged below the Utility Block. Capacity of the Engine Hall EOT Crane shall be as mentioned elsewhere in the specification.			
1.02.06	In Engine Hall at EOT crane rail level, chequered plate walkway of minimum 500mm clear width from face of the column to the handrail (excluding handrail) on crane side to be provided at column sectional depth for full length of the building. Cage ladder shall be provided for reaching the EOT crane operators cabin (if provided) and walkway level.			
1.02.07	Proper approach shall be provided for access to all equipment during normal operation and maintenance. Unless otherwise specified, platforms, staircases and ladders shall follow the stipulations specified elsewhere in this specification.			
1.02.08	Equipment requiring monitoring during regular operation shall be approachable from the nearest floor level through staircase. Staircase with minimum width of 1200 mm shall be provided for approach to elevated structures at 5m height from the nearest platform. Below this height ship ladder will be preferred. However, vertical cage ladder with minimum clear width of 600 mm may also be acceptable.			
1.02.09	Valves including actuators and instrument tapings shall be located in accessible positions and operating/maintenance platform for the same shall be provided. All piping shall be routed at a clear height of 2500mm (min.) from the nearest access level to clear man movement.			
1.02.10	Lift landing levels shall be provided for Control Room, Control Equipment Room, and each floor and up to the topmost floor of the Utility Building. Location of Lifts shall be fixed during detail engineering stage while finalizing Plant Layouts. For further technical details refer respective portion of the Technical Specification.			
1.02.11	(a) All safety requirements as per Factories Act, National Electricity Code etc. shall be complied with while developing the layout.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(b)	Switchgear room, Common Control Room, CER and other electrical room/buildings shall be provided with alternate exits in case of fire/accidents as per requirements of Factories Act and TAC. Further, minimum two number fireproof double door shall be provided in Cable vaults and Switch gear rooms.		
1.02.12		Cable trenches/slits, if unavoidable, shall be provided with adequate cushioning of sand and the same shall be covered with PCC.		
1.02.13		For the routing of cable trays & piping which includes Fuel oil & gas pipes, Water piping, Fire Protection pipes etc. Bidder to ensure the following-		
	I.	Gallery and Trestle height in outlying area shall be 3.0 m (headroom).		
	II.	Pipe/Cable gallery structure height at road crossings shall be min. 8m (headroom).		
	III.	Fire water pipes shall be routed either on trestle or shall be supported from main plant structure or shall be buried wherever not feasible. Wherever oil & gas pipes are running over the trestle, fire water pipes shall not be routed on the same trestle. Further, all other pipes shall be routed over ground either on pedestals or on trestle in plant area. No trenches for pipes shall be envisaged as far as possible. All Road crossing of pipes shall be through heavy duty Hume pipe only.		
	IV.	A walkway of 600mm (minimum width) with handrails & toe guards shall be provided all along length of the gallery and trestle for installation and maintenance of cables. Ladders for approach to these platforms shall be provided near roads, passage ways and turning points.		
	V.	Head room for personnel movement shall be 2.1m over the walkways in Pipe/cable trestle galleries for all tiers.		
	VI.	Height of trestle galleries at approach roads to various buildings/facilities shall be 8m. In case building are located in off-site area and are adjacent to each other, then as a good engineering practice, the height of trestle shall be maintained all over as 8.0m.		
1.02.14		Electrical MCC/switchgear rooms		
	1.	The following clearances shall be maintained for HT/LT Switchgear.		
	a.)	Front Clearance:		
		i)	For one Row of Swgr.	- 2.0 M (Min)
		ii)	For two Rows of Swgr.	- 2.5 M (Min)
	b.)	Back Clearance	-	1.5 M (Min.)
	c.)	Side Clearance: Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore, end clearance shall be 800+width of panel (including spare panels/dummy panels etc.)		
	2.	Height of HT/LT Switchgear Room:		
		i)	With Bus Duct	- 4.5 m (min)
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	ii)	Without Bus Duct	–	4.0 m (min)
1.02.15	Cable vault shall have 800 mm wide and 2.1 m high movement passage all around the cable trays in the cable vault for easy laying/maintenance of cables. Proper unit wise segregation / separation of cables shall be provided in cable vault area. Switchgear and control panel shall be placed at different elevations.			
1.02.16	The Transformer fencing shall be at 1.0 M (minimum) distance from the pit wall. The Height of fencing shall be 2.5 M (minimum) and fencing shall have personal entry gate and removable type fencing/gate for transformer withdrawal.			
1.02.17	For all outdoor transformers a pit shall be provided all around at a distance of 1.0 m (minimum) from transformer outer edge. A sump pit shall be provided for each pit.			
1.02.18	Central Control Room All equipment of Air-conditioned Central Control Room housing the system panels, Control desk, OWS, UPS, and Battery etc. shall be provided by the Contractor. Battery shall be located in air ventilated area inside the Control Room. Control Room shall have sufficient free space for movement. Glass partition shall be provided between Central Control Room & Control Equipment Room by the Contractor. The final design of the Control Room shall be finalized during detailed engineering. The following clearances to be maintained for C&I cabinets: <div><div>i)</div><div>Inter panel spacing</div><div>-</div><div>1200mm</div></div> <div><div>ii)</div><div>Clearance from back wall</div><div>-</div><div>1200mm</div></div> <div><div>iii)</div><div>Clearance from front wall</div><div>-</div><div>1200mm</div></div> <div><div>iv)</div><div>Clearance from side wall</div><div>-</div><div>1000mm</div></div> The above clearances are the minimum requirement and may increase with increase in door swing of the cabinets. The cable laying space below the false flooring in the central control room and control equipment room shall be at least of one meter height. Proper Generator wise segregation / separation of cables shall be provided below false flooring area.			
1.03.00	Storage Rooms for Mandatory Spares and Other Spares for O&M Rooms shall be provided in the Utility building and Off-site area for storing mandatory and other spares for O&M. This space shall be in addition to the area for laydown and maintenance requirements specified elsewhere in the Technical Specification.			
1.04.00	Laydown area for maintenance and overhauling: I. The layout of the Engine Hall shall permit sufficient laydown area for all the parts/components to enable carrying out maintenance and overhauling operations without any restrictions and without any hindrance to the operating personnel of other Engine modules. II. The Bidder shall furnish general arrangement drawings indicating the equipment lay down area with details such as blocks indicating orientation of dismantled items, travel path etc.			
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PART-B
VOLUME – I
CHAPTER – M3
WATER SYSTEM

CLAUSE NO.	WATER SYSTEM			
1.00.00	TECHNICAL REQUIREMENTS OF WATER SYSTEM AND ASSOCIATED EQUIPMENTS: This Chapter describes the system description, technical requirements of Raw water system, Water & effluent treatment system, UF-RO system, Reject handling system and its associated system/equipment. The minimum technical requirements and equipment shall include but not be limited to the followings. The specification covers general requirements in respect of design, material, constructional features, manufacture, inspection, testing the performance at the Vendor's/ Sub-Vendor's works and delivery to site erection, field testing and commissioning of equipment/system. All materials and components of equipments, valves, pumps and piping etc. shall be compatible with sea water environment /chemical/fluids being handled.			
2.00.00	SYSTEM DESCRIPTION It has been envisaged to collect the rainwater in rainwater harvesting reservoirs to meet the water demand for its conceived integrated project for holistic development of Great Nicobar Islands (GNI). Accordingly, it has been conceived that fresh water shall be used for power plants (i.e. Engine jacket cooling, Lub oil cooling, potable water, Service water, intermittent fire water requirements etc.), which shall be supplied by ANIDCO at one point nearby proposed power plant from rainwater harvesting reservoirs. Raw water supplied by ANIDCO shall be collected in Raw water tank/sump (nearby plant boundary) for further pumping it to raw water reservoir via Raw water transfer pumping system. Further, raw water pumps located at Raw water pumps house (RWPH) near raw water reservoir shall pump the raw water for its treatment at pre-treatment plant & secondary treatment (Dual media filtration) system. UF-RO system shall further treat the secondary treated water to meet the water quality required for engine make-up system. To proposed plant shall be ZLD complied. To comply the ZLD requirement, plant shall have effluent treatment system, Sludge & RO reject handling system to treat the generated effluent for its reuse and recycle internally. Sludge handling system has been envisaged for collection, its dewatering and drying the sludge generated from treatment plant. Decanted water from sludge shall be treated for its re-use/recycle and dried sludge/cake shall be discharged at designated place through movable trolley (Not in bidder's Scope).			
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3.00.00	<p>RO reject shall be transferred into a solar evaporation pond for its evaporation and further use in horticulture/ surface cleaning etc as much as possible. Balance RO reject (if any) shall be discharged into the sea complying to ANPCC norms & at a suitable location specified elsewhere.</p> <p>Raw water analysis is attached herewith as Annexure-II of Project Information chapter for design of suitable water treatment system.</p> <p>(a) Lamella clarifier/ Thickener</p> <table><tr><td>Sl No</td><td colspan="3">Lamella clarifier/ Thickener</td></tr><tr><td>(i)</td><td>Material of construction</td><td colspan="2">FRP / Carbon Steel with Polyurethane coating (2mm thick min)</td></tr><tr><td>(ii)</td><td>Drive</td><td colspan="2">Slow speed Motor driven through reduction gear unit or variable frequency drive as per manufacturer's standard.</td></tr></table> <p>(b) Tube Settler</p> <p>The material of Tube settler shall be of FRP / Carbon Steel with Polyurethane coating (2mm thick min). The material of tube pack shall be UV inhibited virgin PVC. In case of plate type separator, the plates shall be made of GRP (glass reinforced plastic). The resin for the manufacturing of GRP plates shall be orthophthallic type. The length of the tubes/plates through which the water flow shall not be less than 1.5 m, the tubes/plates shall be inclined by 50-80 deg. angle to the horizontal. Angle of inclination of sludge hopper shall be minimum 55 Deg to horizontal plane.</p> <p>(c) Common for Lamella clarifier/ Thickener / Tube Settler</p> <p>Walkway (bridge) and platform to approach all the internals of Tube settler / lamella clarifier / Thickener shall be provided. Clear width of the bridge shall not be less than 1000 mm. Suitable walkway around periphery of Tube settler / lamella clarifier / Thickener with hand-railing, access ladder with platform, hand railing to be provided. Suitable water jet arrangement shall be provided. All the pipelines carrying the sludge shall be provided with flushing connection.</p>				Sl No	Lamella clarifier/ Thickener			(i)	Material of construction	FRP / Carbon Steel with Polyurethane coating (2mm thick min)		(ii)	Drive	Slow speed Motor driven through reduction gear unit or variable frequency drive as per manufacturer's standard.	
	Sl No	Lamella clarifier/ Thickener														
	(i)	Material of construction	FRP / Carbon Steel with Polyurethane coating (2mm thick min)													
	(ii)	Drive	Slow speed Motor driven through reduction gear unit or variable frequency drive as per manufacturer's standard.													
4.00.00	<p>Agitator</p>															
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CLAUSE NO.	WATER SYSTEM			<div>एनटीपीसी NTPC</div>
5.00.00	Sl No	Description	Parameter	
	i)	Application	Flash Mixer and any other area (as per bidder design)	
	ii)	Type of agitator	Motorized Vertical type with reduction gear unit	
	iii)	Accessories	The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal (for side entry agitators), impeller, support legs, agitator mounting flange including bolts nuts and gasket etc	
	iv)	Material of Construction		
	a)	Agitator shaft & Impeller	FRP	
	b)	Base Frame	Carbon Steel with Polyurethane coating (2mm thick min)	
	Dual Media Filter (DMF)			
	Sl No		Parameter	
	i)	Type of filtration unit	Horizontal/Vertical cylindrical pressure vessel with dished end confirming to IS: 2825	
	ii)	Design Standard	ASME Sec -VIII	
	iii)	Design Pressure	8 Kg/cm2(g) (Min)	
	iv)	Design Temperature	10 Deg C higher than Max temp of that any part of vessel is likely to attain	
	v)	Maximum velocity of filtration	10 m/hr. at design capacity	
	vi)	Minimum Free Board (Left over the filtering media) to facilitate backwashing	75%	
	vii)	Backwash requirement	As per manufacturer's standard	
	viii)	Maximum Velocity during backwashing	35.0 m /hr	
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CLAUSE NO.

WATER SYSTEM

	when air scouring employed	
ix)	Duration of air Scouring	As per manufacturer's standard
x)	Corrosion allowance	Min 2 mm
xi)	Thinning allowance for dished end	Min 2 mm
xii)	Material of construction	
a)	Vessel	Carbon steel confirming to SA 515 Gr 70 or SA 516 Gr.70 with Polyurethane coating (2mm thick min.) or rubber lining with 4.5 mm thick
b)	Thickness of Shell & Head	8 mm (Minimum)
c)	Nozzle flange, manhole / cover	Same as vessel including lining as noted
xiii)	Accessories	Sight Glass, Vessel support, Lugs, foundation bolts, inserts, drain & vent connection with suitable valve etc
xiv)	Details of filtering medium of filter (Minimum)	
a)	Type of media	Anthracite & Quart Sand
b)	Type of supporting media	Gravel
c)	Depth of Filter media (Min)	1000 mm (500 mm Sand & 500 mm Anthracite)
d)	Properties of Sand	
e)	Depth of supporting media (Min)	350 mm
f)	Particle size in mm	0.6 -1.2
g)	Uniformity Co-efficient	1.3-1.7
h)	Silica Content	More than 99.8%
i)	Specific Gravity of media	2.55-2.65

j)	Particle Size of Gravel in mm	2-6 / 6-12 / 12-25/25-40
k)	Properties of Anthracite	
l)	Uniformity Co-efficient	1.6
m)	Dust content	< 1%
n)	Sp. Gravity	1.3 to 1.75

6.00,00


Belt Press


The Belt Press shall be used for dewatering the sludge coming out of preceding thickener. The Belt Press shall be designed for continuous operation. The Belt Press design shall be as per manufacturer's standard. The outlet of thickener shall be pumped into the Belt Press system by the help of screw pumps. The dried solid cake from the Belt Press shall flow by gravity. The Belt Press shall be located at an elevated platform, at least 3.5 M above (clearance should be sufficient for truck movement) the finished floor level so that dried cake can be directly discharged into hydraulic operated trolley. The Belt Press system shall be provided with washing lines for its cleaning. All parts coming in contact with the fluids shall also be made of SS-316 material and other parts shall be of Carbon Steel with Polyurethane coating (2mm thick min).

7.00.00


Air Blower


	Application	As applicable
i)	Blower type	Air cooled Rotary Twin Lobe type or centrifugal type, (Oil free)
ii)	Service	Continuous & Outdoor
iii)	Fluid Handle	Atmospheric Air
iv)	Pressure Relief valve	Spring Loaded with 10 % of Blower Capacity,
v)	Noise	< 85 dBA at 1 mtr from Blower
vi)	Drive	As Required (Min 15 % margin over BkW at rated duty point, Not less than the Maximum power required by blower)
vii)	Material of Construction	


CLAUSE NO.	<div style="text-align: right;">  </div> WATER SYSTEM		
	a)	Casing, Impeller /Lobe	Cast Iron to IS:210 FG 260
	b)	Shaft	Carbon steel BS:970 En-8/ANSI-1045
	c)	Gears	Carbon steel
	d)	Coupling Pulley	Carbon steel
	e)	Base Frame	Carbon steel with Polyurethane coating (2mm thick min.)
8.00.00	Oil skimmer Oil skimmer shall be provided so that oil impurities floating on the sump is skimmed and collected in a tank located over ground. Facility shall be provided to collect free oil to a MS oil drum of 200 liters capacity.		
9.00.00	Ultrafiltration (UF) System UF membrane shall be capable of producing UF permeate by removing colloidal silica level to the extent suitable for downstream reverse osmosis (RO) unit. The system shall be designed to allow multiple starts and stops without affecting the service life of the membranes. The system may experience extended periods of no flow; system design shall protect the system against periods of no flow as recommended by membrane manufacturers. Spent chemicals from the chemically enhanced backwashing & CIP shall be neutralized in Neutralization pit. Online Turbidity transmitter, online Membrane cleaning system, on-line membrane flushing system local grab sampling points shall be provided.		
10.00.00	Reverse Osmosis system (ii) Each stream shall be capable of operating either independently or in combination with the other ones. The streams shall be skid-mounted and be furnished completely with all headers and related piping, mounted on the skid. The skid should be designed to provide ample room for servicing and monitoring the equipment. The isolation or removal of an individual permeator for testing or servicing shall be possible while the RO-train is in operation, by means of flexible, self-closing couplings. (ii) The permeate water is discharged to product water system where it is treated for removal of excess CO ₂ , correction of pH, correction of alkalinity (for potabilization, if applicable) etc. and stored. Permeate		
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	<p>shall be delivered to respective Degassifier thru dedicated Suck-back arrangement (if applicable). Cleaning and Flushing systems shall be provided for membrane protection.</p> <p>(iii) Pressure vessels- The design, fabrication, and testing requirements for the pressure vessels shall be in accordance with ASME Section X to allow a code stamp, or meet the minimum requirements of ASME Section X.</p> <p>(iv) Clean in place system (CIP)- The cleaning system shall be designed for cleaning and sterilizing of minimum one train of the RO system separately. The RO-plant shall be provided with fixed pipe connections. Provisions must be made for the neutralization and disposal of chemical cleaning waste.</p> <p>(v) Degasser system (if applicable)- Degasser tower shall be designed to reduce dissolved Carbon-dioxide (Co2) in treated water to the level indicated in the guarantees. Fill Material of degasser tower shall be Polypropylene or equivalent. Blowers shall be provided to remove Co2 from water. Degasser tower & degassed water tank shall be internally rubber lined of minimum thickness of 4.5 mm and externally painted with epoxy.</p>			
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	Annexure-IA			
	GENERAL SPECIFICATION FOR HORIZONTAL PUMPS			
(1)	SCOPE			
	This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps.			
(2)	CODES AND STANDARDS			
	The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.			
(3)	LIST OF APPLICABLE STANDARDS			
	IS : 1520	:	Horizontal Centrifugal Pumps for clear cold fresh water	
	IS : 5120	:	Technical requirements of rotodynamic special purpose pumps	
	API : 610	:	Centrifugal pumps for general refinery service.	
	IS : 5639	:	Pumps Handling Chemicals & corrosion liquids	
	IS : 5659	:	Pumps for process water	
	HIS	:	Hydraulic Institute Standards, USA	
	ASTM-1-165-65	:	Standards Methods for Liquid Penetration Inspection.	
	In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.			
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(4)	DESIGN REQUIREMENTS			
	(a) The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also, the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve. The operating range of the pump shall be 40% to 120% of the duty point unless otherwise mentioned elsewhere. The maximum efficiency of pump shall preferably be within ± 10% of the rated design flow as indicated in data sheets.			
	(b) The total head capacity curve shall be continuously rising from the operating point towards shut – off without any zone of instability with the highest head at shut-off condition. Shut-off head shall be more than the rated design head and the percentage variation may vary depending on the specific speed of the pumps (i.e) 10-15% for pumps of specific speed upto1000 US units, about 15 to 20% for specific speed in the range of 1000 to 2000 US units, about 20% to 40% for specific speed of 2000 to 4000 US units and above 50% for specific speed of 4000 to 7000 US Units.			
	(c) Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.			
	(d) Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration(displacement) limits shall be restricted to the following values (with corresponding velocity) during operation:			
	Speed	Antifriction Bearing	Sleeve Bearing	
	1500 rpm and below	75.0 micron	75.0 micron	
	3000 rpm	50.0 micron	65.0 micron	
	The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment surface.			
	(e) The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements.			
(f) Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.				
(g) The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.				
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(5)	DESIGN CONSTRUCTION			
	<p>(a) Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets shall be referred to.</p> <p>(b) Pump Casing Pump casing shall have axially, or radially split type construction as specified. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature. Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.</p> <p>(c) Impeller Impeller shall be closed, semi-closed or open type as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled. The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.</p> <p>(d) Impeller/Casing Wearing Rings Replaceable type wearing rings shall be provided at suitable locations of pumps as per manufacturer's standard practice. Suitable method of locking the wearing ring shall be used.</p> <p>(e) Shaft The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed. The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.</p> <p>(f) Shaft Sleeves Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland. Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.</p> <p>(g) Bearings</p>			
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	<p>Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble-free operation shall be furnished.</p> <p>The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life of 20,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.</p> <p>Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly. Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.</p> <p>(h) Stuffing Boxes</p> <p>Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.</p> <p>(i) Mechanical Seals</p> <p>Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.</p> <p>(j) The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.</p> <p>(k) Pump Shaft Motor Shaft Coupling</p> <p>The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of</p>			
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(6)	<p>the pump without disturbing the motor. Necessary coupling guards shall also be provided.</p> <p>(l) Base Plate A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed, and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.</p> <p>(m) Assembly and Dismantling Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.</p> <p>(n) Drive Motor (Prime Mover) Continuous Motor rating (at 50⁰ C ambient) shall be at least ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and in no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump. The KW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).</p>																								
	<p>Technical Data sheet of Horizontal Centrifugal Pumps</p>																								
	<table><tr><th>No</th><th>Designation\ Application</th><th>Horizontal Centrifugal Pumps (Other Than RO Reject handling Pumps)</th></tr><tr><td>1)</td><td>Operating Speed</td><td>1500 rpm (nominal)</td></tr><tr><td>2)</td><td>Pumps and drives to be designed for</td><td>Outdoor duty & Continuous Operation</td></tr><tr><td>3)</td><td>Location of pumps</td><td>Respective areas Pump as per Bidder's Scope</td></tr><tr><td>4)</td><td>Type of lubrication</td><td>Grease</td></tr><tr><td>5)</td><td>Suction condition</td><td>As per Respective areas Pump</td></tr><tr><td>6)</td><td>Type of Shaft Sealing</td><td>Gland packing / Mechanical Seal</td></tr></table>				No	Designation\ Application	Horizontal Centrifugal Pumps (Other Than RO Reject handling Pumps)	1)	Operating Speed	1500 rpm (nominal)	2)	Pumps and drives to be designed for	Outdoor duty & Continuous Operation	3)	Location of pumps	Respective areas Pump as per Bidder's Scope	4)	Type of lubrication	Grease	5)	Suction condition	As per Respective areas Pump	6)	Type of Shaft Sealing	Gland packing / Mechanical Seal
	No	Designation\ Application	Horizontal Centrifugal Pumps (Other Than RO Reject handling Pumps)																						
	1)	Operating Speed	1500 rpm (nominal)																						
	2)	Pumps and drives to be designed for	Outdoor duty & Continuous Operation																						
	3)	Location of pumps	Respective areas Pump as per Bidder's Scope																						
	4)	Type of lubrication	Grease																						
	5)	Suction condition	As per Respective areas Pump																						
	6)	Type of Shaft Sealing	Gland packing / Mechanical Seal																						
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	7)	Type of coupling (motor & pump)	Flexible
	8)	Material of Construction	
	i)	Casing, Stuffing Box, Gland	ASTM A CF8M / SS 316
	ii)	Impeller	ASTM A351 CF8M
	iii)	Wearing rings (if applicable)	SS – 316
	iv)	Shaft & Shaft Sleeves	SS-316
	v)	Fasteners	SS 316
	vi)	Gland packing	Teflon Impregnated
	vii)	Gasket	Neoprene Rubber
	viii)	Base plate	Carbon Steel (Min 2 mm PU coating) (Min 12 mm thick)
	9)	Accessories	a. Required Instrumentation b. Companion flanges with nuts, bolts and gaskets, Anchor bolts, nuts, sleeves and inserts. c. Internal piping with valves, filters & Instruments for sealing/ cooling/ lubrication system up to and including isolating valve etc. d. Positioning dowels, Eye bolts, lifting etc. e. Ladders, Platforms & Other accessories
(6)	Technical Data sheet of RO Reject handling Pumps		
	No	Designation\ Application	Horizontal Centrifugal Pumps (RO Reject handling Pumps)
	1)	Operating Speed	1500 rpm (nominal)
	2)	Pumps and drives to be designed for	Outdoor duty & Continuous Operation
	3)	Location of pumps	Respective areas Pump as per Bidder's Scope
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4)	Type of lubrication	Grease
5)	Suction condition	As per Respective areas Pump
6)	Type of Shaft Sealing	Gland packing / Mechanical Seal
7)	Type of coupling (motor & pump)	Flexible
8)	Material of Construction Note (*) – Having PREN (Pitting Resistance Equivalent Number) greater than 40	
i)	Casing, Stuffing Box, Gland	ASTM A890 Gr5A/ASTM 995 Gr 5A/ASTM 744 CN3MN -Refer Note (*)
ii)	Impeller	ASTM A890 Gr5A/ASTM 995 Gr 5A/ASTM 744 CN3MN -Refer Note (*)
iii)	Wearing rings (if applicable)	Duplex Stainless Steel
iv)	Shaft & Shaft Sleeves	ASTM A473 S32760 - Refer Note (*)
v)	Gland packing	Teflon Impregnated
vi)	Gasket	Neoprene Rubber
vii)	Fasteners	Duplex Stainless Steel
viii)	Base plate	Carbon Steel (Min 2 mm PU coating) (Min 12 mm thick)
9)	Accessories	a. Required Instrumentation b. Companion flanges with nuts, bolts and gaskets, Anchor bolts, nuts, sleeves and inserts. c. Internal piping with valves, filters & Instruments for sealing/ cooling/ lubrication system up to and including isolating valve etc. d. Positioning dowels, Eye bolts, lifting etc. e. Ladders, Platforms & Other accessories

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	<div style="text-align: right;">Annexure IB</div> <div style="text-align: center;">GENERAL SPECIFICATION FOR SUBMERSIBLE PUMPS</div> <div> <div>1.00.00</div> <div>SCOPE</div> <div>1.01.00</div> <div>This specification covers general requirements in respect of design, material, manufacture, construction, testing & inspection at Vendor's / sub-vendor's delivery to site, of submersible pumps. The minimum technical requirements and equipment shall include, but not be limited to the following:</div> <div>2.00.00</div> <div>CODES AND STANDARD</div> <div>2.01.00</div> <div>List of Applicable Indian Standards</div> <div>IS: 8034 - Submersible pumps for clear cold fresh water</div> <div>IS: 5120 - Technical requirement of Rotodynamic Special Purpose pumps.</div> <div>3.00.00</div> <div>DESIGN AND PERFORMANCE REQUIREMENTS</div> <div>a) The pump shall be of single stage mono - block type with non-clog design driven by squirrel cage induction motor type.</div> <div>b) Components of Identical pumps shall be interchangeable.</div> <div>c) Pumps shall have continuously rising head characteristics.</div> <div>D) Pumps sets shall be suitable for parallel operation as well as solo operation in the system. The performance characteristics of the pumps running in parallel shall be identical.</div> <div>4.00.00</div> <div>MOTOR RATING</div> <div>Continuous motor rating (at 50 deg. C ambient) for pumps shall be at least ten percent (10%) above the maximum load demand of the driven equipment in the complete operating range to take care of the system frequency variations.</div> <div>5.00.00</div> <div>FEATURES OF CONSTRUCTION</div> <div>a) Pumps shall be of Submersible, wet pit, volute type.</div> <div>b) Pumps shall be able to pass through solids up to 60 mm and capable of handling wastewater which may contain sludge, plastic solids etc.</div> </div>		
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- c) The pump shall be suitable for reverse rotation and shall not have any adverse effect on the operation of mechanical seal or any other component.
- d) Coupling device shall ensure leak proof joint between the pump and discharge elbow. This shall also enable pump to be removed from the sumps without the necessity of dismantling any nuts, bolts etc.
- e) Pumps shall be portable type and capable of using in any sump as and when required. Pump shall be provided with required stool, flexible, hose chain connection etc. for easy installation, removal, and maintenance. Adequate length of chain required for lowering the pump into the sump and flexible type discharge pipe shall be provided.
- f) Impeller
Enclosed impellers shall be equipped with seal rings on their hubs. In case of open impeller, the pump shall be designed to take care of the additional thrust produced. The impellers shall be dynamically balanced to the grade 6.3 as per ISO 1940.
- g) For Submersible Type pumps all Control & Instrumentation is to be provided as per manufacturer's standard proven practice.

6.00.00
SUBMERSIBLE PUMPS DATASHEET

NO	DESCRIPTION	PARAMETERS
1)	Designation	As applicable
2)	Type of pump	Fixed submersible mono-block type with auto-coupling arrangement
3)	Rated Flow of each pump(cum/hr)	As per bidder's design
4)	Total head of each pump	As per bidder's design
5)	Operating Speed	1500 rpm (maximum)
6)	Location of pumps	Respective areas Pump Sump of Bidder's Scope (as applicable)
7)	Service of duty	Continuous
8)	Type of Working Fluid	Contaminated water
9)	Type of impeller	Closed/ Semi- open

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	10)	Suction condition	Submerged
	11)	Minimum Water level	As per bidder's design
	12)	Normal Water Level	As per bidder's design
	13)	Maximum Water level	As per bidder's design
	14)	Bed Invert level	As per bidder's design
	15)	Accessories to be provided with each pump	<p>a) Required Instrumentation as per approved P & IDs during detailed engineering stage.</p> <p>b) Discharge Bend/ Duck foot supported on sump floor./Bottom stand</p> <p>c) AISI 316 lifting chain of minimum 10 m length and lifting shackle.</p> <p>d) All fasteners required for fitting of accessories</p> <p>e) Motor Control Panel with soft Starter, Indicating meters, display units for motor controls wherever required, Power analyzer, indicating lamps, MCBs/MCCBs and other control / indicating equipment as required.</p> <p>f) The panel shall be foot mounted type.</p> <p>g) Motor over-temperature protection device</p> <p>h) Seal failure detectors and associated cores in cables</p>
	16)	Material of Construction:	
	a)	Casing	ASTM A351 CF8M Grade / SS 316
	b)	Impeller	ASTM A351 CF8M Grade
	c)	Wearing rings (if applicable)	SS-316
	d)	Impeller Shaft /Shaft Sleeve	SS-316
	e)	Shaft mechanical seal and seal spring	SS-316
	f)	Chains / Guiderails	Stainless steel
	g)	Discharge pipe	HDPE of required diameter, Grade PE-100, PN 16 (Min) as per IS4984
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	Annexure IC			
	GENERAL SPECIFICATION FOR SCREW PUMPS			
1.00.00	SCOPE			
1.01.00	This specification covers general requirements in respect of design, material, manufacture, construction, testing & inspection at Vendor's / sub-vendor's delivery to side, of screw pumps. The minimum technical requirements and equipment shall include, but not be limited to the following:			
2.00.00	CODES AND STANDARD			
	The design manufacture and performance of screw pumps shall be complied with all currently applicable statues, regulation, and safely codes in the locality where the Equipment will be installed. The Equipment shall also conform to the latest applicable Indian standards /equivalent standards.			
2.01.00	DESIGN AND PERFORMANCE REQUIREMENTS			
	a) The pump shall be of single stage type with non-clog design driven by squirrel cage induction motor type.			
	b) Components of Identical pumps shall be interchangeable.			
	c) Pumps shall have continuously rising head characteristics.			
	D) Pumps sets shall be suitable for parallel operation as well as solo operation in the system. The performance characteristics of the pumps running in parallel shall be identical.			
4.00.00	MOTOR RATING			
	Continuous motor rating (at 50 deg. C ambient) for pumps shall be at least ten percent (10%) above the maximum load demand of the driven equipment in the complete operating range to take care of the system frequency variations.			
5.00.00	FEATURES OF CONSTRUCTION			
	a) Pumps shall be able to pass through solids up to 60 mm and capable of handling wastewater which may contain sludge, plastic solids etc.			
	b) The pump shall be suitable for reverse rotation and shall not have any adverse effect on the operation of mechanical seal or any other component.			
	c) Coupling device shall ensure leak proof joint between the pump and discharge elbow. This shall also enable pump to be removed from the sumps without the necessity of dismantling any nuts, bolts etc.			
	d) For Screw pumps all Control & Instrumentation is to be provided as per manufacturer’s standard proven practice.			
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6.00.00	SCREW PUMPS DATASHEET			
	NO	DESCRIPTION	PARAMETERS	
	1)	Designation	As applicable	
	2)	Type of pump	Screw pump, Single stage	
	3)	Rated Flow of each pump(cum/hr)	As per bidder's design	
	4)	Total head of each pump	As per bidder's design	
	5)	Operating Speed	1500 rpm (maximum)	
	6)	Location of pumps	Respective areas Pump Sump of Bidder's Scope (as applicable)	
	7)	Service of duty	Continuous	
	8)	Type of Working Fluid	Thickened sludge	
	9)	Type of impeller	As per Mfg standard	
	10)	Suction condition	As per bidder's design	
	11)	Minimum Water level	As per bidder's design	
	12)	Normal Water Level	As per bidder's design	
	13)	Maximum Water level	As per bidder's design	
	14)	Bed Invert level	As per bidder's design	
	15)	Accessories to be provided with each pump	i) Required Instrumentation as per approved P & IDs during detailed engineering stage. j) Bottom stand k) All fasteners required for fitting of accessories l) Motor Control Panel with soft Starter, Indicating meters, display units for motor controls wherever required, Power analyzer, indicating lamps, MCBs/MCCBs and other control / indicating equipment as required. m) The panel shall be foot mounted type. n) Motor over-temperature protection device o) Seal failure detectors and associated cores in cables	
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16)	Material of Construction:	
a)	Casing	ASTM A351 CF8M Grade / SS 316
b)	Rotor /Shaft Sleeve	SS-316
c)	Wearing rings (if applicable)	SS-316
d)	Shaft mechanical seal and seal spring	SS-316
e)	Discharge pipe	HDPE of required diameter, Grade PE-100, PN 16 (Min) as per IS4984


CLAUSE NO.	<div style="text-align: right;">  </div> <div style="text-align: center;">WATER SYSTEM</div>		
<p>1.00.0</p> <p>1.01.00</p>	<div style="text-align: right;">Annexure-ID</div> <div style="text-align: center;"><u>Specification for Piping System</u></div> <p>Piping system includes all in plant interconnecting and transport piping, valves, fittings, supports and specialities.</p> <p>The Design, manufacture, testing, erection, testing and commissioning of piping and valves shall conform to the latest revisions of the Indian / International Standards & Codes as referred this Subsection and elsewhere in the tender documents subject to any modification and requirement as specified hereinafter.</p> <p>General Design Criteria</p> <ol style="list-style-type: none"> 1) All piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. The minimum thickness for pipes and fittings shall be adhered to. Higher thickness in equivalent material is acceptable. However, no credit will be given for higher thickness. 2) All piping systems shall be properly designed to take care of hydraulic shocks and pressure surges which may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolts, etc. for the safeguard of the piping systems under above mentioned conditions. External and internal attachments to piping shall be designed so as not to cause flattening of pipes, excessive localised bending stresses or harmful thermal gradients in pipe walls. 3) Piping and fittings shall be manufactured by an approved firm of repute. They should be truly cylindrical of clear internal diameter specified, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects. 4) The primary consideration in a piping arrangement shall be to provide an economical, safe piping layout which allows ease of operation and maintenance of the plant. Adequate space shall be provided around the equipment for taking up convenient operation and maintenance. 5) In general, wherever possible all pipes shall be routed over pipe pedestals. Where access and maintenance space is required pipe racks shall be considered. 6) All piping system covered under this system are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system 		
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insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work.

- 7) Attached schematic drawing in tender is indicative only.
- 8) Outdoor Piping shall be laid above ground on pipe sleepers/ pedestals or pipe trestles. Inside the building pipes to be laid over ground for easy access and maintenance.
- 9) Overhead Clearance of trestles/equipment above roads shall be minimum 8 meters and shall be minimum 2.5 meters in other areas. Adequate clearance should be provided around equipments to facilitate ease of operation & maintenance. The clearance shall not be less than 1.0 m-around pumps, and minimum 1.5 meter at drive end.
- 10) Pipes as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.
- 11) High points in piping system shall be provided with vents along with valves as per the system requirement. Low points shall be provided with drains along with drain valves as per the system requirement. Drain lines shall be adequately sized to clear the lines. Vent shall not be less than 25 mm size. Suitable slope shall be provided for all pipelines towards drain points.
- 12) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipment, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc.
- 13) Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following:

		Water Velocity in m/sec		
	Pipe Size	Below 50 mm	50-150 mm	200 mm & above
(a)	Pump suction	-----	1.2-1.5	1.2-1.8
(b)	Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5
(c)	Header	-----	1.5-2.4	2.1-2.4

- 14) Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.

CLAUSE NO.	WATER SYSTEM																						
2.00.00	<p>15) The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.</p> <p>16) recirculation pipes along with valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30% design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.</p> <p>17) Non-metallic pipes shall be laid as per recommendations of the design standard and manufacturer adopting proven practice. type of joints shall be selected based service / pressure and recommendation of design standard joining method, type of preparation of jointing procedure, installation and testing procedure shall be furnished by the pipe manufacturer as per design standard,/their proven practice and the same shall be approved by employer. installation & testing shall be carried out under the supervision of the supplier.</p>																						
	<p>Pipes, Valves & fittings</p> <p>Requirements specified here is indicative only. All materials and components of valves, piping and other equipment and appurtenances shall be compatible with the respective water/chemicals.</p>																						
	<p>1) Piping as tabulated below-</p>																						
	<table><tr><th>S.No</th><th>Service</th><th>Material of Construction</th></tr><tr><td>1.</td><td>Raw Water / Clarified water / service water / Wastewater / Potable water / UF-RO system pipe/ RO reject handling pipe / Piping for other usage</td><td>High density polyethylene (HDPE) pipes to Grade PE-100, PN 16 (Min) as per IS4984</td></tr></table>						S.No	Service	Material of Construction	1.	Raw Water / Clarified water / service water / Wastewater / Potable water / UF-RO system pipe/ RO reject handling pipe / Piping for other usage	High density polyethylene (HDPE) pipes to Grade PE-100, PN 16 (Min) as per IS4984											
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<p>Note: -</p> <p>(i) HDPE pipe Jointing shall be of fusion welded butt joints.</p> <p>(ii)HDPE Pipe fittings- HDPE confirming to IS 8008 & Flanges shall be UPGF (flange drilling- ANSI B 16.5 Cl 150).</p>																							
<p>2) Material of Valves as tabulated below-</p> <table><tr><th>Sl no</th><th>Service</th><th>Valve type</th><th>Body Disc / Ball</th><th>Shaft</th><th>Seat / Seat ring</th></tr><tr><td>1</td><td>Water lines</td><td>Ball / Globe</td><td>CPVC/PP</td><td>CPVC/PP</td><td>PTFE</td></tr><tr><td>2</td><td>Air lines</td><td>valve (sch 80)</td><td>Cast carbon steel or forged carbon steel</td><td>ANSI 420</td><td>EPDM</td></tr></table>						Sl no	Service	Valve type	Body Disc / Ball	Shaft	Seat / Seat ring	1	Water lines	Ball / Globe	CPVC/PP	CPVC/PP	PTFE	2	Air lines	valve (sch 80)	Cast carbon steel or forged carbon steel	ANSI 420	EPDM
Sl no	Service	Valve type	Body Disc / Ball	Shaft	Seat / Seat ring																		
1	Water lines	Ball / Globe	CPVC/PP	CPVC/PP	PTFE																		
2	Air lines	valve (sch 80)	Cast carbon steel or forged carbon steel	ANSI 420	EPDM																		
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO- CS-6401-001-2		VOLUME-I CHAPTER-M3	PAGE 23 OF 24																		

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WATER SYSTEM

3	Water & Air lines	Check Valve	ASME-B16.34 CL.150 A126-B Hastealloy-C, EPDM FF	ASME-B16.34 CL.150 A126-B Hastealloy-C, EPDM FF	EPDM
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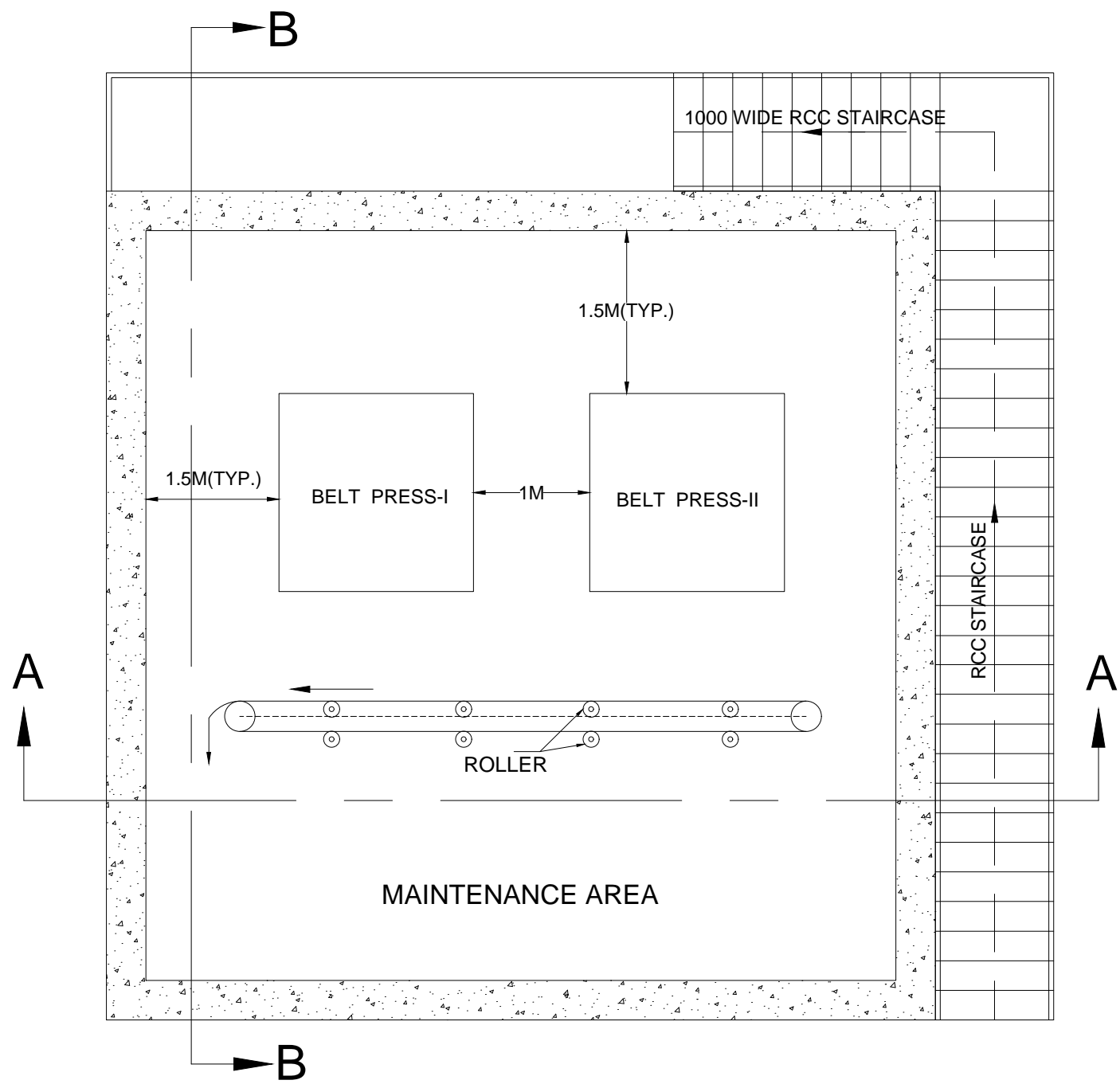
Type of valves in RO skid shall be as per Manufacturer's standard practice & of proven design for intended applications. Further, material of construction for all valve components shall be compatible with the respective water/chemicals etc.

3.00.00

Painting

Painting of all structural steel materials shall be with two coats red oxide primer followed by two coats of chlorinated rubber/epoxy paints as per AWWA D-102 and shall be with due surface preparation/blasting. Minimum DFT shall be 300 microns.

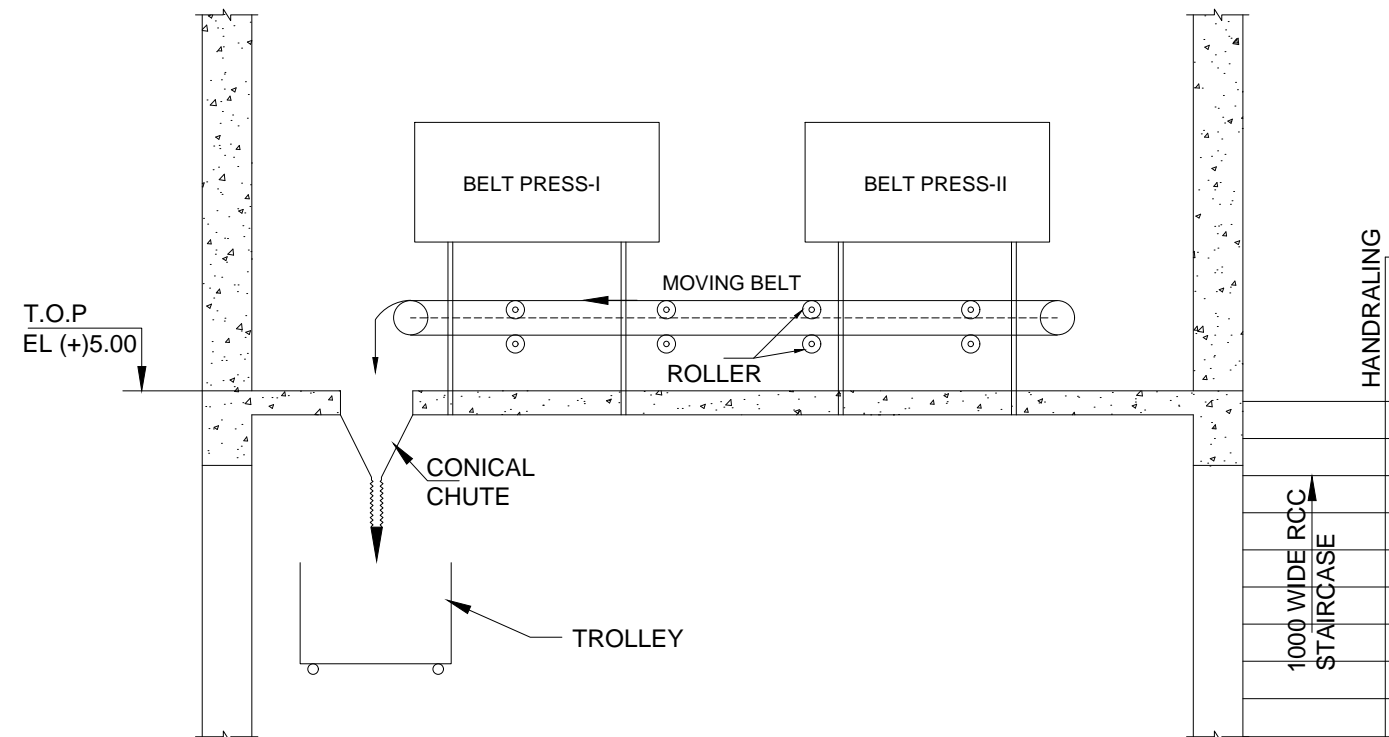
This document is the property of NTPC LIMITED. No part of this document will be reproduced by any means without the written permission.



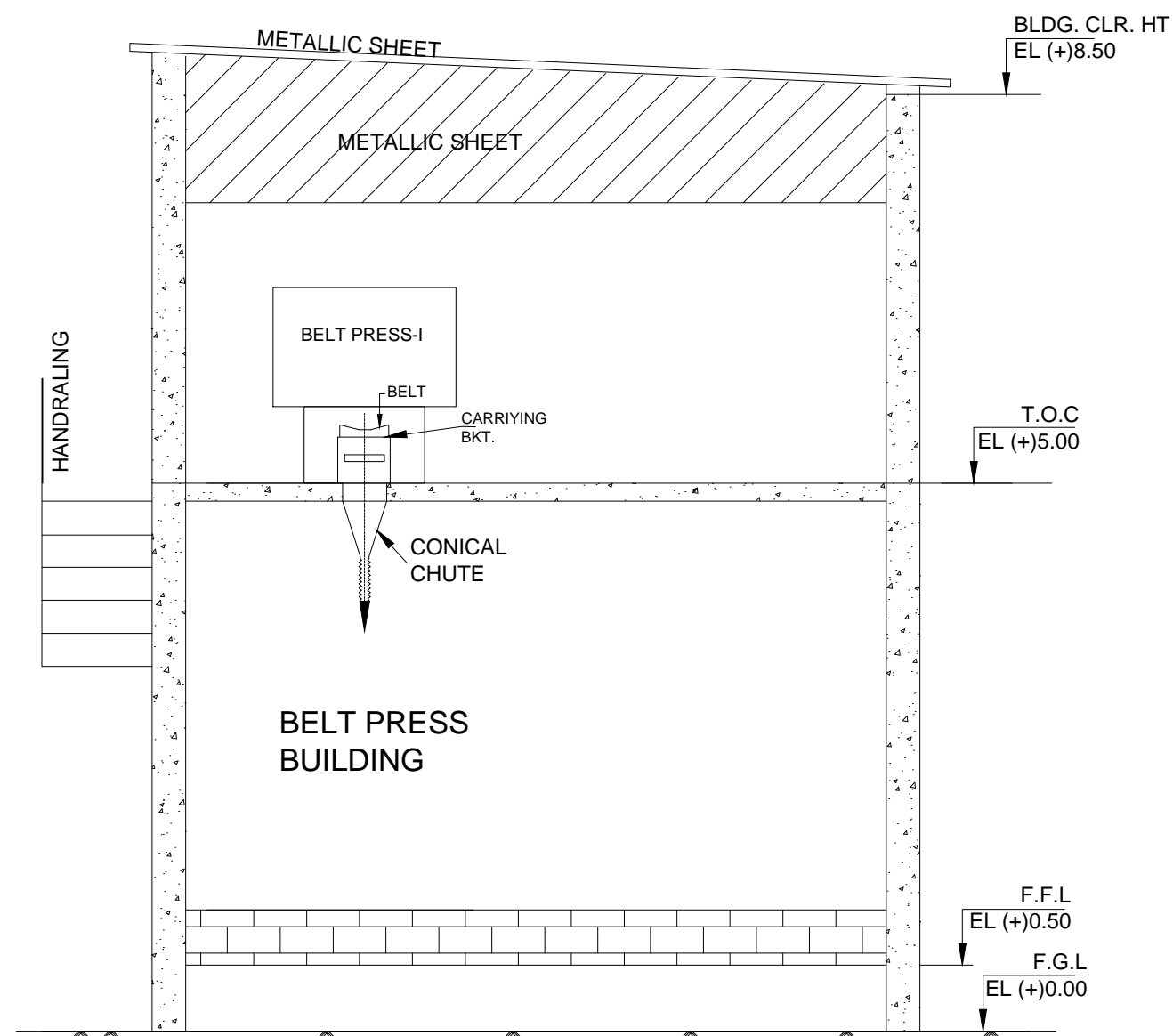
BELT PRESS BUILDING PLAN

NOTES :

1. THE SHOWN GA DRAWING OF BELT PRESS BUILDING IS INDICATIVE ONLY.
2. BIDDER TO DESIGN THE BUILDING IN SUCH A WAY THAT 2 Nos OF MOVABLE TROLLEY CAN BE PLACED AND TOWED UP WITH ENGINE FROM EACH BELT PRESS SIMULTANEOUSLY.
3. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE TECHNICAL SPECIFICATIONS & OTHER TENDER DRAWINGS.



VIEW A-A



VIEW B-B

LEGEND:-

- F.G.L - FINISHED GROUND LEVEL
F.F.L - FINISHED FLOOR LEVEL
T.O.C - TOP OF CONCRETE
BLDG. CLR. HT - BUILDING CLEAR HEIGHT

FOR TENDER PURPOSE ONLY



NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: GREATER NICOBAR ISLAND GAS POWER PROJECT

TITLE: INDICATIVE GA DRG. OF BELT PRESS BUILDING


SIZE: A1 SCALE: -- DRG.NO: 6401-999-A-POM-002 REV: A

REV.	DESCRIPTION	DESIGN	CHKD.	C	M	E	C&I	APPD	DATE
A	RELEASED FOR TENDER								

CAD FILE NAME : -----

PART-B
VOLUME – I
CHAPTER – M4
FIRE DETECTION AND PROTECTION SYSTEM

CLAUSE NO.	<div> <div>TECHNICAL REQUIREMENTS</div> <div>एनटीपीसी NTPC</div> </div>		
<div>1.00.00</div> <div>1.01.00</div> <div>1.02.00</div> <div>1.03.00</div> <div>1.04.00</div> <div>2.00.00</div> <div>3.00.00</div> <div>3.01.00</div> <div>4.00.00</div> <div>4.01.00</div>	<div> <div>FIRE PROTECTION AND DETECTION SYSTEM</div> <div> <div>GENERAL DESCRIPTION</div> <p>A comprehensive Fire Detection and Protection System covering all the areas of the power plant including various facilities/ system /buildings (if applicable) is included in the scope of the Contract.</p> <p>The complete Fire Detection and Protection Systems shall be as per the guidelines/ codes/ standards / rules of TAC/ NFPA / IS: 3034 / OISD etc.</p> <div> <div>Fire Water Source</div> <p>Water for the Fire Protection system shall be drawn from fire water storage tanks to be provided by the Bidder. There shall be two sources of water to fill fire water tank:</p> <ol style="list-style-type: none"> raw water as primary source. treated water as second source. <p>Fill in line from above two sources shall be in the scope of vendor. Bidder shall interconnect the same to fire water tank through individual motorized isolation gate valve. Refer plant water and effluent treatment scheme.</p> </div> <div> <div>Pressurization System</div> <p>This system consists of two (2) nos. electric motor driven jockey pumps (1 no. working + 1 no. stand-by).</p> </div> <div> <div>HYDRANT SYSTEM</div> <p>Hydrant system shall consist of fire water pumps, pressurization arrangement, water mains network, hydrant valves, landing valve, isolation gate valves, water monitors, hoses, branch pipes, nozzle, hose boxes, central hose houses etc. Basket Strainer (2x100%) with differential pressure switch and gauge shall be provided in common fire water header at outside FW pump house.</p> </div> <div> <div>HVW AND MVW SPRAY SYSTEM</div> <div> <div>General</div> <p>It shall consist of fire water pumps, pressurization arrangements, water mains network, deluge valves, flow switches, isolation gate valves with limit switches, Y-type strainers, spray nozzles/ projectors, spray nozzles piping network, detection system, instrumentation, local control panels, cables etc.</p> </div> </div> <div> <div>FIRE DETECTION, ALARM AND CONTROL SYSTEM</div> <div> <div>Codes and Standards</div> <ol style="list-style-type: none"> The design, manufacture, testing, performance, etc. of the various components of the analog addressable Fire Detection and Alarm System shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the contractor of this responsibility. Unless otherwise specified, the Fire Detection and Alarm System and the components shall conform to the latest applicable Indian or IEC Standards. Equipment complying with any other authoritative National Standards such as British, USA, VDE, etc. will also be considered, provided the parameters specified are equivalent or better than the corresponding IS. The Contractor shall be solely responsible for obtaining the required approval and clearance for the different components and systems of the Fire Detection and Alarm System from the following authorities, as applicable: <ol style="list-style-type: none"> Department of Atomic Energy (Certification of safety from Radioactivity). Central Building Research Institute, Roorkee. </div> </div> </div> </div>		
	<div> <div>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</div> </div>		<div> <div>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2</div> </div>
	<div> <div>VOLUME-I CHAPTER - M4 FIRE DETECTION & PROTECTION SYSTEM</div> </div>		<div> <div>PAGE 1 OF 34</div> </div>

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4.02.00	(iii) Central Mining Research Station, Dhanbad.			
	(iv) Local Fire Authorities.			
	d. The equipment and the system shall be of types approved by any of the following bodies, as applicable:			
	1. Loss Prevention Council, (LPC), U.K.			
	2. National Fire Protection Association, (NFPA), USA			
	3. Under-writers laboratories, (UL), USA			
	4. Factory mutual (FM)			
	5. BIS, India			
	Areas to be covered under Fire detection and alarm System			
	a) Multisensor type detection system (Above and below the false ceiling or below the false flooring as the case may be)			
i) All switchgear / MCC/battery rooms of main plant, Switchyard transformer area/building, Administrative Building, Canteen Building and other auxiliary buildings like water treatment, pump houses etc. of entire project.				
ii) All cable galleries of main plant, switchyard, switchgear room, etc. protected by MVW spray system. Further, multisensor detectors shall also be provided inside all cubicles/panels of control room, control equipment room and UPS / Battery charger areas of main plant building.				
iii) Above and below false ceiling areas of all air-conditioned rooms of main plant building, administrative building, canteen building, office areas, various control rooms.				
b) Linear heat sensing cable detection system				
Cable Galleries covered under MVW Spray System.				
c) Quartzoid bulb heat detection system				
Area/Equipment protected by HVW & MVW spray system except Cable Galleries/Vault.				
d) For buildings / enclosures with high height Beam detectors shall be provided for fire detection system.				
4.03.00	General requirements for all types of Detectors			
4.03.01	Detectors shall be provided with the necessary compression type cable terminating glands for the incoming cables of flameproof type or PVC/metallic flexible/rigid conduits.			
4.03.02	The detector shall be located where the largest combustion gas concentration can be expected.			
4.03.03	Adequate compensation and considerations shall be made for effects for wind velocities such as air-conditioning system and exhaust fans where dilution of particles of combustion is greater.			
4.03.04	The exact location of detectors shall be coordinated with other services like air-conditioning grills, light fittings, cable trays etc. to provide aesthetically pleasing appearance. The return air paths of air-conditioning shall be avoided for detector location.			
4.03.05	The detectors shall not be affected by temperature, humidity; air flow or by drift failures and shall not give any false alarm due to above.			
4.03.06	The detectors shall not be sensitive to vibrations. Any special mounting arrangements required to counteract vibration shall be included in the contractor scope.			
4.03.07	The quantity of multi- sensor detectors in each zone shall be based on the coverage factor of 25-sq. meter per detector. However, the actual quantity of detectors required, taking into consideration obstructions due to floor beams, ventilation, doors, windows etc., shall be worked out and supplied (based on the actual layout) and installed by the contractor.			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2	VOLUME-I CHAPTER - M4 FIRE DETECTION & PROTECTION SYSTEM	PAGE 2 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>																
4.03.08	The detectors shall not give false alarm due to high humidity, temperature, and velocity of air in the surroundings and static electricity conditions.																			
4.03.09	Process actuated switch devices such as pressure switches, flow switches, level switches, etc. shall be provided with suitable individual addressable interface (local or remote) units or modules so that these devices are addressable from the panel.																			
4.05.00	<div>Linear Heat Sensor Cables</div> <table><tr><td>Application</td><td>Detection of Stationary fire</td></tr><tr><td>Type</td><td>Digital</td></tr><tr><td>Operating voltage</td><td>24 V DC</td></tr><tr><td>Approval</td><td>FM/UL</td></tr><tr><td>Conductor material</td><td>Steel</td></tr><tr><td>Insulation</td><td>Heat sensitive polymer</td></tr><tr><td>Outer Sheath</td><td>Black or colored PVC or flouro polymer suitable for the application environment</td></tr><tr><td>Operating Temperature (Alarm)</td><td>70 Deg.C for Cable Gallery</td></tr></table> <div>Installation features for LHSC detectors</div> <div><div>1.</div><div>The detection zone/loop divisions of LHSC system shall match with MVW spray zones.</div></div> <div><div>2.</div><div>Linear heat sensing cable detector shall run in a zigzag fashion (with an included angle of 90 deg.) on each top cable tray, bottom tray and every alternate intermediate trays of each section of cable tray without undue sagging and interfering the normal operations. All supporting materials for mounting of LHSC shall be provided by the bidder.</div></div>				Application	Detection of Stationary fire	Type	Digital	Operating voltage	24 V DC	Approval	FM/UL	Conductor material	Steel	Insulation	Heat sensitive polymer	Outer Sheath	Black or colored PVC or flouro polymer suitable for the application environment	Operating Temperature (Alarm)	70 Deg.C for Cable Gallery
Application	Detection of Stationary fire																			
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4.06.00	<div>Addressable Analog Intelligent Detectors</div> <p>In addition to the features specified under the item General requirements for all types of Detectors, the Addressable Analog Intelligent Detectors shall be provided with the following features:</p> <p>Detectors not specifically listed for sensitivity testing from the control panel are not acceptable due to the expense involved with manual testing as required by NFPA 72E.</p> <p>Each detector in a loop shall have short circuit isolator suitable for style-7 wiring as per NFPA-72.</p> <p>The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system.</p>																			
4.07.00	<div>Multi sensor Detectors</div>																			
4.07.01	Multi sensor detectors shall incorporate a heat detection element and a photoelectric detection element. Both the elements shall be incorporated in a single unit. Both the elements shall be operative at all times and the fire signal shall be available from any or both elements combined together.																			
4.07.02	The detectors shall be sensitive to very low smoke densities of the order of say 0.05 g/m³. Also it shall be possible to adjust this sensitivity on a step less basis over a range so that the optimum sensitivity could be selected at site to suit the conditions of installations. The coverage area of the smoke detection under standard NFPA test conditions shall not be less than 80-90m².																			
4.07.03	In areas such as false ceiling where detectors themselves are not easily accessible, the remote response indicators outside the enclosed areas shall be provided to indicate the fire condition.																			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
4.08.00	System Configuration			
4.08.01	Each of the Addressable Fire Alarm panel shall be able to communicate with one another as well as with repeater annunciation panel and PLC based control panels located at different places. The detectors or other devices of any other unit/area shall be addressable only from the respective Addressable Fire Alarm Panel, so that each of the Addressable Fire Alarm Panel is under the control of designated operating personnel at that location. Facility to operate pumps of booster pump house and fire water pump house shall be provided from PC based monitoring station.			
4.08.02	At least one spare loop shall be provided in each of the addressable type fire alarm panel located in control equipment room with complete loop card and all other accessories so that Employer can expand the system in future. Further, at least 10% of loop capacity be left free in each of the connected loop in all the panels, so that, additional devices may be connected to the system in any of the loop by Employer in future.			
4.08.03	Fire system (as a whole including PLC control systems) shall be provided with necessary interface hardware and software for dual fibre optic connectivity & interconnection with station wide LAN for two –way transfer of signals for information sharing. The information shall be made available through Ethernet link following TCP/IP standard. The system shall be OPC compliant. All required plant data shall be transferred ensuring complete security. The exact number of points shall be finalized during detailed engineering.			
4.09.00	Analog Addressable Fire Detection and Alarm System			
4.09.01	General Requirements			
4.09.02	This specification in general covers the functional requirements, and general design aspects of Microprocessor based, Analog Addressable Fire Detection Alarm / Annunciation and Control System.			
4.09.03	<p>The following description intends to describe only the brief hardware and functional requirements, scope of hardware requirements etc. but the actual configuration of the system shall be in line with the prevalent normal practices in the industry and shall conform to latest product range of selected manufacturer.</p> <p>The fire detection and control system offered shall be complete in all respects for the safe and reliable operation of the entire system. Any additional hardware/software than those mentioned herein required to make the system complete shall be included in the scope of the Bidder.</p>			
4.09.04	Conventional detectors with interface modules are not acceptable. Each zone of LHSC detector shall be provided with interface module.			
4.09.05	All the fire detection systems, process actuated switch devices such as pressure/ flow/temperature switches and relays of control functions shall be hooked up with the analogue addressable fire detection and alarm system. Required addressable interface units shall be provided for various switch devices by the bidder to make them addressable.			
4.09.06	Bidder shall provide isolators at the start & end of the loop.			
4.09.07	<p>The complete system shall include, but not be limited to the following:</p> <p>(a) Master system CPU.</p> <p>(b) Analog Addressable Fire Detection and Alarm System panels including alarm modules, system supervisory control modules, auxiliary output control modules etc.</p> <p>(c) PC based monitoring station with color graphic display terminal with programming and historical archiving facility along with laser printer.</p> <p>(d) Power supplies, batteries and battery chargers</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>	
	(e) Analog addressable type smoke detectors. (f) Non addressable type conventional detectors (Linear heat sensing cable detectors) and switching devices each with its own addressable interface modules. (g) Software and hardware as required for complete operation of the system. (h) Complete Wiring/cabling including its conduits/trays/fixtures etc.		
4.10.00	System Functional Requirements		
4.10.01	The fire alarm panel shall evaluate the signals received from the detectors and shall handle the following functions: 1. System self-monitoring and fault signaling. 2. Transmission of alarm and fault signals to the respective fire alarm panels and as well as in the repeater panel in fire station. Further, the panel shall activate a hooter/sounds in each of the area locally provided with fire/smoke detection system. Further, the system shall enable operation of spray system from the panel through monitoring station when the system operation is selected under remote, manual mode. 3. Initiate control functions like closure of fire doors, shutdown of air-conditioning and ventilation, emergency lighting etc. 4. Triggering stationary extinguishing systems such as clean agent system. 5. Supervising of unauthorized removal of a detector head from its base and giving a fault alarm on the control panel. 6. Supervising and monitoring the detection cabling, to indicate fault conditions in case of open/short circuit in the wiring. 7. Supervising by a separate annunciation window, changeover from mains supply to battery supply. "Mains On" indication shall be continuously on, as long as the main supply is available. 8. Facilitating simulation of fire conditions to enable the testing of circuits (without creating actual fire) under the test mode from the fire Alarm panel. 9. The control unit shall contain all the systems main switches lamps and fuses. Switches and lamps shall be easily identified even in closed casings. 10. All the circuits from the detectors to the panels and the circuits from panels to the actuating/operating devices of the respective extinguishing system shall be of closed loop type and shall be supervised for open-circuiting and short-circuiting of cables. The cable fault shall be audio-visually annunciated on the panels. Separate hooters with different tones shall be provided for 'fault' alarms and 'fire' alarms. 11. Actuate solenoid valve in spray system in case of fire from respective fire alarm panel. For achieving this if any additional hardware is required like relays, power supply and cables, the same may be provided.		
4.10.02	Analog Addressable Fire Detection and Alarm System shall also meet the following functional requirements: i. Each of the system shall support analog addressable detectors of all types, non-addressable type detectors/devices along with its addressable interface units/modules, Video display units etc. ii. Each of the devices and/or detectors shall be individually, uniquely and continuously addressable by the panel to which it is connected.		
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	<div><div><div>iii.</div><div>Detectors shall be interrogated for sensitivity settings from the control panel, logged for sensitivity changes indicating the requirement for cleaning and tested by a single technician using the field test routine. Sensitivity of each of the detectors made available in the panel shall be adjustable from the panel.</div></div><div><div>iv.</div><div>The system shall be capable of self-adjustment to compensate for the accumulation of contaminants that would change the detector sensitivity in either a more or less sensitive direction to prevent false indications or failure to alarm in the actual fire conditions. The system shall annunciate a trouble condition when any analog addressable smoke detector reaches 80% of its alarm threshold due to gradual contamination, signaling the need for service and eliminating unwanted alarm.</div></div><div><div>v.</div><div>Continuous supervision/monitoring of all the circuits and its components shall be made available from the panel for open, short circuits and grounding.</div></div><div><div>vi.</div><div>The system shall be able to recognize and indicate an alarm condition in a degraded mode of operation, in the event of processor failure or the loss of system communications to the circuit interface panels.</div></div><div><div>vii.</div><div>The system shall be programmable at site and required hardware shall be included in the scope of supply. The system software Programs shall be password protected and shall include full upload and download capability. During program upload or download the system shall retain the capability for alarm reporting. The system shall download to a PC for program editing. The software shall be eligible for the employer to add the spare loop provided in the fire alarm panel or addition of additional devices/detectors in and of loop in any of the fire alarm panel.</div></div><div><div>viii.</div><div>The system shall support the use of color interactive History Reporting video display terminal for the display of information in an appropriate format.</div></div><div><div>ix.</div><div>The system shall include software for system database, historical event log, logic and operating system. The system shall require no manual input to initialize in the event of a complete power down condition. It shall return to an online state performing all programmed functions upon power restoration.</div></div><div><div>x.</div><div>Software logic modules and system database shall be programmable using a windows compatible program on PC. It shall be possible to program or edit the system database off site after downloading from the panel.</div></div><div><div>xi.</div><div>All detectors shall incorporate internal automatic temperature compensation to overcome the effects of either high or low ambient temperatures in the installed environment on the detector sensitivity. The detectors shall be tested at a specified frequency by raising the detector sensitivity level to the alarm threshold, to check the operation of the detector without system alarming automatically by the control panel.</div></div><div><div>xii.</div><div><div>In an alarm or trouble condition the following shall occur on the monitoring station:</div><div><div>1.</div><div>Sound an audible.</div></div><div><div>2.</div><div>Write details of the actuation to a system log file on the PC.</div></div><div><div>3.</div><div>Print the details of the actuation to the system printer.</div></div></div></div></div>			
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4.11.00	<div>4. Activate the color graphic display system controls, providing functions such as zooming, scrolling of Alarms, troubles, etc.</div> <div>xiii. System configuration shall be menu driven and capable of being operated by a person with no previous computer programming experience.</div>			
	<div>Panel Display Requirements.</div> <div>System display shall consist of minimum 80 character back lighted alphanumeric LCD display readable at any angle. Thirty-two character customer defined custom messages shall describe the location of the active device. In addition to the above, the following features shall be available.</div> <div><div>a. The system shall be capable of programming to allow troubles occurred and restored in the system to be automatically removed from the display queue, eliminating the necessity for individual acknowledging of these events. This feature shall not affect the historical logging of events as programmed.</div><div>b. As a minimum an LED display for “Alarm”, “Audible Silenced”, “Supervisory”, “Trouble”, “Security”, “Power On”, And “Partial System Disabled”.</div><div>c. Touch activated membrane switches for “Alarm Acknowledge”, “Audible Silence”, “Supervisory Acknowledge”, “Security Acknowledge”, “Reset”, “Display Hold”, And “Display Next”.</div><div>d. All membrane switches shall be tactile with audible feedback when pressed.</div></div>			
4.12.00	<div>System Software Requirements</div> <div><div>i) The software shall control the operation, function and display of the graphic system and provide for automatic boot up and run from the hard disk drive of the computer.</div><div>ii) All project specifics actuating device programming shall be capable of being carried out on site via password access.</div><div>iii) The system shall monitor all alarm, supervisory; trouble and security conditions detected by the fire alarm control panel and provide separate disk based files, for each condition. These logs may be enabled, disabled, or cleared with password access.</div></div> <div>This log information is not to be lost upon power failure or fire alarm control panel reset. A utility file shall be provided to sort the log data by date or by device and display this information either on the screen or the system printer.</div> <div><div>iv) Selective memory storage up to 800 events, shall be stored in flash memory and displayed, printed or downloaded by classification for selective event reports.</div><div><div>a. Software shall allow selection of events to be logged, including; inputs as alarms, troubles, supervisors, securities, status changes and device verification; out puts, as audible control and output activation; action, as reset, set sensitivity, arm/disarm, override, password, set time and acknowledge.</div><div>b. Audible and visual indications shall be generated when memory is 80% and 90% full to allow downloading of data. The system shall be programmable</div></div></div>			
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	<p>circular logging, assuring that at least the last 400 events will always be stored in non-volatile memory.</p> <p>v) Software has driven logic for adjusting the alarm threshold windows on detectors to compensate for accumulating contamination and keep detector response sensitivity constant. The software shall compensate for either over-sensitized or desensitized units, raising a system flag when a detector approaches the allowable limits of adjustment, indicating a requirement for cleaning.</p> <p>a. Values shall be stored in non-volatile memory allowing activation of all tracking functions within 90 sec of system initiation from a "cold boot". During the boot sequence, alarms from detectors programmed with the feature shall be suppressed.</p> <p>When the full data history is active all devices shall be checked and any active alarms displayed.</p> <p>b. The control panel shall place each detector in the system in an alarm condition, transparent to the system user, every twenty-four hours as a dynamic check of the accuracy of the alarm threshold setting. Upon reception of the alarm report, the system detector shall be restored to its pretest state.</p> <p>c. The system shall be capable of monitoring the stage of detectors and displaying a message when a detector is approaching the limits of adjustment as a result of contaminates. A second message shall be displayed when the detector reaches the limits of adjustment due to these contaminate.</p> <p>d. The system shall be capable of recognizing that a detector has been cleaned, initiating a series of tests to determine if the cleaning was successful and display a detector cleaned message, readjusting that detectors normal sensitivity setting reference.</p> <p>vi) When an alarm or trouble is registered at the fire alarm control panel the graphics system shall display the first screen image for the first actuated device. The system shall be capable of zooming in for further information if required. At all times when in the alarm or trouble mode the fire control panel status i.e. number of current alarms and or troubles is to be displayed on the graphics screen.</p>			
4.13.00	Power Supply for Fire Alarm Panels & Repeater Alarm Panel			
4.13.01	One set of 24V DC redundant power supply system comprising of 2 x 100% chargers and 1 x 100% batteries shall be provided for each fire alarm panel and repeater alarm panel. The batteries for fire alarm system shall be sealed maintenance free lead acid type. The battery backup for each fire alarm panel and repeater alarm panel shall be 24 hours and 30 minutes (in alarm conditions). At least 25% of the devices shall be considered to be active in alarm conditions. Each of the redundant chargers shall be sized to meet connected load requirements and keep the connected batteries full charged (Float Mode). Furthermore, the charger shall be sized to enable the boost charge of a fully discharged battery in 10 hours while feeding the load.			
4.13.02	The batteries shall be sized as per relevant IEEE standard. For battery sizing calculation, an aging factor of 0.8, a temperature correction factor (based on temperature of 4 deg. C), voltage drop of 2V in cables. Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering.			
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4.13.03	The battery chargers and batteries shall be placed at a suitable location inside the fire alarm panel with partitions.													
4.13.04	The detailed specification related to power supply system of fire detection & protection system shall be as specified in other sections of the technical specification.													
4.14.00	Control & Instrumentation requirements for Fire water pump house. The specification related to Basic design criteria, Measuring Instruments, Process connection & piping, Control panels/desk, Type test requirements etc. shall be as specified in other sections of the technical specification.													
4.14.01	PLC based control panels: The specification for PLC shall be as specified in other sections of the technical specification.													
4.14.02	The specification for PC, printer and other HMI items shall be as specified in other sections of the technical specification.													
4.14.03	Power Supply for the PLC system 24 V DC power supply system for each PLC based control system shall comprise of two sets, each set consisting of the following: a) 1x100% microprocessor controlled, intelligent, modular rectifier banks b) 1 no. of Controller for each of the above rectifier banks c) 1x100% Nickel - Cadmium batteries for one (1) hour duty d) 1x100% DC distribution board. Also 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) shall be provided as common for both the sets. The detailed specification of the Battery chargers, Batteries, DCDBs, BHMS etc shall be as specified in other sections of the technical specification.													
4.14.04	Control Cabinets/Panel/Desk The detailed specification of the PLC panels, RIO panels, control desk etc shall be as specified in other sections of the technical specification.													
4.15.00	Cabling for fire alarm system All instrumentation cables twisted & shielded, FRLS PVC insulated and sheathed data highway / fibre optical cables, short term fire-proof cables including prefabricated cables (with plug-in connectors) etc. shall be provided by Contractor. The contractor shall follow the cable philosophy as below:													
		<table><tr><th colspan="2">Application</th><th rowspan="2">Type of cable</th></tr><tr><th>From</th><th>To</th></tr><tr><td>PLC cabinets</td><td>PC, Printers etc.</td><td>As Mfr.'s Standard. However, connection between PLC and the remote I/Os shall be through fibre optic cable by Bidder if length is>300 M & coaxial cable if length<300 M</td></tr><tr><td>Detectors (including detectors mounted inside panels) /Any loop device</td><td>Detector (including detectors mounted inside panels) / Isolator/ Interface unit</td><td>Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.</td></tr></table>		Application		Type of cable	From	To	PLC cabinets	PC, Printers etc.	As Mfr.'s Standard. However, connection between PLC and the remote I/Os shall be through fibre optic cable by Bidder if length is>300 M & coaxial cable if length<300 M	Detectors (including detectors mounted inside panels) /Any loop device	Detector (including detectors mounted inside panels) / Isolator/ Interface unit	Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.
Application		Type of cable												
From	To													
PLC cabinets	PC, Printers etc.	As Mfr.'s Standard. However, connection between PLC and the remote I/Os shall be through fibre optic cable by Bidder if length is>300 M & coaxial cable if length<300 M												
Detectors (including detectors mounted inside panels) /Any loop device	Detector (including detectors mounted inside panels) / Isolator/ Interface unit	Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.												
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	Detectors (including detectors mounted inside panels) / Isolator / Interface Unit	JB	Shielded, Twisted, PVC Cu. FRLS cables Type “S” Refer Note 2, 3, 4 and 5 below.	
	JB	Fire alarm Panel	Shielded, Twisted, PVC Cu. FRLS cables Type “S” Refer Note 2, 3, 4 and 5 below.	
4.16.00	Notes: 1. 10% spare pair shall be provided for all cables having more than four pairs. 2 Type “S” cable shall be multicore control cable having overall shielding & specification similar to instrumentation cable except insulation thickness and voltage grade which shall be 1100 V. Type “S” cable shall also satisfy requirements of Article 760 of NFPA 70. 3. Short term fire proof cable shall be provided for inert gas protected areas. Short term fire proof cables shall be Mineral insulated copper conductor and copper sheathed type satisfying requirements of Fire resistance, safety in the industrial application areas mentioned in the specification and also, shall be approved by UL standards and certified by LPCB. The contractor shall provide all the cables so as to complete the system. 4. Cable size of 2 core 1.5 sq.mm shall be used for loop wiring in-case of both control cable and short term fire proof cable. 5. Cable size of 2 core 2.5 sq.mm shall be used to provide power supply to various devices in the loop in-case of both control cable and short term fire proof cable. 6. The detailed specification of instrumentation cables and optical fiber cable shall be as specified in other sections of the technical specification. 7. Detector cables outside the building shall be corrugated steel taped armoured laid through cable trays wherever available and for rest of the areas, cable shall be buried at 600 mm depth with sand filling and brick covering at the top. 8. Detector cable within the building shall be either unarmoured & laid through galvanized iron (GI) conduits or armoured cables, as per the standard and proven practice of the manufacturer.			
	Detection System of Cable Galleries i) In cable galleries, MVW spray system shall be actuated either by detection of fire by Linear Heat sensing cable detectors or by fire signal from Multisensor detection system. Apart from the automatic operation of spray system in the detected zone, the adjacent two zones shall also be sprayed with water automatically after a set time delay simultaneously. ii) LHSC detector shall run in a zig-zag fashion (with an included angle of minimum 90° atleast) in each of the top tray, bottom tray and in every alternate trays. The mounting arrangement of LHSC detector shall be as per manufacturer’s standard practice. iii) The detection zone/ loop divisions shall match with MVW spray zones.			
4.17.00	Multisensor Detection System i) Upon detection of fire, multisensor detector shall be annunciated in the respective panels and shall activate a local hooter/sounder in the areas where fire is activated and this fire signal shall be employed to initiate the fire extinguishing system of that area such as automatic MVW spray system of cable galleries, fire extinguishing system of Control rooms/Control Equipment Rooms.			
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<div> <div>5.00.00</div> <div>5.01.00</div> <div>6.00.00</div> </div>	<div> <div> <div>ii)</div> <div>Cross zoning of the signal from two adjacent multisensor detectors shall be employed to initiate the fire extinguishing system of inert gas protected areas and MVW spray system of cable galleries.</div> </div> <div> <div>iii)</div> <div>Multisensor detector shall be provided for return air ducts of main plant, which shall consist of intake probe, detector housing, and exhaust pipe etc. The detector shall be mounted outside the duct.</div> </div> <div> <div>iv)</div> <div>The design coverage area for detectors (to be considered) shall not exceed 25 Sq.M. for each detector.</div> </div> <div> <div>INERT GAS EXTINGUISHING SYSTEM</div> <div>General</div> <div> <div>a)</div> <div>Fire protection system for the Central control room and other areas as defined below shall be by means of INERT gas extinguishing system. The INERT gas system shall employ any of the proven inert gas system specified under NFPA-2001. System shall be automatic and shall be activated by a dedicated detection system to be provided for each hazard area.</div> </div> <div> <div>b)</div> <div>System shall consist of inert gas (as per NFPA-2001) gas cylinders filled with the agent gas, cylinder mounting accessories, cylinder manifold, automatic discharge valves, discharge piping, nozzles, automatic operating devices, manual actuation devices/abort switches, associated fire detection/alarm system audio-visual safety warning devices, instrumentation associated control systems, panels etc.</div> </div> </div> <div> <div>FIRE WATER STORAGE, PUMPS & PUMP HOUSE</div> <div> <div>i)</div> <div>Horizontal type centrifugal pumps shall be provided for main fire water pumps and jockey pumps. Maximum speed of the pumps shall be 1500 rpm. However, for jockey pumps the speed up to 3000 rpm is acceptable. The motor driven pump and the corresponding diesel engine driven pump shall completely interchangeable in respect of speed, impeller diameter, etc.</div> </div> <div> <div>ii)</div> <div>Capacity, discharge pressure & quantity of pumps common for the hydrant water system and spray water system shall be designed as per Tariff Advisory committee (TAC) guidelines. However, for minimum design requirement please refer Annexure- II</div> </div> <div> <div>iii)</div> <div>At least one hydrant pump of identical capacity be provided as standby pump so that in case any of the working hydrant pump is not available, the total requirement can be met by the standby pump.</div> </div> <div> <div>iv)</div> <div>The standby main fire water pumps shall be of diesel engine driven.</div> </div> <div> <div>v)</div> <div>The diesel engine drive of the pump shall conform to the requirements of TAC. Each of the diesel engine shall be provided with batteries (2x100%) and battery chargers (2x100%).</div> </div> <div> <div>vi)</div> <div>Battery of the diesel engine shall be lead acid type as per IS and shall be large enough to crank the engine twelve times successively, each for a duration of 10 sec. without any charging in between.</div> </div> <div> <div>vii)</div> <div>Each engine shall be provided with fuel oil tank having adequate capacity to hold sufficient fuel oil for a minimum of twelve (12) hours of full load run. The fuel oil tank shall preferably be mounted on the engine. No fuel oil tank will be provided by the Employer.</div> </div> <div> <div>viii)</div> <div>Continuous drive motor rating (at 50°C ambient) shall be at least 10% (ten percent) above the maximum load demand of the pump in the entire operating range of the pump.</div> </div> <div> <div>ix)</div> <div>The feeding line of the hydrant system from the header shall be provided with 2x100% capacity basket type filters to avoid any particles in the system.</div> </div> </div> </div>
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<p>7.00.00</p> <p>7.01.00</p>	<p>x) The system shall be complete with required instrumentation, control recirculation pipeline with valves for each of the pumps, NRV in discharge outlet etc.</p> <p>xi) Pumps shall be designed for continuous operation at its best efficiency point to meet the specific requirements of the system for which it is to be employed. Pumps of each category shall be suitable for parallel operation.</p> <p>xii) Fire Water Storage Tanks: Two numbers each of 50% capacity vertical cylindrical column supported fixed cone roof type MS fire water storage tanks shall be provided by the bidder. To avoid vacuum creation inside the tank, two (2) nos. vents each of size min. 150 NB shall be provided on the roof of the tanks. Bidder shall ensure that the total capacity of fire water storage shall be as per the recommendation of TAC with a minimum effective capacity of each tank equal to 900 m³.</p> <p>PIPING AND VALVES</p> <p>General Data for Pipes etc.</p> <p>i) Mild steel as per IS:1239 (Part-I) heavy grade (up to 150 NB) & as per IS:3589 Gr 410 (above 200 NB) or Equivalent for pipes normally filled with water.</p> <p>ii) Mild steel as per IS:1239 (Part-I) heavy grade (up to 150 NB) & as per IS:3589 Gr.410 (above 200 NB) or Equivalent and galvanized as per IS:4736 for pipes normally empty and periodically charged with water.</p> <p>iii) Pipe protection shall be as follows: To prevent soil corrosion buried pipes / pipes in trench shall be properly lagged with corrosion protective tapes of coal tar type as per IS:15337 or AWWA C 203. The total thickness of protective tapes to be applied on buried pipes / pipes in trench shall be 4.0mm. This can be achieved by using 4.0mm thick tape in single layer or 2.0mm thick tape in double layer.</p> <p>iv) Pipe thickness: a) For pipe sizes up to 150 NB: As per IS:1239 Part-I heavy grade. b) For pipe sizes 200 NB and above refer Annexure-II.</p> <p>v) All valves shall be as per applicable IS/BS codes and shall be provided with locking arrangement (with locks) in open or close condition. Further, all gate/butterfly valves of size 200 mm & above shall be provided with spur gear reduction unit.</p> <p>vi) All the flanges and counter flanges shall conform to ANSI B 16.5 CI 150.</p> <p>vii) Strainer Body as per IS: 2062 (tested).</p> <p>viii) Pipe Fittings 1) The material shall conform to ASTM A 234 Gr WPB or ASTM A 105 or equivalent and dimensional standard conforming to ANSI B 16.11 (socket & threaded type), ANSI B 16.9 (for butt welded fittings) and ANSI B 16.5 (for flanges and flanged fittings) as the case may be. Further, galvanized malleable cast iron fittings as per IS:1879 in Cast iron fitting as per BS-1641 are also acceptable. 2) Grooved couplings: Vendor may also use mechanical grooved couplings type fittings in GI pipelines for HVW / MVW spray system. All materials and products shall be either Underwriters Laboratories (UL) Listed or Factory Mutual (FM) Approved and installed in accordance with NFPA Standard 13 / equivalent Standard. 3) The fittings shall be galvanized as per IS: 4736 for galvanized pipe application. In case of branching connections from GI mains for spray piping network, sockets may be welded for more than two pipe reductions instead of standard tees. 4) Fabricated fittings shall not be acceptable up to pipe size to 300 NB. For sizes 350 NB and above, fittings may be fabricated as per BS: 2633/BS: 534.</p> <p>ix) Welding of galvanized iron pipes/fittings would be permitted provided the same is carried out by means of special electrodes suitable for the above application and the same shall be approved by Employer. After welding, welded portions shall be applied with three coats of zinc silicate treatment/rich paint over one coat of suitable primer. Further, the Contractor shall provide proper zinc paint at the point of welding.</p>			
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8.00.00	PAINTING									
8.01.00	All the Equipment shall be protected against external corrosion by providing suitable painting.									
8.02.00	The Contractor shall clean the tank plates and structure steel before erection by wire brushing and air blowing. After erection of tank and hydro testing, tanks are subjected to surface preparation and painting as per procedure detailed below at Annexure-I:									
8.03.00	Surface Preparation and Painting for External Piping Surfaces: a) Surface preparation: Near white metal blast cleaning with surface profile 35-50 microns as per surface preparation specification SSPC.SP10 of Society of Protective Coatings, USA. b) Type of Primer: Inorganic zinc (ethyl) silicate primer coat (1 X 70 microns): Self-curing Inorganic Zinc (ethyl) Silicate Primer Coat (having minimum 80% of metallic Zinc content in dry film, Solid by Volume Minimum 60% ±2%) to be applied over blast cleaned surface. c) Intermediate Coat (2 X 90 microns): Polyamide Cured pigmented Micaceous Iron Oxide Epoxy based Paint (containing lamellar MIO minimum 30% on pigment, Solid by Volume Minimum 80% ±2%). d) Final Coat (1 X 70 microns): Acrylic Aliphatic Polyurethane, two pack, isocyanate based color pigmented Paint (Solid by Volume Minimum 55% ±2%). Min. Total DFT (Microns) to be maintained: 320 (Min) and Color shall be as per NTPC Color Coding Scheme. Note: For external surfaces (galvanized steel), proper surface preparation with power tool cleaning up to grade ST2, ISO:8501-01 followed by zinc phosphate primer with 50 microns DFT, again followed by Acrylic Aliphatic Polyurethane coat of 40 microns DFT.									
8.04.00	Deluge Valves, Hydrant Valves, Water monitors, etc. Painting of all equipment/components of FDPS package shall be as per manufacturer's standard practice suitable for site conditions or as detailed below whichever is superior in quality.									
	<table><tr><th>Environment</th><th>Paint scheme</th><th>Total DFT</th></tr><tr><td>Corrosive Environment (as in coastal areas)</td><td>Primer- zinc filled epoxy Intermediate – Epoxy MIO Finish – Aliphatic Polyurethane (shade RAL3000) (P.O Red)</td><td>Min 200 microns</td></tr></table>			Environment	Paint scheme	Total DFT	Corrosive Environment (as in coastal areas)	Primer- zinc filled epoxy Intermediate – Epoxy MIO Finish – Aliphatic Polyurethane (shade RAL3000) (P.O Red)	Min 200 microns	
Environment	Paint scheme	Total DFT								
Corrosive Environment (as in coastal areas)	Primer- zinc filled epoxy Intermediate – Epoxy MIO Finish – Aliphatic Polyurethane (shade RAL3000) (P.O Red)	Min 200 microns								
9.00.00	MULTIPURPOSE NOZZLE The multipurpose nozzle should be such that water under pressure is applied on fire in the form of a jet, spray or fog. Material of construction for multipurpose nozzle shall be of SS316 as per manufacturer's standard.									
10.00.00	FIRE TENDER AND FIRE STATION EQUIPMENTS The Fire tender and fire station equipment shall be as per attached Annexure-III with Part-B of technical specification.									
11.00.00	For schematic of FWPH and Spray System, refer “P&ID of Fire Water Pump House (6401-000-POM-A-049)” and “P&ID of HVW/MVW Spray System (6401-000-POM-A-048)” annexed to this chapter.									
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A) SURFACE PREPARATION AND APPLICATION OF PRIMER/PAINT:												Annexure-I	
s. n.	description	Surface preparation	Primer coat			Intermediate coat			Intermediate coat			Total DFT (µm)	
			Paint	No. of coat	Min. DFT (µm)	Paint	No. of coat	Min. DFT (µm)	Paint	No. of coat	Min. DFT (µm)		
1	Fire water tank (external surface)	SP4*	PS6	1	100	PS12	1	100	PS18	1	120	320	
2	Fire water tank (Internal surface)	SP4*	PS6	1	100	-	-	-	PS18	1	120	300	
3	Fire water tank- outside surface of bottom plate resting on ground	SP4*	-	-	-	-	-	-	PS21	1	35	35	
4	All auxiliary Structural Steel components for pipe supports	SP10	PS7	1	75	PS11	1	100	PS19 PS17	1 1	100 50	325	
5	Painting for splash-zone piping external & internal surface (in the vicinity of Sea-Surface experiencing wave-splash off and on)	SP10	PS7	1	70	PS10	2	100	PS17	1	100	370	
<p>B) The following surface preparation schemes are envisaged here for surface preparation before application of primer.</p> <p>(1) SP4*= Blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron</p> <p>(2) SP10= Near white metal blast cleaning with surface profile 35-50 microns as per surface preparation specification SSPC.SP10 of Society of Protective coatings, USA</p> <p>C) Following are the Primer/painting schemes envisaged herein:</p> <p>(1) PS6 = Epoxy based zinc phosphate</p> <p>(2) PS7 = Inorganic zinc (ethyl) silicate primer coat Self-curing Inorganic Zinc (ethyl) Silicate Primer Coat (having minimum 80% of metallic Zinc content in dry film, Solid by Volume Minimum 62% ±2%) to be applied over blast cleaned surface.</p> <p>(3) PS10 = Low solvent glass flakes reinforced epoxy, Solid by Volume Minimum 96% ±2%</p> <p>(4) PS11 = Micaceous Iron Oxide Epoxy intermediate coat, Polyamide Cured pigmented Micaceous Iron Oxide Epoxy based Paint (containing lamellar MIO minimum 30% on pigment, Solid by Volume Minimum 80% ±2%)</p> <p>(5) PS12 = Epoxy based TiO2 pigmented coat</p> <p>(6) PS17 = Acrylic Aliphatic Polyurethane, two pack, iso-cyanate based colour pigmented Paint (Solid by Volume Minimum 55% ±2%)</p> <p>(7) PS18 = Epoxy based finish coat/ paint</p> <p>(8) PS19 = Polyamide Cured colour pigmented Epoxy based Paint (Solid by Volume Minimum 62% ±2%)</p> <p>(9) PS21 = Coal tar Epoxy Enamel</p>													
POWER PROJECT (108 MW ±5 MW) EPC PACKAGE			TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2				CHAPTER - IV FIRE DETECTION & PROTECTION SYSTEM				PAGE 14 OF 34		

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>																																																																																								
	<div>Annexure-II</div> <div>Technical Data:</div> <table><tr><td>1. Fire water pumps</td><td>Main Fire Water Pumps (common for hydrant & spray system)</td><td colspan="2">Jockey</td></tr><tr><td>Number of pumps</td><td>3 (2 motor driven & 1 diesel engine driven)</td><td colspan="2">2 (both motors driven)</td></tr><tr><td>Design Capacity</td><td>273 m³/hr (min) or as per system requirement</td><td colspan="2">10.8 m³/hr (min) or as per system requirement</td></tr><tr><td>TDH of pump (MWC)</td><td>88 (min) or as per system requirement</td><td colspan="2">88 (min) as per system requirement</td></tr><tr><td>MOC</td><td colspan="3">Casing:IS:210 Gr. FG 260 (2.5% Ni), Impeller: Bronze IS:318 Gr.II, Impeller shaft, coupling: SS316</td></tr><tr><td>2. Hydrant Valve</td><td colspan="3">Oblique female type as per IS:5290 MOC: Body/bonnet/stop valve/valve seat/trim: SS316</td></tr><tr><td>3. Water monitor</td><td colspan="3">As per IS:8442 Type-I, Size: 75mm, Nozzle diameter: 38mm MOC: Water barrel/reducer/elbow: SS316 Nozzle: SS confirming to IS:3444 Gr4</td></tr><tr><td>4. Water branch pipe & nozzle</td><td colspan="3">As per IS:903 / IS:2871 MOC: Branch pipe: SS316 (Gr 4 of IS:3444) (both ends) Nozzle: SS316 (Gr 4 of IS:3444), Size: min 16mm & max 25mm</td></tr><tr><td>5. Water line Gate</td><td colspan="3">- Design Code: a) IS:14846 or BS:5150 (for valves coming inside fire water pump house) b) BS:5150 (for valves at other locations) - valves shall be of rising spindle type. - Pressure rating: PN1.6 (as per IS:14846) / PN16 (as per BS:5150) MOC: Body/bonnet/Yoke/Wedge: CI to IS:210 FG-200 Spindle: SS to ASTM-A-276 type 410</td></tr><tr><td>6. Check Valve</td><td>Below 50NB size Design Code: IS:778 (below 50NB) MOC: Body/cover/flap: Leaded tin bronze to IS:318 Gr. LTB-2</td><td colspan="2">50NB & above IS:5312 / BS:5153 CI to IS:210 FG-200</td></tr><tr><td>7. 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GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2	VOLUME-I CHAPTER - M4 FIRE DETECTION & PROTECTION SYSTEM	PAGE 15 OF 34																																																																																								

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एन टी पी सी NTPC</div>
	ANNEXURE-III			
	<u>FIRE TENDER AND FIRE STATION EQUIPMENTS</u>			
	FIRE TENDER AND FIRE STATION EQUIPMENTS:			
	The scope of equipment to be provided under this specification shall cover all the system and major equipment detailed hereunder. However, for all those items for which details are not covered below relevant IS standard (latest revision) may be referred to.			
1.0	FIRE WATER TENDER (TYPE-B) FOR FIRE BRIGATE WITH ALL ACCESSORIES			
1.1	Fire water tender, Type-B for fire brigade use shall be provided as per IS 950. All accessories listed in IS: 950 shall also be provided with above fire water tender.			
1.2	The design and construction of water tender shall be in accordance with IS: 950.			
1.3	The appliance shall incorporate a high and low pressure fire pump of minimum capacity 3000 LPM at 0.7 MPa and 300 LPM at 3.5 MPa capacity in line with IS:950.			
1.4	The appliance shall carry a water tank of 5000 litres capacity depending upon the type of chassis used. It shall carry an extension ladder and shall be capable of towing trailer pumps.			
1.5	Gross vehicle weight shall not be less than 25000kg. Maximum speed on level road fully laden, acceleration from standing start through the gear (fully laden) and overall dimension shall be as per IS: 950. The appliance shall be capable of being started from rest on a gradient of 1 to 4.			
1.6	The choice of material to be used in the construction of the appliance shall be made with a view to combining lightness with strength and durability.			
	(i)	Pump casing & low pressure impeller	Lead Tin bronze (grade LTB2 of IS:318)	
	(ii)	High pressure impeller	Phosphor-bronze or stainless steel or aluminum-bronze (IS: 617)	
	(iii)	Impeller ring & impeller neck ring	Lead tin bronze (grade LTB2 of IS:318)	
	(iv)	Pump shaft	Stainless steel (Grade 04Cr18Ni10 of IS:6603)	
	(v)	Pump Panel	Aluminum sheet/ chequered plates (IS: 737) or Mild steel sheet (IS: 513)	
1.6.1	All parts which form water ways or come into contact with water shall be of stainless steel.			
1.7	Design and construction of water tender shall be as per IS: 950.			
1.8	The tank body and baffles shall be of minimum 5mm thick mild steel plates.			
1.9	The tank shall have a bolted manhole of 450mm diameter (min.) and shall have a gun metal threaded ring and cap. of 300mm dia. for filling the water tank from the top. The manhole cover shall be made from 5mm thick mild steel plates and epoxy coated from inside and outside. A cleaning hole of at least 250mm dia. shall be provided at the bottom.			
1.10	The design and selection of pump, pump, suction & delivery valves, primer and pipeline & valves etc. shall be in compliance with IS: 950. The pump performance data shall be as per IS: 950.			
1.11	Hose reels and water/Foam Monitor required shall be as per IS 950.			
1.12	An electrically operated cable winch of 6 t capacity shall be provided. The winch unit shall be complete with minimum 5.5 HP 12 V dc series wound electric reversible motor for increased pulling power, rope drum, and 27 m heavy duty galvanized EIPS wire rope with replaceable self-locking clevis hook and shall be mounted on the front bumper of the vehicle with suitable strong supports.			
1.13	Telescopic Light Mast or Inflatable Emergency Lighting System shall also be provided as per IS Code.			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2	VOLUME-I CHAPTER - M4 FIRE DETECTION & PROTECTION SYSTEM	PAGE 16 OF 34

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>																																				
1.14	Tool-Kit Container:-A specially fitted recessed tray for the normal kit of tools, carried on the appliance, shall be provided.																																							
1.15	The stability of the appliance shall be such that when under fully equipped and loaded conditions (but excluding crew), if the surface on which the appliance stands is tilted to either side, the point at which overturning occurs is not passed at an angle of 30° from the horizontal.																																							
1.16	All parts of the appliance shall be of good workmanship and shall have streamlined finish.																																							
1.17	The appliance shall be painted fire red colour conforming to Shade No. 536 of IS 5. The paint shall conform to IS 2932.																																							
1.18	Instruction Book, accessories and equipment shall also be provided.																																							
2.0	Not Used.																																							
3.0	FOAM FIRE TENDER WITH ALL ACCESSORIES GENERAL: The foam fire tender including all accessories shall be designed & manufactured as per the following specifications and sound engineering practice. All the equipments & accessories shall be fixed on the appliance in a compact & neat manner& so placed that each part is easily & readily accessible for use and maintenance. Foam fire tender with aerodynamic design generally confirming to IS 10460.																																							
3.1	CHASSIS The chassis shall be suitable with minimum 16 Tons Gross vehicle weight (GVW). The engine fitted on the chassis shall comply with the respective emission norms in force at the time of delivery of chassis. The chassis shall be with the following specifications. <table><tr><td>1.1</td><td>Engine</td><td>Diesel engine developing not less than 150 bhp and conforming to prevalent emission norms.</td></tr><tr><td>1.2</td><td>Clutch</td><td>Single plate dry friction type hydraulically actuated.</td></tr><tr><td>1.3</td><td>Gear</td><td>Synchromesh gear box with 6 forward and 1 reverse gear.</td></tr><tr><td>1.4</td><td>Front Axle</td><td>Heavy duty, forged, 'I' beam.</td></tr><tr><td>1.5</td><td>Rear Axle</td><td>Single reduction, hypoid gears, fully floating axle shaft.</td></tr><tr><td>1.6</td><td>Steering</td><td>Integral hydraulic power assisted steering.</td></tr><tr><td>1.7</td><td>Brakes</td><td>Dual circuit fully air braking system with pneumatically operated brakes on rear wheel.</td></tr><tr><td>1.8</td><td>Suspension</td><td>semi- elliptical leaf spring at front and rear with hydraulic double acting shock absorber on front.</td></tr><tr><td>1.9</td><td>Frame</td><td>Ladder type heavy duty frame with riveted 1 bolted cross members.</td></tr><tr><td>1.10</td><td>Wheels and</td><td>Suitable size available in local market with minimum 16 Tyres PR – 7 Nos. (Including spare wheel)</td></tr><tr><td>1.11</td><td>Fuel Tank</td><td>Minimum 160 litres capacity.</td></tr><tr><td>1.12</td><td>Electrical System</td><td>12/24 volts. 120 Ah capacity battery with Alternator.</td></tr></table>				1.1	Engine	Diesel engine developing not less than 150 bhp and conforming to prevalent emission norms.	1.2	Clutch	Single plate dry friction type hydraulically actuated.	1.3	Gear	Synchromesh gear box with 6 forward and 1 reverse gear.	1.4	Front Axle	Heavy duty, forged, 'I' beam.	1.5	Rear Axle	Single reduction, hypoid gears, fully floating axle shaft.	1.6	Steering	Integral hydraulic power assisted steering.	1.7	Brakes	Dual circuit fully air braking system with pneumatically operated brakes on rear wheel.	1.8	Suspension	semi- elliptical leaf spring at front and rear with hydraulic double acting shock absorber on front.	1.9	Frame	Ladder type heavy duty frame with riveted 1 bolted cross members.	1.10	Wheels and	Suitable size available in local market with minimum 16 Tyres PR – 7 Nos. (Including spare wheel)	1.11	Fuel Tank	Minimum 160 litres capacity.	1.12	Electrical System	12/24 volts. 120 Ah capacity battery with Alternator.
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<p>1.13 Cowl Standard cowl duly painted in RED colour with instrument cluster, rear view mirrors, Wiper system, original driver seat, safety belts.</p> <p>1.14 GVW Not less than 16000 Kgs.</p> <p>1.15 safety features Anti-Lock Breaking System (ABS)</p>	
3.2	PUMP:	
3.2.1	The pump shall be centrifugal type, multi pressure, having output capacity of 3000LPM at 8 kg/cm ² and 300 LPM at 35 kg/cm ² at 3 mtrs suction lift at NTP condition. The low-pressure side will be of single stage and the high-pressure side also with single stage having regenerative type impeller.	
3.2.2	<p>The pump shall comply to the following performance parameters.</p> <p>a) Normal Pressure output : 3000 LPM at 8 kg/cm²</p> <p>b) High pressure output : 300 LPM at 35 kg/cm²</p> <p>c) Maximum pressure in : 14 kg/cm² (shut off pressure)</p> <p>Normal pressure mode.</p> <p>d) Maximum pressure in : 35 kg/cm²</p> <p>High pressure mode</p> <p>e) Deep lifting capacity of : 30 cm/sec. max. upto 7 Mtrs in</p> <p>Pump. 30 sec. at NTP condition.</p>	
3.2.3	The overall pump shall be constructed from gunmetal. The normal (low) pressure impeller, volute, and impeller wearing shall be made from gunmetal confirming to Gr I of IS: 318 and the regenerative type high pressure impeller shall be of Aluminum, Bronze (AB-2). The pump shaft shall be made from stainless steel confirming to IS: 6603. The bearing housing will be made of C.I. and all the studs and bolts coming in contact with water shall be of stainless steel. The bearings used in the pump shall be of reputed make.	
3.2.4	The normal and high-pressure impeller shall be mounted on a single shaft and normal, (low) pressure impeller shall be dynamically balanced.	
3.2.5	The pump shall be provided with self-adjusting mechanical carbon seal with interface plate. The mechanical seal assembly shall with stand dry running of pump upto 2minutes without any damages.	
3.2.6	The pump shall be provided with an inbuilt filter of easily removable type, which shall filter the water before entering into the high-pressure stage impeller.	
3.2.7	Operation of low pressure to high pressure or vice-a-versa shall be possible by actuation of single lever.	
3.2.8	The pump shall have facility to operate low pressure and high-pressure mode simultaneously or individually. While high pressure mode is in operation and delivering 300 LPM at 35 kg/cm ² , the pressure in low pressure side shall not exceed 8.5 kg/cm ² .	
3.2.9	The pump shall be provided in built (integrated in the pump outlet manifold) Pressure Relief Valve (PRV) which shall operate automatically and shall not allow the high-pressure to increase beyond 40 kg/cm ² .	
3.2.10	The size of high-pressure outlet shall be of 25 mm connected to high-pressure hose reel.	
3.2.11	The pump shall be provided with one suction inlet of 125 mm dia. having round threads confirming to IS:902 and three numbers of 63 mm delivery outlets having screw down type valves fitted with instantaneous couplings as per IS: 903. The delivery valve spindle sealing shall not be of gland type. The high-pressure outlet shall not be less than 25 mm and shall either be flange on screw type.	
3.2.12	The efficiency of the pump shall be such that the power and RPM required shall not be more than available with the engine.	
3.2.13	The pump housing shall have provision to connect to internal cooling system.	
3.2.14	The pump shall be mounted at the rear of the vehicle connected to P.T.O. by propeller shafts and universal and slip joints with sufficient number of bearing supports. All the propeller shafts shall be dynamically balanced and shall be procured from the OEM (the chassis manufacturer).	
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2	VOLUME-I CHAPTER - M4 FIRE DETECTION & PROTECTION SYSTEM PAGE 18 OF 34


CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
3.2.15	<p>Pump Primer:-The priming system shall be horizontal Reciprocating type or water ring type. The priming shall be fully automatic in operation and shall not require any operation whatever from the pump operator other than throttling the engine to the required RPM. The primer shall get automatically disengaged once the pressure is registered at the pump. The primer shall be capable of lifting the water in 30 seconds from the depth of 7 mtrs. (up to pump inlet) at NTP condition. The pump shall attain a dry vacuum of 620 mm of Hg. The primer shall disengage automatically at a pump pressure of 1.5 to 2.0 kg/cm².</p> <p>In addition Exhaust ejector type primer capable of lifting water from 7 mtrs within 30seconds shall also be provided.</p>			
3.2.16				
3.3	<p>PUMPTEST: The pump fitted on the vehicle shall be subjected to various tests as detailed below:</p>			
3.3.1	The pump with its all fitments will be subjected to Hydrostatic testing on a pressure of 21 kgs./cm ² .			
3.3.2	The pump shall be run dry for a period of minimum two minutes at 2000 RPM to check the integrity of mechanical carbon seal. After this test there shall not be any leakage of water through carbon seal.			
3.3.3	The pump performance test will be carried out by running the pump at constant RPM at 2600 and measuring the discharge at various pressure.			
3.3.4	The pump will be subjected to Endurance test for a period of four hours continuous running. The first Three hours the pump shall deliver rated output of 3000 LPM at 8 kg/cm ² and next one hour will be 300 LPM at 35 kg/cm ² .			
3.3.5	During the endurance test the water shall not be replenished in the cooling system and the temperature of the cooling water and engine oil should not exceed the manufacturer's standard recommendations for the continuous operation and engine should not show any sign of stresses.			
3.3.6				
3.3.7	Foam induction test to check the calibration of metering valve.			
	Foam production test with monitor and side lines for foam quality.			
3.4	<p>POWER TAKE OFF:</p> <p>The P.T.O shall be Heavy duty type with suitable ratio capable of transmitting the full torque of the engine in first gear. The lever for engaging the P.T.O. shall be provided in the Driver's cabin with proper locking arrangement. The PTO shall be mounted on heavy duty cross members and support brackets between the longitudinal members of the chassis frame. Means shall be provided to check the oil level in the PTO and suitable drain plug shall be provided at the bottom. A cooling coil made of copper tubes shall be provided inside the PTO at the bottom to prevent the oil of the PTO from heating.</p>			
3.5	<p>WATER TANK -</p>			
	The capacity shall not be less than 5000 liters. The tank body and baffles shall be of minimum 5 mm thick SS 316 plates. The sides of the tank shall have Die Pressed reinforced webs for better strength and rigidity. The design of the tank should be such that the complete width of the vehicle is utilized and the height of the tank is to be kept as low as possible for better stability.			
3.5.1	A tank of required capacity constructed out of mild steel treated for anticorrosion shall be suitably mounted on the chassis in a manner keeping in view the proper load distribution on the axles.			
3.5.2	A full length runner from behind the driver cabin till end of chassis frame shall be provided and made out of M.S. Channel of 100 x 50 x 5 mm suitably fixed to the chassis, frame with 6mm thick M.S. plate and bolted to chassis frame wherever holes are available in the chassis frame and also with 518" 'U' bolts and nuts shall be nylock nuts only.			
3.5.3	The tank shall be suitably baffled with minimum 2 nos. of baffles fitted longitudinally and 21 nos. baffles fitted transversely to prevent surge when the vehicle is braking, cornering or accelerating.			
3.5.4	The baffles shall be arranged in a manner to facilitate the passage of a man throughout the tank for cleaning purpose.			
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3.5.5	The tank shall be mounted on minimum three cross members to counter act the stresses caused by chassis flexion and shall be so secured that it can be easily removed. The water tank shall be provided with six chairs, three on either side for mounting the tank on the runner and chassis frame.			
3.5.6	The water tank shall be fixed to the chassis frame and runner with 'U' clamps and aluminum packing block and self-locking nuts.			
3.5.7	Suitable eyes shall be provided on the shell of the tank to enable it to be lifted from the vehicle for repairs / replacement as and when required			
3.5.8	The tank shall be fitted with a 50 mm bore overflow pipe. Two 63 mm instantaneous hydrant connection, incorporating a strainer with NRV, shall be provided close to the pump control panel for filling the tank through 75 mm bore pipe. Minimum 125 mm bore pipe line shall be taken from the tank to the suction inlet of the pump incorporating minimum 125 mm internal dia. butterfly type valve. Drain valve shall be provided at the bottom of the tank.			
3.5.9	The MS plates used for the tank shall be Zinc Plated or galvanized and shall be given adequate anti-corrosive treatment of epoxy treatment consisting of one coat of primer with two coats of finish after preparing the surface by sand or shot blasting from inside and outside after fabrication if it is not galvanized. The open end of the overflow pipe should be taken down to a point well below the chassis without affecting the effective ground clearance when fully loaded and shall discharge away from the wheels.			
3.5.10	Visual -level gauge of the glass / acrylic tube shall be provided at the control panel calibrated 1/4, 1/2, 3/4and full (preferably calibrated in litres).			
3.5.11	The tank shall have a bolted manhole of 60 cm dia minimum and should have a gunmetal threaded ring and gun metal cap of 30 cm dia for filling the water tank from the top. The manhole cover shall be made from 5 mm thick M.S. plate and epoxy coated from inside and outside. A cleaning hole of at least 25 cm dia shall also be provided at the bottom.			
3.5.12	The tank shall be connected with the pump and hose reel and valve(s) shall be provided in such a way that any of the following operations are possible: a) Hydrant -tank, b) Hydrant - reel, c) Tank - pump - high and low pressure hose reels, d) Hydrant - pump - low pressure hose reel, and e) Tank - Pump - Monitor (Foam water)			
3.6	FOAM TANK: The foam tank of 500 Ltrs. capacity shall be fabricated out of min. 4mm thick SS plates (304) for bottom & 3mm plates for the sides & baffles. The tank shall be suitably baffled. In addition a 2% of expansion space be made in the tank, over and above foam compound capacity.			
3.6.1	The cleaning hole of 250mm & drain pipe with a ball valve & plug incorporated in it to be provided. The filler orifice of 150mm dia. with a removable strainer (Material-Resistant to the attack of foam compound) will be provided. The filler cap shall be clearly marked "FOAM".			
3.6.2	The design of the tank shall incorporate a removable sump fitted with a drain valve. The foam compound draw off tube shall be positioned in the centre of the sump in such a manner that foreign matter or sludge will not pass into the compound line. The draw off tube shall be fitted with a gauge strainer of suitable material, mesh, size & adequate straining area.			
3.6.3	Means shall be provided for automatic venting of the foam tank when the foam is being produced or the tank is being filled. The device employed shall be as simple as possible &shall not get clogged easily during normal use of the Appliance.			
3.6.4	Inspection hole of 450 mm with cover will be provided. Means shall be provided for automatic venting of the foam compound tank when the foam compound is drawn from it or when the tank is being filled.			
3.6.5	A foam solution transfer pump Rotary type with necessary piping will be provided. Provision will be made for drawing foam compound direct from an external source through a pick up tube while producing foam.			
3.6.6	The draw off tube will be connected to the foam proportioner with NRV in addition to the main control valve. The draw off pipe will be fitted with removable strainer.			
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3.6.7	Visual level gauge of the glass/acrylic tube shall be provided at the control panel calibrated 114, 112, 314 and full (preferably calibrated in litres).		
3.7	FOAM PROPORTIONER: Manually operated selector type around the pump foam proportioning system shall be provided at the rear of the pump. The Pump proportioner shall induct foam & water proportionately to feed the foam monitor and hand lines at rate of 6 % plus/minus 0.5% foam. The proportioner shall be calibrated to ensure the correct intake of air foam liquid to foam equipment. This shall have five different position of selector valve i.e.0, 1, 2, 3 & 4.		
3.8	DELIVERY OUTLETS: There shall be 2 Nos. delivery outlets having standard GM inst. female coupling with screw down type delivery valves with blank caps. It should have twist type lugs made of gun metal.		
3.9	HIGH PRESSURE HOSE REEL: Two high pressure hose reel to facilitate operation of the high pressure section of the Fire Pump shall be provided and mounted so as to be accessible for use from either side of the appliance. The hose should be prevented from kinking. The hose shall be light weight PVC nylon braided hose or equivalent and the working pressure of hose will not be less than 40 Kglcm2. The high pressure Hose reels will hold not less than 30 M of hose in one length, terminating in High pressure fog/jet trigger type gun connected by quick connect couplings. The fog gun shall be made of Aluminium alloy or stainless steel (SS 304). The inlet connection shall have a leak proof rotating type hose connector. The gun shall be of constant flow type with a discharge capacity of 150 LPM approximately. Provision shall be made in the gun controls to achieve combat mode (straight jet) or a fo9 shield in split second. The gun shall have the ability to work on pressure from 20kg/cm to 40kg/cm2 without affecting discharge pattern. The weight of the gun assembly shall not be more than 3 kg.		
3.10	WATER/ FOAM MONITOR: One water cum foam monitor will be provided on the top at suitable location, with cap. of 3000 LPM of water @8.5 Kg/cm2. The monitor will be capable of traversing through 360° in horizontal plane, +75deg& -15deg in vertical plane with discharge range of 70 M (water). The detailed specification of the Monitor is as under: <ul style="list-style-type: none">• Size 100 mm• Body Barrel of SS, GM swivel joint for horizontal & Vertical motion manual operation• Rotation 360'• Elevation 90' (+75' -15')		
3.10.1	CONSTRUCTION DETAILS <ul style="list-style-type: none">• Working pressure :-7 to 10 kg/cm'.• Painting :- As per IS:5 (2 coats of red epoxy paint)		
3.10.2	SELF INDUCTION NOZZLE <ul style="list-style-type: none">• Material of construction Aluminium alloy to IS:617 or GM LTB Gr.2 of IS: 318.• Type of Foam used AFF Foam• Discharge capacity 3000 LPM• Throw horizontal Water: min. 70 mtrs. , Foam: min. 65 mtrs.• Foam Expansion Min. 1:6• Fog (curtain) 160°• K Factor 100. Semi fog for tank cooling, dissipation of vapour & gases at a distance of 10m & above.		
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3.11	PIPELINES AND VALVES			
3.11.1	All pipelines and pipe fittings shall be of Stainless steel (SS 304) and all valves upto 50mm size shall be 3 piece design SS 304 ball valves. All valves above 50mm size shall be standard butterfly valves.			
3.11.2	All piping shall be sized so as to have minimum pressure drop and achieve the required pressure and flow at various locations.			
3.11.3	All piping shall be designed for 10% over the maximum pressures encountered in the pipe.			
3.11.4	The piping shall be flanged for ease of maintenance. However, flange joints shall be kept to minimum.			
3.11.5	All lines shall be hydraulically tested at 1.5 times of the design pressure and pressure shall be held for two hours. In no case the lines shall be tested below 25 kg/sq. cm. (g).			
3.11.6	All lines shall be suitably supported so as to provide rigidity and avoid vibrations.			
3.11.7	All lines less than 50 mm NB size can be socket welded to matching rating fittings.			
3.11.8	All lines above 50mm NB size shall be butts welded with full penetration welds.			
3.11.9	All bolts, nuts and washers used shall be of SS-304.			
3.11.10	COOLING SYSTEM: An indirect cooling system of open circuit type heat exchanger shall be provided for cooling the radiator water & Engine. The heat exchanger tank shall be made from minimum 1.22 mm thick brass sheets and the coil in the coolant tank shall be of copper for effective cooling. The design of the heat exchanger shall be such that the temperature of the engine shall not exceed the operating temperature specified by the chassis manufacturer when the vehicle is being used in stationary conditions			
3.12	CONTROL PANEL			
3.12.1	Adequately illuminated control panel shall be provided near the pump.			
3.12.2	The control panel(s) shall include the following: a) Throttle control for engine; b) Pressure gauge - 0 to 17.5 kgf/cm ² ; for low pressure (glycerin filled) Pressure gauge - 0 to 50 kgf/cm ² ; for high pressure (glycerin filled) c) Compound gauge (glycerin filled) calibrated as under: Vacuum - 0 to 75 cm Hg, preferably in black; Pressure - 0 to 15 kgf/cm ² , preferably in black; d) Primer control for exhaust primer e) Temperature gauge and glow lamp for lubricating system f) Cooling water circuit control. g) Water tank valve h) Foam tank valve i) Foam proportioning valve. j) Auxiliary foam connection with valve. k) Monitor valve l) Delivery valves. m) Suction inlet. n) Hose reel valves. o) Water level indicator p) Foam level indicator			
3.13	BODY WORK AND STOWAGE			
3.13.1	Enclosed accommodation for six persons shall be provided in the driver cab-cum-crew compartment including the driver and in-charge of the crew. Both the seats should be independent. The driver's seat should be adjustable and comfortable. The rear compartment of driver's cabin should have one removable seat for full width of cab for 5 (five) crewmembers. The cab floor should be covered with 3 mm thick Aluminium chequered plate rigidly fixed to the under frame cross members by means of nuts and bolts or riveting except the mudguard arches			
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<p>3.13.2</p> <p>3.13.3</p> <p>3.13.4</p> <p>3.13.5</p> <p>3.13.6</p> <p>3.13.7</p> <p>3.13.8</p> <p>3.13.9</p> <p>3.13.10</p> <p>3.13.11</p> <p>3.13.12</p> <p>3.13.13</p> <p>3.13.14</p> <p>3.13.15</p> <p>3.13.16</p>	<p>which shall be covered with 1.60 mm Aluminium chequered plates. Trap doors for topping up oil etc wherever necessary shall be provided.</p> <p>Grand type light should be provided in the driver's cabin dwell vision and external rear view mirrors should be fitted to the cab.</p> <p>The driver cum crew cabin shall be provided with full four doors, one for driver, one for officer and two at the crew compartment. The doors shall be generously sized for easy embarking/disembarking of crew members. All the doors shall be fitted on the super structural members, each hung upon three invisible coach type M.S. stout hinges and fitted with best. Quality handles.</p> <p>The door handle on outside of driver seat shall have a locking arrangement. Other doors shall be lockable from inside. In addition to the doors locks, aluminum tower bolt shall be provided for all the doors from inside Adequate grab rails shall be provided for easily boarding and alighting from the appliance.</p> <p>The windscreen glass shall be provided in the two halves and shall be semi curved type. Each glass shall be fitted in E.P.D.M. rubber beading. The glasses shall be 5 mm thick toughened safety glass.</p> <p>The rubber beading used for fitting glasses and window frame shall be E.P.D.M. rubber.</p> <p>The driver seat shall be adjustable type vertically, forward and backward. The officer seat shall be fixed type. Both the seats shall be rigidly fixed to the flooring by means of nuts and bolts.</p> <p>The seat cushion shall be of latex foam rubber 75 mm thick upholstered in good quality foam leather cloth. The back seat shall be of latex foam rubber 50 mm thick upholstered in good quality foam leather cloth.</p> <p>Below the crew seat, two lockers shall be provided One for battery box and another for keeping accessories. The extra length of battery cable if required shall be provided</p> <p>The crew seat shall be rigidly fixed to floor by means of nuts and bolts, running full width of the vehicle suitable for sitting five fireman, covered with 75 mm x 50 mm cushion latex foam rubber upholstered in good quality foam leather of approved shade.</p> <p>The rear body shall be fabricated in continuation and in line. The under frame cross members shall be fabricated from the rolled M.S. channel of 100 x 50 x 5 mm size.</p> <p>The M.S. runner of 100 x 50 x 5 mm size shall be provided over the full length of the chassis member for the uniform distribution of load over the chassis.</p> <p>Each cross members shall be secured to the chassis frame by 16 mm dia 'U' Bolts with aluminum packing block and self-locking unit.</p> <p>Balata packing of thickness 6 mm shall be provided in between the chassis frame and across members.</p> <p>The structure frame work shall be of welded constructions and made from 2mm thick MS pressed sections and square tubes. The Angles and channels used shall be of min. 3mmthickness. The complete structure material shall be treated for anti-corrosion by Zinc Plating. The plating thickness shall not be less than 20 microns. Two coats of Epoxy paint shall be applied to the completely welded structure. The structure shall be so designed so as to avoid any vibration I rattling I deformation in the intended usage of the vehicle.</p> <p>The details of super structure are as follows:</p> <ol style="list-style-type: none"> Under frame cross members :100 x 50 x 5 mm (Min.) Floor longitudinal members :50 x 50x 6 mm (Min.) <ul style="list-style-type: none"> The cab and lockers should be of composite construction with sufficient rigidity and reinforcement and shall be kept as light as possible. The interior paneling shall be done from 1.22mm thick aluminium sheets & the exterior paneling shall be done from 1.60mm thick aluminium sheets. The roof on the cabin of the vehicle shall be covered with min. 1.60mm thick aluminium chequered plates. All the lockers sides & complete rear of the vehicle shall be covered with min. 1.22mm thick aluminium chequered plates. The complete rear deck and all lockers floors and the rear foot boards shall be covered with minimum 3mm thick aluminium chequered plate. 			
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	<ul style="list-style-type: none">Sufficient number of Lockers with suitable shelves, partitions and roll in roll out type drawers It rays shall be provided on both sides of the vehicle for secure stowage of all equipment given in annexure. One through and through locker shall be provided immediately behind the drivers cab. All space available below the chassis frame level shall be utilized by providing lockers with proper doors. These doors shall be fitted with suitable chains and hooks on both sides so that the same can be used as foot board.All lockers shall be provided with internal automatic lighting arrangement with the master switch in the cab.All lockers above chassis floor shall be covered with Aluminium roller shutters. The roller shutters shall be made from extruded aluminium sections with suitable roller, spring, guide channels etc. All aluminium sections used shall be properly anodized.The Roller shutters shall be rolled inwards underneath the roof giving unobstructed access to the equipment lockers and the firefighting material.These roller shutters should open in every position of the vehicle even in rough terrain. Guide rails shall support the shutters over entire length on both sides to make them absolutely torsion free. The roller shutters should have a sturdy lock, preventing accidental opening during movement of vehicle.Roller shutters shall be made of hollow rectangular shaped aluminium links which shall be inter connected with rubber /plastic1 PVC profiles sealing the roller shutter watertight when closed. These roller shutters should be durable, maintenance free, weather and corrosion resistant.Suitable storage space shall be provided to store four 2.5-m lengths of suction hoses with couplings at convenient locationSPECIAL PROVISION FOR STOWAGE OF EQUIPMENTS: For all hose fittings like branch pipes etc. quick release type couplings are provided which enables the operator to locate the desired equipment instantly and thereby save valuable time at the time of fire. These couplings also ensure that none of the items damage the internal paneling & thereby increase the life of the vehicle. Suitable clamps, brackets, holders etc. are provided for all other items`			
3.14.	MISCELLANEOUS <ul style="list-style-type: none">a. A suitable bumper shall be provided at the rear rigidly fixed to the super structural members by means of nuts and bolts which is supplied along with the chassis.b. Two cat ladders made out of S.S. round or square pipe of 25mm dia shall be provided.c. 2 nos of 25mm dia aluminum pipe railing with sufficient number of aluminum double socket brackets shall be provided to the rear body over the deck.d. A heavy duty Towing hook shall be provided and fitted the rear bumper by means of nuts and bolts.e. Quick removable type wire mesh guard made from 25x25mm size MS wire mesh of1.60 mm covered in MS angle frame shall be provided to all the glasses of driver-cum crew cabin.f. CABLE WINCH. An electrically operated cable winch of having capacity of not less than 6.5 tons pulling capacity (single layer) should be provided and mounted in the front of the vehicle. The winch unit should be complete with minimum 5.5 hp, 12v DC series wound electric reversible motor for increased pulling power. The motor and solenoids shall be grounded to the battery. It shall have an automatic load holding brake system for more strength. For free spooling the clutch design shall be easy to use type with spring loaded pull and rotate system. The gear system should be 3 stage planetary type for faster line speed and the gear reduction ratio shall not be more than 300:1, the rope drum shall not be of more than 8 inches long having 3.5 inches dia and shall be supplied with minimum,90 ft heavy duty galvanized EIPS wire rope with replaceable self-locking clevis hook and would be mounted on the front bumper of the vehicle with suitable strong supports and a 4 way roller fairlead. The Weight of the			
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	<p>winch shall not be more than 55 kgs. Wireless remote for 12 V system or wired remote for 24 v system shall also be supplied with the unit.</p> <p>g. TELESCOPIC LIGHT MAST A Pneumatic telescopic should be mounted on the vehicle. It should be manufactured from Anodized aluminium 6063 T6alloy tubes and have a max diameter of 115 mm diameter on its base and complete with a foot plate dia.150 with up to six fixing holes for bolts. The temperature range shall be from -40°C up to 60°C, with anti-twist lock, with safety valve and drainage outlet valve. The telescopic mast should be extremely strong and designed with a minimum of 6sections and equipped with a special plastic locking system placed on the ring between the first and the second section meant to eliminate any backlash between all the sections, once the mast is retracted. The mast should be equipped with an internal spiraled electrical cable with 9 wires with a section each of 1.5 mm2 and 13 wires with a section each of 0.22 mm2, the group of 13 wires should be screened. Each section of the mast should have a thickness of not less than 3.5 mm2. For a better movement of the internal cable, the last three internal pistons should be threaded to the corresponding sections. The maximum height of the mast when deployed should be minimum 6000 mm (from the ground), the retracted height should be of maximum1.900 mm: both heights are meant with the integrated tilt & turn unit. The working pressure should not be less than 2.5 bar and more than 3.5 bar. An electro-pneumatic group of valves must be supplied and mounted at the bottom of the mast with the possibility to regulate the extension speed and the retraction speed separately. The light mast should have 4 x 1000 Watt Halogen flood light projectors in weatherproof casing. The floodlights on the top should have a minimum electrical rotation of 360° and a tilt of 310°, by means of a tilt and turn unit with an ABS cover for inspection. A 5 KVA portable Petrol engine operated Gen Set shall be installed at a suitable location in the rear locker and necessary wiring /connections shall be given to the light mast.</p>			
3.15	ELECTRICAL SYSTEM:			
3.15.1	All the important electrical circuits shall have separate fuses suitably indicated and shall be grouped into a common fuse box located at an accessible position. The wiring shall be single pole with negative earth.			
3.15.2	The suitable size wire shall be selected for different circuits considering the current consumption for that circuit.			
3.15.3	Electrical siren of 1.6 Kms range 12/24 volts D.C. shall be provided and fitted at suitable place with two controlling push buttons on one officer side and another at Driver side.			
3.15.4	Two rotating beacon lights with Amber lens shall be provided over the top of driver's cabin.			
3.15.5	The other lights, pump cabin light, locker lights shall be of approved make.			
3.15.6	All the controlling switches of lights on dashboard shall be approved make.			
3.15.7	Two fog lamps of approved make shall be provided and fitted on front-bumper with controlling switch on dashboard.			
3.15.8	New wiper motor assembly of 17 watts with new blades and arms shall be provided if not provided with the chassis. The location of wiper motor shall be such that it shall be easily accessible for repairs.			
3.15.9	Adjustable search light assembly shall be provided at a convenient position on the top of rear body deck with 30 mtrs. Cable drum with Rexene cover.			
3.15.10	Hooter cum P.A. system shall be provided with a speaker mounted on the top of Driver's cabin with Rexene cover. The output shall be 25 watts.			
3.15.11	Adjustable spot light, mounted in a convenient position to give flood or beam 04light at the rear of driver cabin shall be provided.			
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3.16	PAINTING:			
3.16.1	The complete structure material shall be treated for anti-corrosion by Zinc Plating. The plating thickness shall not be less than 20 microns. Two coats of Epoxy paint shall be applied to the completely welded structure.			
3.16.2	The complete external and internal aluminum paneling of driver cum crew cabin and rear body shall be painted with two coats of Zinc Chromate paint.			
3.16.3	The complete exterior of the vehicle shall be painted with two finish coats of "POST OFFICE RED" polyurethane paint of reputed make.			
3.16.4	The internal painting of cabin lockers etc. shall be done with two coats of Grey Synthetic enamel paint of reputed make.			
3.16.5	The name of the fire service/organization shall be painted on both sides of vehicle in letter of suitable size in golden yellow paint with black colour shading.			
3.16.6	The "EMBLEM" of the department shall be painted on both sides of vehicle in natural colours at suitable place.			
3.17	LADDER WITH GALLOWS:			
	An Aluminium extension ladder of trussed type 10.5 mtrs height shall be provided with the vehicle and mounted on suitable ladder gallows. The design of the gallows shall be such that the ladder can be released without difficulty from a reasonably accessible position. Means shall be provided for looking the ladder when stowed			
3.18	B.A. SET BRACKETS:			
	B.A. set brackets for fixing with its fitments shall be provided just behind the crew seat. The mounting of B.A. set bracket shall be such that, it can allow fireman to wear B.A. set while vehicle is approaching to fire call. Proper padding and harnessing arrangement shall be made in the bracket to avoid damages to the critical parts of the BA set.			
3.19	ACCESSORIES:			
	The following accessories shall be provided.			
3.19.1	Fire Bell: (Bell Carillon): One Gun metal fire bell of 250 mm size confirming to IS: 1928 shall be mounted externally on the top of crew compartment and shall be operated within the crew compartment by firemen in seating position.			
3.19.2	Six aluminum hooks for keeping the uniform clothing shall be provided in crew compartment.			
3.20	WIRELESS SET BOX:			
	Box made from 2 mm gauge aluminum sheet with lid shall be provided just behind the officer seat with 13mm wooden plank for fitting the wireless set bracket. The design and mounting will be shown at the time of fabrication work.			
3.21	WORKMANSHIP & FINISH: The GVW of appliance shall not cross the chassis mfgs. Specification with all equipment & Crew. The weight distribution diagram should be submitted for approval. The entire appliance will be painted fire red on the outside. The user name will be written on both-side with yellow colour. Before final painting of Fire Tender two coats of anti-corrosion and primer coat will be applied.			
	The appliance will clearly have the following markings at suitable locations.			
	<ul style="list-style-type: none">• Manufacturers name and Trade mark.• Engine and Chassis No.• Pump No. and capacity of the pump.• Capacity of Water tank, Foam tank• All instruments control will be identified with nameplates			
3.22	ACCEPTANCE TESTS:			
	The following acceptance tests shall be carried out to the complete satisfaction of the user. The design of vehicle to be such that it shall not affect the Chassis Characteristic as specified by the chassis manufacturer such as speed, turning circle, acceleration, braking distance etc.			
	The stability of the appliance shall be such that when under fully equipped & laden condition, if the surface on which the appliance stands is tilted to either side, the point at which over turning			
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	<p>occurs is not passed at an angle of 27 deg from horizontal. This test should be carried out at the vendor factory in front of all the inspecting officers.</p> <p>i) The pump with its all fitments will be subjected to Hydrostatic testing on a pressure of 21 kgs./cm²</p> <p>ii) The pump shall be run dry for a period of minimum two minutes at 2000 RPM to check the integrity of mechanical carbon seal. After this test there shall not be any leakage of water through carbon seal.</p> <p>iii) The pump will be subjected to Endurance test for a period of Four hours continuous running. The first Three hours the pump shall deliver rated output of 3000 LPM at 8 kg/cm² and next one hour will be 300 LPM at 35 kg/cm².</p> <p>iv) During the endurance test the water shall not be replenished in the cooling system and the temperature of the cooling water and engine oil should not exceed the manufacturer's standard recommendations for the continuous operation and engine should not show any sign of stresses.</p> <p>v) The other tests shall be as per detailed performance parameters given for chassis, superstructure, firefighting system which include monitor output & throw, foam induction & expansion, load etc.</p> <p>vi) Accessories shall also be subjected to relevant tests as per the specification indicated above.</p> <p>vii) All accessories and its appendices shall be as per IS: 10460.</p>			
4.0	FIRE JEEP WITH TRAILER PUMPS AND WITH ALL ACCESSORIES			
	<p>Fire Jeep with Trailer pumps and with all accessories shall be provided as per IS: 944. The appendices indicated in the IS code shall also be provided.</p>			
4.1	Scope			
	<p>This standard lays down the requirements regarding material, design and construction, workmanship and finish, and performance tests of 1800-1/min trailer pump for fire brigade use.</p>			
4.2	<p>The trailer pump shall consist of a pump of capacity of not less than 1800-1/min at 0.7 MN/m² (7.0 kgf/cm²) pressure, driven by an internal combustion engine. The combined unit being permanently mounted on a trailer with the pump at the rear, and shall be capable of being towed to safety by a standard vehicle.</p>			
4.3	<p>Overall Dimension: The overall length of the whole unit shall not exceed 3-3m, the height shall not exceed 1-6 m (with spot light) and the wheel track shall not exceed 1-4 m.</p>			
4.4	<p>The design & construction and all material used for the trailer pumps shall fulfil the requirements of IS: 944. Also the accessories mentioned in IS code shall be as per IS code 944.</p>			
4.5	<p>The pump shall be of the centrifugal type and so designed as to afford easy access to the impeller. The pump shall be tested for its performance duties stipulated in IS: 944.</p>			
4.6	<p>The Trailer frame shall incorporate two semi-elliptic spring and axle. The trailer pumps, Towing eye and Draw Bar shall fulfil the requirements of IS code 944.</p>			
4.7	<p>The Instruction book, accessories and equipment etc. and marking, on the Trailer pumps shall be as per IS:-944</p>			
5.0	FIRE SUITS			
	<p>Fire suit shall be provided to as per relevant IS code along with accessories.</p>			
	<p>Specification of Fire Entry Suit are detailed as under:</p>			
5.1	<p>Coat with hood should be sewed fastly together. The hood should have visor with golden reflexive and un-sweaty modification, double protective glass, double fastening metal zip and Velcro being located in to the area of hood.</p>			
5.2	<p>The coat should have a provision of wearing a breathing apparatus.</p>			
5.3	<p>The trousers should be having regular braces, the belt for marking the waist slimmer in the lower parts of trousers, a metal zip for more comfortable putting up the shoes on the feet.</p>			
5.4	<p>Leggings: - Steel in lay on the in step, the lower steel support for fasting the shoes and protecting against getting up the leggings.</p>			
<p>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</p>		<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2</p>	<p>VOLUME-I CHAPTER - M4 FIRE DETECTION & PROTECTION SYSTEM</p>	<p>PAGE 27 OF 34</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
5.5	Gloves: - 05 fingers with membrane against liquid at the wrist with knitting, to use over where over the gloves for protection against heat.			
5.6	<p>Shoes & Overcoat: - The shoes should have back side double fastening, metal zip and Velcro fastening belt for shoe inside the aluminised overcoat. The entire fire entry suit should be provided with gloves, leggings, shoes overcoat and breathing apparatus pouch. The suit shall have enough space to accommodate inside a self-contained breathing apparatus set in complete protected manner. The weight of total suit should not be more than 08Kgs.</p> <p>The entire suit should be certified as per EN-1486 standards and should archive level III with the weight not exceeding more than 08Kgs. Shelf life should not be less than 05 years under any circumstances.</p> <p>Temperature Parameters:- The following temperature parameters should be met by the suit certified by the manufacturer :</p> <p>A) The highest direct flame temperature protection should be offered by the suit.</p> <p>i) 1500 deg.C to 1800degC for a continuous period of 10 seconds.</p> <p>ii) 1400 degC for a continuous period of 30 seconds.</p> <p>iii) 1200 deg C for a continuous period of 03 (Three) minutes.</p> <p>B) The highest direct radiant temperature protection should be offered by the suit:</p> <p>i) 1500 deg. C for a continuous period of 10 seconds.</p> <p>ii) 1420 deg. C for a continuous period of 30 seconds.</p> <p>iii) 1220 deg. C for a continuous period of 03 (Three) minutes.</p> <p>iv) 1200 deg. C for a continuous period of >7 minutes at distance of 1.5 meters from the flame wall. Operations, maintenance, storage and cleaning guidelines along with the catalogues/booklets. Precautions to use the suit and the conditions under which the suit is not be used. Vendor to provide label on his suit as per EN 1486- Level III.</p> <p>The bidder shall submit the copy of the certificate from the approved certifying agency clearly stating that the suit is meeting all EN 1486 and the vendor is authorized to use the label/mark from the certifying agency (e.g.) or any other reputed International Organization in the regard. Additionally, vendor must also certify the compliance w.r.t. additional specifications given above.</p> <p>Conformity for the testing shall be required for the following:-</p> <ul style="list-style-type: none">The aluminized outer fabric (DICKSON 4584) is tested and certified to EN, ISO, EN11612 and EN 1486.The moisture & thermal barrier (Dickson 5474) is tested to EN 1486 for moisture and thermal protection.The Inner layer (Klopman Gemini FR) is tested and certified to EN ISO 11612.The helmet is certified to EN 443.The visor is certified to EN 166 & 171.The shoe is certified to EN20345 for S1P/HRO.			
5.7	<p>PACKING</p> <p>Suit will be supplied in easy to carry nylon bag.</p>			
6.0	<p>CARBON COMPOSITE SELF CONTAINED COMPRESSED AIR OPEN CIRCUIT BREATHING APPARATUS</p>			
6.1	<p>SCOPE</p> <p>This specification prescribes requirements of design, performance and practical test for open circuit type breathing apparatus.</p>			
6.2	<p>GENERAL REQUIREMENT</p>			
6.2.1	<p>Self Contained Breathing Apparatus (SCBA), ergonomically designed, light weight glass and carbon filled nylon composite back plate and intrinsically flame retardant 100% Kevlar webbing and 3 padded harness. Cylinder band should be made up of 100% Kevlar. Two stage pneumatic system comprising positive pressure demand valve with hands free bypass facility, vision 3 face masks with more than 85% field vision and scratch resistance polycarbonate visor should be</p>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2	VOLUME-I CHAPTER - M4 FIRE DETECTION & PROTECTION SYSTEM	PAGE 28 OF 34

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	<p>provided. Warning whistle should have an operating pressure of 55 bars. First stage pressure reducer with single high pressure cylinder connector with steel braided hose. The Apparatus is to be supplied with CCE approved 6/6.8 ltrs, 300 Bar High pressure carbon composite cylinder (duration - 45/46 Mins).</p>			
6.2.2	<p>The unit is to be provided as attached with automatic distress signal unit capable of giving analogue and digital reading of the pressure.</p>			
6.2.3	<p>Low pressure alarm and ADSU featuring a motion sensor which gives alarm if the user is motionless for 30 seconds.</p>			
6.2.4	<p>The BA set has to be CE approved, as per EN137 Class-II 2006 Standard.</p>			
6.2.5	<p>The compressed air breathing apparatus shall be so designed so that the wearer can breathe comfortably, without any risk of poisonous gases entering the breathing circuit. The breathing circuit should be so designed so that there is optimum utilization of compressed air stored in the cylinder during Fire Fighting and rescue operations. The set as a whole shall be so designed so that the handling of the set is easy and does not cause any damage to the set. Set shall be capable of being used with cylinders having working pressure up to 300 bars at least. The BA set should have no air losses. No toxic matter can enter the mask back plate should be ergonomically designed for comfort and stability and there should have provision of connection between wearers.</p>			
6.2.2.	<p>MATERIAL</p>			
6.2.2.1	<p>All the materials used in the construction shall have adequate mechanical strength, durability and resistance to deterioration by heat or by contact with seawater or plain water. Such materials shall be antistatic and fire resistant as far as practicable.</p>			
6.2.2.2	<p>Exposed parts excluding cylinders, that is, those, which may be subject to impact during practical performance tests, shall not be made of magnesium, titanium, aluminum or alloys containing such proportions of these metals which on impact give rise to frictional sparks capable of igniting flammable gas mixtures.</p>			
6.2.2.3	<p>Materials that may come into contact with the skin shall be non-staining soft, pliable and shall not contain dermatitis substances.</p>			
6.2.2.4	<p>The apparatus shall be sufficiently robusted to withstand the rough usage; it is likely to receive in service and designed so that it will continue to function satisfactorily while temporarily accidentally submerged in water at a maximum depth of one meter and thereafter until the air in the cylinder is exhausted.</p>			
6.2.3	<p>SEPARATION OF PARTS</p> <p>The design and construction of the apparatus shall permit its components parts to be readily separated for cleaning, Examination and testing. The couplings required to achieve this shall be readily connected and secured, where possibly by hand, and means for sealing used shall be retained in position when the joints and couplings are disconnected during normal maintenance.</p>			
6.2.4	<p>ADJUSTABLE PARTS</p> <p>All parts requiring manipulation by wearer shall be readily accessible and easily distinguishable from one another by touch. All adjustable parts and controls shall be so constructed that their adjustment is not liable to accidental alteration during use</p>			
5.1.1	<p>WEIGHT</p> <p>The weight of the apparatus shall not exceed 09 Kg. The cylinder used for compressed air should have the approval of Chief Controller of Explosive.</p>			
6.2.6	<p>LEAK TIGHTNESS</p> <p>The apparatus shall be of positive pressure type so as to prevent ingress of the external atmosphere. There should be not leakage from any joint.</p>			
6.2.7	<p>Airline connection and second user connection and inlet-cum-outlet shall be provided on the pressure reducer for attaching, airline connection for second user connection.</p>			
6.3	<p>FACE MASK</p>			
6.3.1	<p>The face mask should be made either of Neoprene or Silicone. The air inlet value should connect to the mask by simply clipping it on the enable wearer to switch on the positive pressure at the last minute.</p>			
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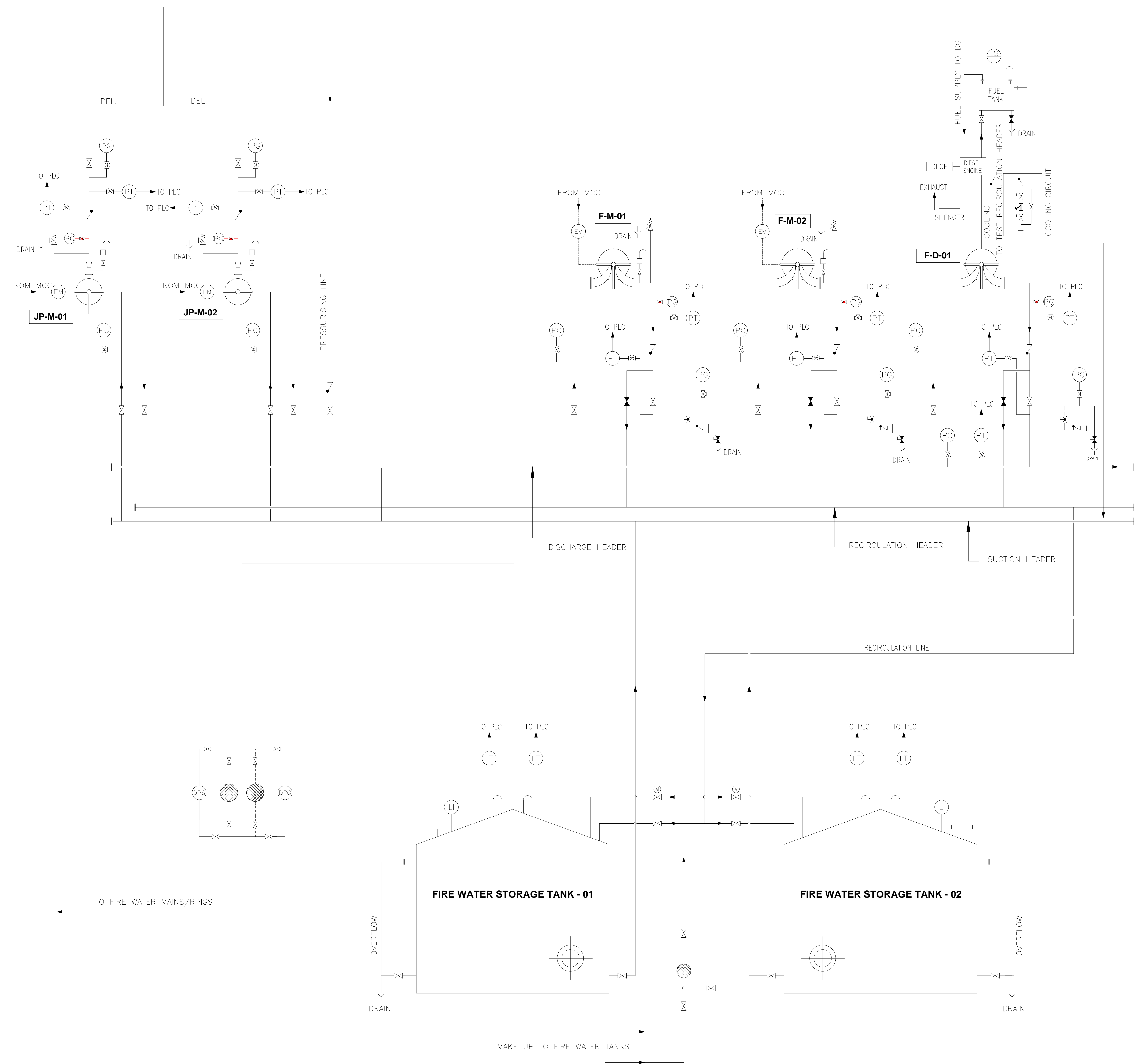
CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
6.3.2	Face mask shall cover the eyes, nose , mouth and chin , it shall be provided with an additional flap for providing adequate sealing on the face of the wearer of the breathing apparatus against the outside gas, when the skin is drying or moist, when the head is moving and when the water is peaking.			
6.3.3	The face mask shall have an inner mask to reduce misting and dead space so that the mask is always remain at center.			
6.3.4	Face mask shall be secured to the face by means of an adjustable./replaceable head harness and they shall be fitted with a neck strap to support them when not being worn. There shall be five head harness but one strap i.e. the top one should			
6.3.5	Means for speech transmission shall be incorporated and so designed that it is in front of the mouth.			
6.3.6	The face mask shall be constructed of silicon rubber in order that it is soft, light in weight, comfortable to the wearer to wear for long duration, resistant to chemicals and heat, thus having longer life.			
6.3.7	The connection for demand valve shall be provided in front of the Face Mask.			
6.3.8	The visor shall be made of clear polycarbonate.			
6.4	FACE CONNECTOR The connection between the face mask and the demand valve shall be of Clickon/Push fit type well secured so that, the set is having fully automatic positive pressure , there is optimum utilization of compressed air stores in the cylinder and the mask by mistake is not used with a filter canister.			
6.5	HEAD HARNESS The head harness shall hold the face mask firmly and comfortably in position. It shall be molded from silicon rubber. It should be easily detachable for cleaning and decontamination. There shall be five quick release harnesses out of which only 4 shall need to be tightening with the 5th i.e. top one shall be prefixed to ensure quick donning and center placing of the mask while wearing.			
6.6	BODY HARNESS The body harness shall be designed to allow the user to done the apparatus quickly and easily without assistance and shall be adjustable for fit. Buckles fitted to waist and shoulder harness shall be so constructed that once adjusted they will not slip.			
6.7	EXHALATION VALVE The apparatus shall be provided with a unidirectional exhalation valve spring loaded to maintain positive pressure in the face mask. The resistance of the valve should not exceed 6 millibars, it shall be protected against dirt and mechanical damage.			
6.8	DEMAND VALVE It shall be fully automatic positive type. Designed to provide a flow rate of at least 50 ltrs /min at all cylinder pressure above 20 bar. It shall be designed to push fit/click on to the mask.			
6.9	SUPPLEMENTARY SUPPLY The apparatus shall be provided with a manually operated push type means on the demand valve itself for supplementary supply.			
6.10	HIGH PRESSURE TUBE It shall be having outer covering of neoprene rubber. The test pressure of the tube shall be above 600 bar. It shall be fitted to the set in a manner that it cannot be separated by hand. The entire high pressure tube shall be covered by a medium pressure tube having medium pressure supply for safety reasons.			
6.11	MEDIUM PRESSURE TUBE. It shall be having outer covering of neoprene rubber. The test pressure of the tube shall be above 20 bar. It shall be so designed that it can be separated by hand and cannot be fitted at the joints where High Pressure Tube is fitted.			
6.12	PRESSURE GAUGE			
6.12.1	It shall indicate pressure on opening of the cylinder. The range shall be 0-350 ban. It shall be placed that the wearer can easily see the pressure while using the set.			
6.12.2	The pressure gauge shall have a blowout release. The blowout release should be so located that in the event of an explosion or fracture of the pressure element of the gauge, the blast will			
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<p>6.12.3</p> <p>6.13</p> <p>6.14</p> <p>6.15</p> <p>6.16</p> <p>6.17</p> <p>6.18</p> <p>6.19</p> <p>6.20</p> <p>7.0</p> <p>7.1</p> <p>8.0</p>	<p>be away from the front. The gauge window shall be made of 'material of non-splintering glass or of clear plastic materials.</p> <p>A tap or restrictor shall be provided so that if pressure gauge and connection hose are removed from the apparatus, flow will not exceed 25 lit/Min at full cylinder pressure, if the gauge or flexible connecting tube be damaged after the apparatus has been functioning for a period of time equal to half the nominal working duration with an air consumption of 40 lmin the loss of air from the damaged component shall not reduce the normal effective duration of the apparatus by more than the reserved period.</p> <p>WARNING DEVICE</p> <p>The apparatus shall be provided with warning whistle next to the pressure gauge. It shall be consuming minimum amount of compressed air and should emit continuous at least 90 dbls sound. Warning whistle next to pressure gauge enables to user to ascertain his whistle and can check the same.</p> <p>BACK PLATE</p> <p>It is to be made of light weight glass and carbon filled nylon composite back plate and intrinsically flame retardant 100% Kevlar webbing and 3 padded harness. Cylinder band should be made up of 100% Kevlar.</p> <p>The back plate shall be so designed that the use can lift the set by having a firm grip of back plate in order to avoid lifting of set from cylinder valve or body harness. The method of fixing cylinder shall be such that 4, 6 and 9 liter cylinder of working pressure 200/207/300 bar can be fitted without any alternation.</p> <p>PRESSURE REDUCER</p> <p>The apparatus shall be provided with a diaphragm less piston pressure reducer which is capable of reducing pressure from 300 bars to 7 bar (approx.). The designing ' shall be such that back pressure development shall be minimum, second inept outlet shall be provided on the reducer. High pressure and medium pressure safety shall also be provided on the reducer.</p> <p>COMMUNICATIONS:</p> <p>It should be designed for use with standard carbon composite SCBA, this unique radio communication interface should fully interface & integrate with existing standard radios available universally and must be intrinsically safe and approved to ENK136 Class3.</p> <p>ADSU</p> <ul style="list-style-type: none"> • Should be made of solid state technology - infrared motion sensor with no internal contacts to wear out. • Should be provided with long life lithium magnesium dioxide batteries. • Should have loud 112 decibel alarm. <p>GAS CYLINDER & MAIN VALVE,</p> <p>Cylinder used shall be of steel having 616.8 liter water capacities, 300 bar working pressure 1800 Liters compressed air for 45/46 minute duration. The cylinder & valve should be approved by Chief Controller of Explosive, Nagpur, India.</p> <p>PACKING</p> <p>The breathing apparatus shall be packed in hard bag molded plastic or FRP.</p> <p>MARKING</p> <p>The trademark of manufacturers Identification shall be marked on the facemask, demand valve, pressure reducer and back plate. The serial number of the set and the date of manufacturing shall also be marked on the back plate.</p> <p>FIRST AID KITS</p> <p>SCOPE</p> <p>This standard specifies the contents of portable first-aid kit intended for providing immediate and effective first-aid treatment of common injuries.</p> <p>First aid kits shall be as per relevant code IS: 13115.</p> <p>TELESCOPIC LADDER (ALLOY ALUMINUM)</p> <p>Alloy Aluminum Telescopic Ladder: An alloy aluminum self-supported extension ladder shall be made from sides of "Round "section Heavy duty and steps 1" Dia non-slip corrugated tubing, complete with all safety devices and limits & rubber Shoes folding platform, safety rings hand</p>			
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8.1	<p>rail fitted to extending section, that can lock at any required height. Height shall not less than 25 feet.</p> <p>DESCRIPTION;</p> <p>Telescopic extension ladders shall be easily portable and closed length of 5 feet, extending to a length of 25 Feet and adjustable features wide comfortable treads and an automatic locking system. This ladder shall be easy to store, transport and carry which makes it ideal for fire and rescue use.</p> <ul style="list-style-type: none">• Telescopic design for easy transporting and storage• Automatic locking mechanism for convenience and security• Light weighted but strong alloy aluminum construction• Large slip – resistant feet• Suitable for firefighting and rescue works																					
8.2	<p>SPECIFICATION:</p> <table><tr><td>a. Closed height</td><td>:</td><td>5 feet</td></tr><tr><td>b. Extended height</td><td>:</td><td>not less than 25 feet</td></tr><tr><td>c. Maximum load</td><td>:</td><td>200 kg</td></tr><tr><td>d. Weight</td><td>:</td><td>20±5 kg</td></tr><tr><td>e. Class use</td><td>:</td><td>Firefighting and Rescue works</td></tr><tr><td>f. Material</td><td>:</td><td>Alloy Aluminum</td></tr></table>				a. Closed height	:	5 feet	b. Extended height	:	not less than 25 feet	c. Maximum load	:	200 kg	d. Weight	:	20±5 kg	e. Class use	:	Firefighting and Rescue works	f. Material	:	Alloy Aluminum
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e. Class use	:	Firefighting and Rescue works																				
f. Material	:	Alloy Aluminum																				
9.0	<p>SPECIFICATION OF FIBER GLASS BLANKET</p> <p>Fiber Glass Blanket shall be made of fiber Glass fabric of 01mm thick fabric an ideal material and made of imported Dual Mirror. Aluminized Glass fiber fabric which will be approved by the center of Environment and Explosive Safety (CFEES). The fire blanket for welding shall be made fiberglass fabric, coated fiberglass fabric or silica fabric and finished with making by edge wrapping, metal buckles and finished with plastic bag and labels.</p> <p>The product shall be woven with specific high twisted yarn and then treated; the heat resistance temperature of the blanket shall be about 18000C with special treatment. To meet the heat resistance requirement, the fabric shall bed most suitable to meet the heat resistance requirement. Fire Blankets shall be generally used for covering the area while welding and occasionally for extinguishing the fire. Size of blanket shall be :6 Ft X 6 Ft.</p>																					
10	<p>MULTIPURPOSE FLOW NOZZLE</p> <p>The branch shall be made of extruded Aluminum Alloy hard anodized for resistance to corrosion having light in weight and hydraulically efficient design for low back thrust allowing for extended operation with multiple flow settings. It shall be capable for making hollow jet, Spray, and Fog in different fire fighting situations. The variable flow rate shall be adjusted from 360 LPM to minimum 900 LPM at 7 Kg/cm2 and flush without shutting down. It shall have a Spray angle of 160° and horizontal throw in still air around 35 meters at 7-8 bar pressure. Spinning teeth shall be provided at the outlet to give an effective dense fog. A Pistol grip handle of rubber coated shall be provided for easy handling of branch.</p> <p>The provision to shut-off pressure assisted flush without shutting down shall be provided.</p> <p>WEIGHT : Not more than 3.5 Kg , INLET: 63 mm Instantaneous Male Coupling.</p>																					
11	<p>PORTABLE THERMAL IMAGING CAMERA</p> <p>The thermal imagine camera shall be capable help to locate victims in smoke-filled, dark and high-temperature condition. It shall be Identifies live victims by measuring the body temperature up to a distance of 1.2 miles. The thermal imaging camera shall be fully radiometric operating infrared camera system to capture and display thermal images and thermal profiles of objects. The thermal camera incorporates the latest technology due to a USB 2.0 interface that allows a real-time thermal imaging with 128 images per second and simultaneous real time images with 60 HZ as well as stationary and portable operation that is very well priced. The images shall be archived as snapshots or as video sequences. The thermal camera shall be equipped with a small bolometer (UFPA) with 160 x 120 pixels and 25 x 25 μm pixel size. The high thermal sensitivity allows capturing finest details. The thermal camera shall be ideal equipment in areas of research and development, checkpoints, process automation or for general portable tasks.</p>																					
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	<p>Via a USB cable the thermal camera shall be connected to a computer and be read-out without further ado.</p> <p>The temperature data of the thermal camera shall be transferred as a thermal image to the provided software Connect. Based on PI-SPECTRAL technology the real-time picture shall be recorded through a visual channel as a real image (VIS) combined with a thermal image (IR) simultaneously. The software also allows remote-controlling the camera.</p> <p>Furthermore, the camera features a line scan camera function allowing monitoring moving objects during processing. With a weight of not more than 1.2 kg, the thermal camera shall be very light and compact design without comparison. The thermal camera combines portable and compact application with stationary operation. Some of the application ranges shall be electronic development, process controlling during extruding, process controlling during calendaring or development and processing of solar technology, LCD flat screens or any other electronic types of equipment.</p> <p>TECHNICAL SPECIFICATION OF THERMAL IMAGE CAMERA:</p> <table><tr><td colspan="2">Imaging Performance</td></tr><tr><td>FOV / Minimum focus distance</td><td>25° x 19° / 0.4 m</td></tr><tr><td>Spectral range</td><td>7.5–13 μm</td></tr><tr><td>Image frequency</td><td>60 Hz</td></tr><tr><td>Focus</td><td>Manual</td></tr><tr><td>Focal Plane Array (FPA)</td><td>Uncooled micro bolometer</td></tr><tr><td colspan="2">Image presentation</td></tr><tr><td>Display</td><td>Built-in 3.5" LCD touch screen, 320 x 240 pixels</td></tr><tr><td colspan="2">Measurement</td></tr><tr><td>Accuracy</td><td>±2 °C or ±2% of reading</td></tr><tr><td colspan="2">Measurement analysis</td></tr><tr><td>Automatic hot/cold detection</td><td>Auto hot or cold spot meter markers within area 0o C to +900oC</td></tr><tr><td>Emissivity correction</td><td>Variable from 0.01 to 1.0 or selected from list of materials</td></tr><tr><td>Measurement corrections</td><td>Reflected temperature, optics transmission and atmospheric transmission</td></tr><tr><td>Isotherm</td><td>Detect high/low temperature/interval</td></tr><tr><td colspan="2">Laser pointer</td></tr><tr><td>Laser alignment</td><td>Position is displayed on the IR image</td></tr><tr><td colspan="2">Set-up</td></tr><tr><td>Image controls</td><td>Palettes (Arctic, Gray, Iron, Lava, Rainbow and Rainbow HC), image adjustment (auto/manual)</td></tr><tr><td>Set-up controls</td><td>Local adaptation of units, language, date and time formats; automatic shutdown , display intensity</td></tr><tr><td colspan="2">Image storage</td></tr><tr><td>Format</td><td>Standard JPEG - including measurement data on SD memory card</td></tr><tr><td>Type</td><td>IR/visual images; simultaneous storage of visual and IR images</td></tr><tr><td colspan="2">Power</td></tr><tr><td>Battery type</td><td>Lithium-Ion (field replaceable) - 4 hours operating time</td></tr><tr><td>Charging system</td><td>In camera, AC adaptor, 2-bay charger or 12 V from a vehicle</td></tr><tr><td>Power management</td><td>Automatic shutdown and sleep mode (user selectable)</td></tr><tr><td>AC operation</td><td>AC adaptor, 90-260 V AC</td></tr><tr><td>Adaptor voltage</td><td>12 V output to camera</td></tr><tr><td colspan="2">Environmental specifications</td></tr><tr><td>Operating temperature range</td><td>-15 to +50 °C</td></tr><tr><td>Storage temperature range</td><td>-40 to +70 °C</td></tr><tr><td>Humidity</td><td>IEC 60068-2-30/24 h 95% relative humidity +25 °C to +40 °C / 2 cycles</td></tr><tr><td>Shock / Vibration</td><td>25 g (IEC 60068-2-29) / 2 g (IEC 60068-2-6)</td></tr><tr><td>Drop</td><td>2m</td></tr><tr><td>Encapsulation</td><td>IP 54 (IEC 60529)</td></tr><tr><td colspan="2">Data communication interfaces</td></tr><tr><td>Interfaces</td><td>USB-mini, USB-A, Composite video</td></tr></table>				Imaging Performance		FOV / Minimum focus distance	25° x 19° / 0.4 m	Spectral range	7.5–13 μm	Image frequency	60 Hz	Focus	Manual	Focal Plane Array (FPA)	Uncooled micro bolometer	Image presentation		Display	Built-in 3.5" LCD touch screen, 320 x 240 pixels	Measurement		Accuracy	±2 °C or ±2% of reading	Measurement analysis		Automatic hot/cold detection	Auto hot or cold spot meter markers within area 0o C to +900oC	Emissivity correction	Variable from 0.01 to 1.0 or selected from list of materials	Measurement corrections	Reflected temperature, optics transmission and atmospheric transmission	Isotherm	Detect high/low temperature/interval	Laser pointer		Laser alignment	Position is displayed on the IR image	Set-up		Image controls	Palettes (Arctic, Gray, Iron, Lava, Rainbow and Rainbow HC), image adjustment (auto/manual)	Set-up controls	Local adaptation of units, language, date and time formats; automatic shutdown , display intensity	Image storage		Format	Standard JPEG - including measurement data on SD memory card	Type	IR/visual images; simultaneous storage of visual and IR images	Power		Battery type	Lithium-Ion (field replaceable) - 4 hours operating time	Charging system	In camera, AC adaptor, 2-bay charger or 12 V from a vehicle	Power management	Automatic shutdown and sleep mode (user selectable)	AC operation	AC adaptor, 90-260 V AC	Adaptor voltage	12 V output to camera	Environmental specifications		Operating temperature range	-15 to +50 °C	Storage temperature range	-40 to +70 °C	Humidity	IEC 60068-2-30/24 h 95% relative humidity +25 °C to +40 °C / 2 cycles	Shock / Vibration	25 g (IEC 60068-2-29) / 2 g (IEC 60068-2-6)	Drop	2m	Encapsulation	IP 54 (IEC 60529)	Data communication interfaces		Interfaces	USB-mini, USB-A, Composite video
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GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2	VOLUME-I CHAPTER - M4 FIRE DETECTION & PROTECTION SYSTEM	PAGE 33 OF 34																																																																												

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPG</div>
	USB		USB-A: Connect external USB device - USB-mini-B: Data transfer to and from PC / Streaming MPEG 4	
	Physical characteristics			
	Camera weight, incl. battery		Not more than 1.2 KG	
	Camera size (L x W xH)		246 x 97 x 184 mm	



LEGEND :

- GATE VALVE
- GATE VALVE (NORMALLY CLOSED)
- CHECK VALVE
- GLOBE VALVE
- MOTORISED VALVE
- GLOBE VALVE (NORMALLY CLOSED)
- 3-WAY VALVE
- PRESSURE REDUCING VALVE
- RELEIF VALVE
- PRESSURE GAUGE
- PRESSURE TRANSMITTER
- ELECTRIC MOTOR
- ULTRASONIC LEVEL TRANSMITTER
- LEVEL INDICATOR
- LEVEL SWITCH
- DIFFERENTIAL PRESSURE GAUGE
- BASKET STRAINER (SIMPLEX)
- Y-TYPE STRAINER
- HYDRANT MAIN
- SPRAY MAIN
- MOTOR DRIVEN HYDRANT PUMP
- DIESEL DRIVEN HYDRANT PUMP
- MOTOR DRIVEN SPRAY PUMP
- DIESEL DRIVEN SPRAY PUMP
- DIESEL ENGINE CONTROL PANEL
- JOKEY PUMP MOTOR DRIVEN
- DIFFERENTIAL PRESSURE SWITCH

Note:

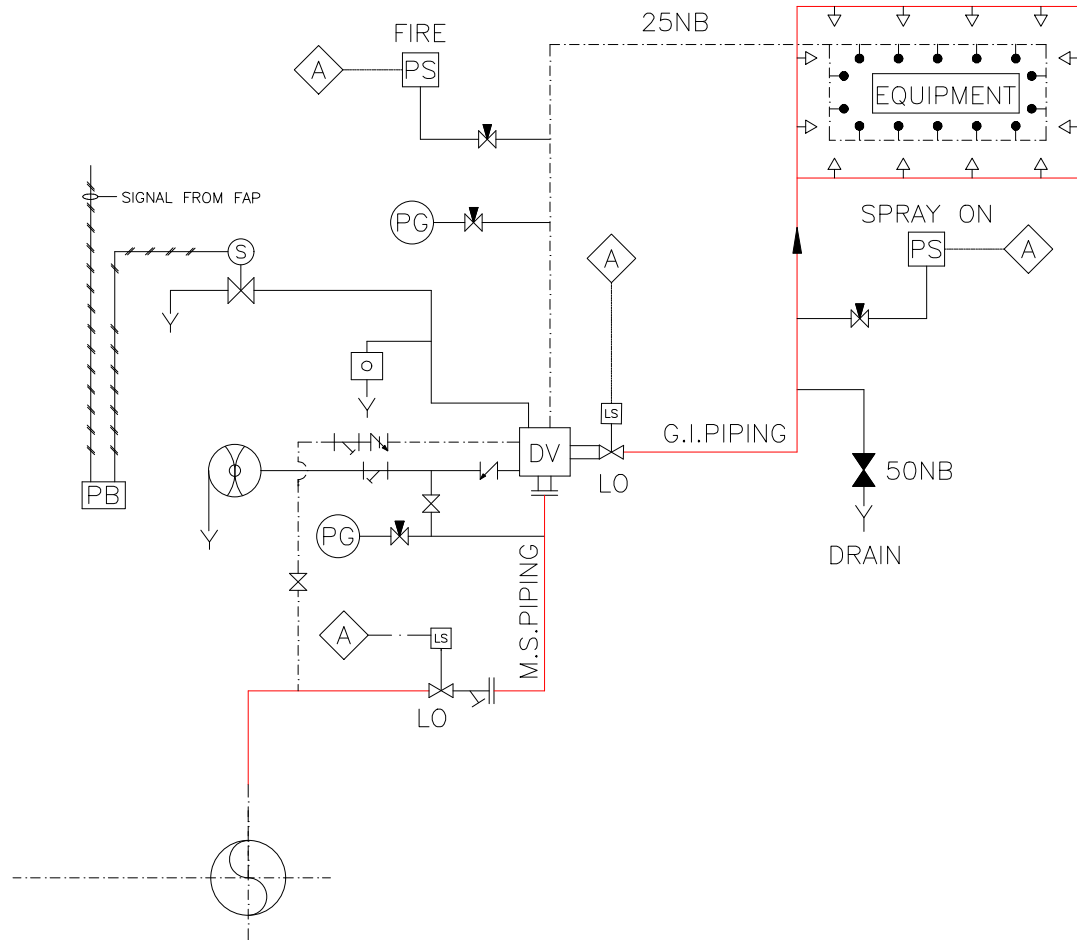
- THIS DRAWING SHALL BE READ IN CONJUNCTION WITH TECHNICAL SPECIFICATION.

FOR TENDER PURPOSE ONLY

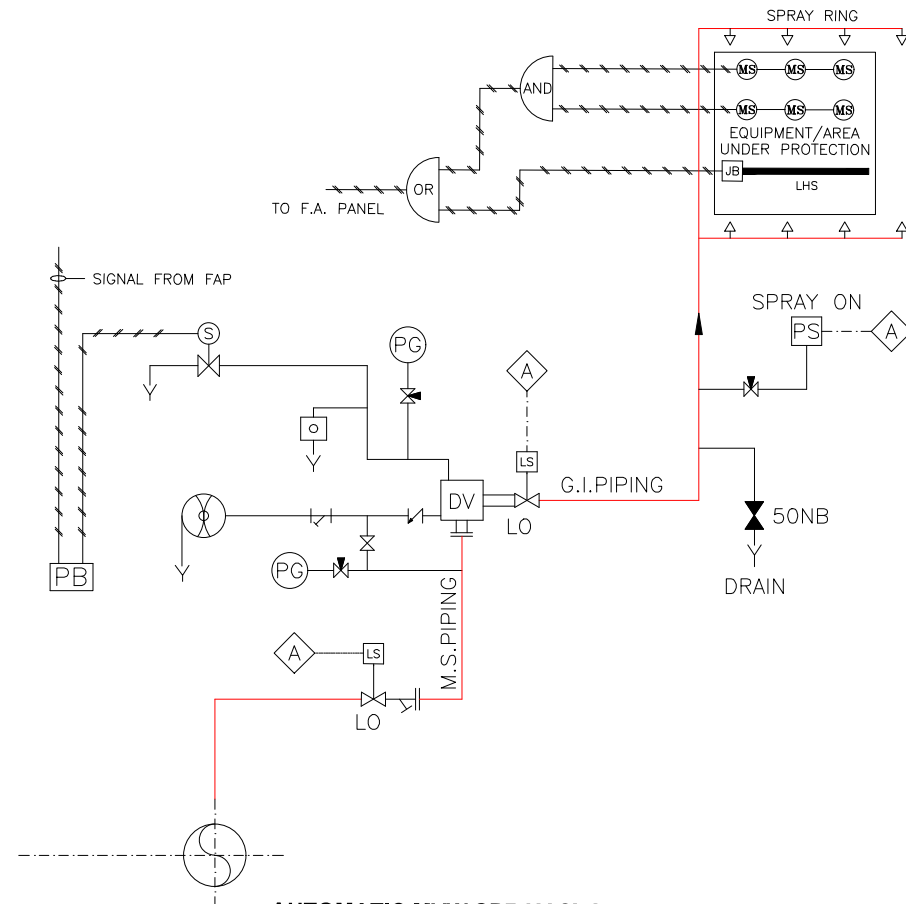
NTPC Limited.
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT		TITLE		SIZE		SCALE		ORG. NO.		REV.	
A		FOR TENDER PURPOSE ONLY		A1		SCALE		6401-000-POM-A-049		A	
REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	M	E	C&I	APPD	DATE	

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AUTOMATIC HVW SPRAY SYSTEM (TYP)



AUTOMATIC MVW SPRAY SYSTEM (TYP)
FOR CABLE VAULT/CABLE GALLERIES

LEGEND :

- SPRAY LINE
- CONTROL CABLE
- WET DETECTION PIPE
- SOLENOID VALVE
- BUTTERFLY VALVE
- NON RETURN VALVE
- GATE VALVE WITH LIMIT SWITCH
- 'Y' TYPE STRAINER
- ANNUNCIATION IN FIRE ALARM PANEL
- WATER MOTOR GONG
- DRAIN
- PRESSURE SWITCH
- PRESSURE GAUGE
- MULTISENSOR DETECTOR
- LINEAR HEAT SENSER
- INFRA RED DETECTOR
- PUSH BUTTON STATION
- JUNCTION BOX
- LIMIT SWITCH
- QUARTZOID BULB DETECTORS

FOR TENDER PURPOSE ONLY

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ENGINEERING DIVISION


PROJECT
GREAT NICOBAR ISLAND GAS POWER PROJECT

TITLE
P&I DIAGRAM OF HVW/MVW SPRAY SYSTEM


SIZE A1	SCALE NTS	DRG.NO. 6401-000-POM-A-048	REV. A
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REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	OS	C	M	E	C&I	APPD	DATE
A											

PART-B
VOLUME – I
CHAPTER – M5
AIR CONDITIONING
&
VENTILATION SYSTEM


CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	GENERAL			
1.01.00	<p>This section of specification covers details of system specifications, detailing the areas to be air conditioned and ventilated, basis of design, brief description of the system, equipment and services to be furnished by bidder.</p> <p>The Design, Engineering, Supply, Construction, Erection, and Testing & Commissioning of all the equipment & works shall be on the basis of single point responsibility in bidder's scope of work for satisfactory completion of the system in all respects.</p>			
1.02.00	CODES & STANDARDS			
1.02.01	The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment are to be installed. Nothing in this specification shall be considered to relieve the bidder of this responsibility.			
1.02.02	Unless otherwise specified, equipment shall conform to the latest applicable BEE, ECBC, Indian or IEC standard. Equipment complying with other authoritative standards such as British, USA, ASHRAE etc. will also be considered if it ensures performance equivalent or superior to Indian Standard.			
2.00.00	AREAS TO BE COVERED UNDER AIR CONDITIONING SYSTEM			
2.01.00	All control rooms, Control Equipment Rooms, RIO rooms, VFD Rooms, UPS & Battery Charger Rooms, Meeting/Conference Rooms, Office areas, etc. of all the buildings/areas under the scope of the Bidder.			
3.00.00	AREAS TO BE COVERED UNDER VENTILATION SYSTEM			
3.01.00	Machine (Engine) Hall, GIS Hall, all MCC/Switchgear rooms, Pump Houses, Compressor House, Battery Rooms, Store, Pantry, Toilets, etc. and all other buildings/areas under the scope of the Bidder.			
4.00.00	REDUNDANCY OF EQUIPMENTS			
4.01.00	<p>a) 100% standby shall be provided for control rooms/RIO room/VFD Room, etc. served by ductable split/package type air conditioners.</p> <p>At least one (1) no. unit, capacity same as each working unit as a common standby shall be provided for control rooms/RIO room/etc. served by non-ductable split (cassette / Hi-wall) type air conditioners.</p> <p>No stand-by shall be provided for office areas of various buildings.</p> <p>b) Fresh air fans shall be 1 x 100 % capacity for each PAC Room.</p>			
5.00.00	EQUIPMENT DESCRIPTION OF AIR CONDITIONING SYSTEM			
5.01.00	<p>PACKAGED AIR CONDITIONER:</p> <p>(a) Packaged air conditioners shall be an encased assembly as a self-contained unit primarily for floor mounting, designed to provide free delivery of conditioned air to the conditioned space. It shall include a primary source of refrigeration for cooling and dehumidification, means for circulating and cleaning air and means for heating and humidifying air. Fresh air fans shall be provided in PAC Room.</p> <p>(b) The cabinet, housing the components of packaged air conditioners, shall be of heavy gauge sheet steel and suitable for floor mounting. The access panels shall be of easily</p>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2	VOLUME-I CHAPTER-M5 AIR CONDITIONING & VENTILATION SYSTEM	Page 1 of 12

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	<p>removable type. The entire casing shall be thermally insulated with 25 mm thick insulation of totally flame proof type (T.F. type). Suitable drain connection shall be provided for removal of condensate collected inside a tray under cooling coil.</p> <p>(c) Controls shall be so provided that failure of one equipment of PAC will automatically trip that PAC unit.</p> <p>(d) HP and LP cutout shall be provided for compressor protection. A thermostat with adjustable setting shall also be provided in the return air circuit to control the room temperature by ON-OFF mode.</p> <p>(e) Provision shall also be made for manual re-starting and stopping of the compressor.</p> <p>(f) Interlock shall be provided such that compressor can start only starting the air handling fan.</p> <p>(g) Interlock shall be provided so that compressor can start only if condenser fan in running. Further if the condenser fan stops, the compressor shall also trip.</p> <p>(h) To control the humidity throughout the year, the humidistat shall be interlocked with humidifier and reheater.</p>			
5.02.00	NON DUCTABLE (HI-WALL/CASSETTE) AND DUCTABLE SPLIT AIR-CONDITIONERS			
5.02.01	<p>Hi-wall Split/cassette air conditioners shall in general consist of the following:</p> <p>i) Casing</p> <p>ii) Hermetically sealed rotary/scroll Compressor</p> <p>iii) Air cooled condenser</p> <p>iv) Evaporator and condenser cooling fan</p> <p>v) Cooling coil (copper).</p> <p>vi) Filters</p> <p>vii) Piping, valves, réfrigérant strainer, insulation, etc.</p> <p>viii) Controls, instruments, control panel/starter panels.</p> <p>ix) Vibration isolator pads, ducting (if applicable), etc. if required.</p> <p>x) Refrigerant as per manufacturer practice.</p> <p>Note: (1) Humidity control inside air-conditioned space served by split air conditioners is not envisaged.</p> <p>(2) Air Conditioners shall conform to minimum star rating as per latest code/ standard/ guidelines issued by Bureau of Energy Efficiency (BEE), Ministry of Power, Govt of India. However, for non-ductable split (hi-wall/cassette) Air Conditioners, minimum star rating shall be as below:</p> <p>a) Capacity up to and including 3TR: 5 Star</p> <p>b) Capacity from 3TR to 5TR: 4 Star</p>			
5.03.00	<p>Indoor unit of Ceiling Mounted Cassette Type Unit (Multi Flow Type):</p> <p>The housing of the unit shall be powder coated galvanized steel. All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view.</p> <p>Units shall have four-way supply air grills on sides and return air grills in center.</p> <p>Each unit shall have high lift drain pump and very low operating sound.</p>			
5.04.00	<p>Pan Humidifier (if applicable):</p> <p>Pan humidifier shall be made of 22-gauge SS 304 tank, duly insulated with 25 mm thick resin bonded fiber glass insulation (min. 24 Kg/m3 density) with 0.5 mm GSS cladding. The humidifier shall be complete with stainless steel immersion heaters, safety thermostat, float valve with stainless steel ball, sight glass, overflow and drain connections, steam outlet</p>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2	VOLUME-I CHAPTER-M5 AIR CONDITIONING & VENTILATION SYSTEM	Page 2 of 12

CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.05.00	nozzle and float switch. Step controller shall be provided for switching on / off heater banks as per system requirement.			
	Material of Construction for Piping, Valves & Fittings:			
	a.	Refrigerant piping:	:	Seamless steel tubes conforming heavy grade IS:1239 or copper tubes as per IS:2501 (copper material as per IS:191 hard copper grade).
	b.	Drain piping	:	Heavy grade-IS:1239 or Equivalent up to 150 NB & galvanized as per IS:4736.
	c.	Valves	:	The refrigerant line valves shall have steel or brass body with TEFLON gland packing. The construction of disc. shall be either globe or angle type. The valve seat shall have white metal lining or equivalent.
d.	Fittings	:	Fittings, flanges, and pipe joints of refrigerant piping shall conform to ANSI B31.5	
6.00.00	BALANCE EQUIPMENT SPECIFICATION (COMMON FOR AC AND VENTILATION SYSTEM)			
6.01.01	AXIAL FANS			
	a)	These fans shall have fixed / variable pitch cast aluminum blades of aerofoil design.		
	b)	The fan casing shall be of heavy gauge sheet steel construction.		
	c)	Necessary rain protection cowl, inlet and outlet cones, bird protection screen, adjustable damper, vibration isolators, back draft dampers etc. shall be provided.		
	d)	The speed of the fan shall not exceed 1000 rpm for fan with impeller diameter above 450 mm and 1500 rpm for fan with impeller diameter 450 mm or less. However, for fans having static pressure of 30 mm WC or above the speed of the fan shall not exceed 1500 rpm for fan with impeller diameter of above 450 mm and 3000 rpm for fan with impeller diameter of 450 mm or less. The first critical speed of rotating assembly shall be at least 25% above the operating speed.		
	e)	All other accessories like supporting structure etc. as required shall be provided.		
	f)	Fans of capacity 1000 m3/hr. & lower shall be of propeller exhaust type.		
	g)	Battery rooms shall be provided with spark proof (with flame proof motor) fans.		
6.01.02	Roof Ventilators			
	a)	The roof extractors shall be “COWL” type.		
	b)	Impeller shall be of axial flow type, cast Aluminium in one piece and dynamically balanced. Casing shall be heavy gauge sheet steel construction of 3 mm thick for impeller up to 750 mm diameter and 5 mm for fans with impeller of diameter 750 mm and above. In casing, access door with locking arrangement be provided.		
	c)	The cowl shall be designed for weather protection of the fan also inside of the roof on which the extractor is installed. Galvanized bird screen of 15 mm Square be provided with the cowl. All accessories and steel support as required will be provided.		
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2		VOLUME-I CHAPTER-M5 AIR CONDITIONING & VENTILATION SYSTEM
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.01.03	d)	The speed of the fan be limited as per limitation given above for axial fans.		
	e)	All accessories like rain protection exhaust hood, transformation piece, vibration isolators, steel supports vibration isolators, bird screen, etc. as required shall be provided.		
	f)	The vibration level for fans shall be as per ISO: 14694.		
	For fan fixing details, refer the drawing “Fixing details of wall mounted axial fans and roof extractor fans (6401-000-POM-A-058)” annexed to this chapter.			
6.02.00	AIR FILTERS			
6.02.01	Pre Filter			
	1)	Type: Flange / Cassette		
	2)	Pre-filter shall contain washable non-woven synthetic fiber or High-density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or G.I. wire mesh on both sides.		
	3)	Other requirements: (as applicable)		
	a)	Suitable aluminium spacers be provided for uniform air flow;		
	b)	Casing shall be provided with neoprene sponge rubber sealing.		
	c)	Capable of being cleaned by water flushing.		
	d)	Density of filter medium shall increase in the direction of air flow in case of metallic filter.		
	e)	Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.		
	4)	Efficiency:		
		Average arrestance of 65 - 80 % when tested in accordance with BS:6540/ASHRAE – 52 – 76 / EN-779.		
	5)	Minimum thickness	: 50 mm	
	6)	Face Velocity	: Not more than 2.5 m/sec.	
	7)	Pressure drop	: Initial pressure drop - Not to exceed 5.0 mm WC at rated flow. Final pressure drop - Upto 7.5 mm WC.	
	8)	Location	: a) At the discharge of each Fresh air fan	
			: b) At the discharge of each Supply air fan	
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2		VOLUME-I CHAPTER-M5 AIR CONDITIONING & VENTILATION SYSTEM
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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>															
6.02.02	Fine Filters (Microvee type) <div><div>1) Type : Flange / Cassette</div><div>2) Fine filter shall contain washable non-woven synthetic fiber or High-density Polyethylene (HDPE) media having 18G GSS / 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or G.I. wire mesh on both sides.</div><div>3) Other requirements :<div><div>a) A neoprene sponge rubber sealing shall be provided on either face of the filter frame.</div><div>b) Capable of being cleaned by air or water flushing.</div><div>c) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.</div></div></div><div>4) Efficiency : Average arrestance > 90% when tested in accordance with BS:6540/ASHRAE–52-76 / EN-779.</div><div>5) Minimum thickness : 150 mm or 300 mm.</div><div>6) Face Velocity : Not more than 1.2 m/sec for 150 mm and not more than 2.4 m/sec. for 300 mm.</div><div>7) Pressure drop : Initial pressure drop - Not to exceed 10 mm WC at rated flow.<div>Final pressure drop-Up to 25 mm WC.</div></div><div>8) Location :<div>i) At the discharge of each Fresh air fan</div><div>ii) At the discharge of each supply air fan having static pressure 30mm wc or more.</div></div></div>																		
6.03.00	LOW PRESSURE AIR DISTRIBUTION SYSTEM																		
6.03.01	Material of air distribution system shall be through galvanized steel sheet (Conforming to Class 275 of IS: 277) or Aluminium alloy (grade 19000 / SIC or 3100 / NS3 of IS: 737)																		
6.03.02	Thickness of rectangular ducts shall be as follows: <table><tr><th>Larger Dimension of duct (mm)</th><th>Thickness of GI sheet(mm)</th><th>Thickness of Aluminium sheet (mm)</th></tr><tr><td>up to 750 mm</td><td>0.63 (24 G)</td><td>0.80</td></tr><tr><td>751 to 1500</td><td>0.80 (22 G)</td><td>1.00</td></tr><tr><td>1501 to 2250</td><td>1.00 (20 G)</td><td>1.50</td></tr><tr><td>2251 & above</td><td>1.25 (18 G)</td><td>1.80</td></tr></table>				Larger Dimension of duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)	up to 750 mm	0.63 (24 G)	0.80	751 to 1500	0.80 (22 G)	1.00	1501 to 2250	1.00 (20 G)	1.50	2251 & above	1.25 (18 G)	1.80
Larger Dimension of duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)																	
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1501 to 2250	1.00 (20 G)	1.50																	
2251 & above	1.25 (18 G)	1.80																	
6.03.03	Thickness of round ducts shall be as follows: <table><tr><th>Diameter of Round duct (mm)</th><th>Thickness of GI sheet(mm)</th><th>Thickness of Aluminium sheet (mm)</th></tr></table>				Diameter of Round duct (mm)	Thickness of GI sheet(mm)	Thickness of Aluminium sheet (mm)												
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GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2	VOLUME-I CHAPTER-M5 AIR CONDITIONING & VENTILATION SYSTEM	Page 5 of 12															

CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.03.04		150 to 500	0.63	0.80
		501 to 750	0.80	1.00
		751 to 1000	0.80	1.00
		1001 to 1250	1.00	1.50
		1251 & above	1.25	1.80
	Duct Fabrication and Supports:			
	a)	Duct fabrication shall be as per the latest relevant BIS/SMACNA standard.		
	b)	Ducts for A/C system may be site fabricated or factory fabricated and installed at site. However, in case of partly used factory fabricated ducts, vendor shall take back the unused ducts.		
	c)	The ducts routed inside the buildings with larger side greater than 2250 mm shall be supported by 16mm MS rods and 50x50x3 mm MS double Angles while those below 2250 mm shall be supported by 10mm MS Rods and 40x40x3 MS angles. The duct supports shall be at a distance of not more than 2000 mm for A/C system. The MS rods for these ducts routed inside the building shall be hung from the existing floor beams/wall beams/roof beams/columns with provision of necessary auxiliary or special steel members or by hooks or can be provided by contractor by dash fasteners fixed to the ceiling slab. No supports shall be taken from horizontal/vertical bracings of the structures. All items of duct support including MS rods, MS angles and double angles, auxiliary or special steel members, hooks, dash fasteners coach screws and all other supporting material required shall be provided by the bidder.		
	d)	Where the sheet metal duct connects to the intake or discharge of fan units a flexible connection of fire retarding, at least 150 mm width shall be provided of closely woven, rubber impregnated double layer asbestos/canvas or neoprene coated fibre glass.		
e)	All curves, bends, off-sets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have the same velocity as in the main duct to which the branch duct is connected.			
f)	Wherever duct passes through a wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to the adjoining space.			
g)	Wherever pipe hangers or rods pass through the ducts, light and streamline easement around the same shall be provided to maintain smooth flow of air.			
h)	Access doors shall be provided in the duct work or casing on the both sides of the equipment to be serviced. All access doors shall be of adequate size and shall be lined with substantial felt edging to prevent air leakage. Access doors shall be of built up construction, structurally strong and each shall have at least two hinges. Access doors shall have two rust proof window sash of approved type. All doors shall be set so as to flush with insulation or plaster finish on the duct.			
i)	Wherever horizontal ducts are running outside the building and or at locations where it is not possible to support the ducts from ceiling/floor due to non-availability of the same, the base steel frame/truss work for supporting the ducts between two columns shall be provided by Bidder. Further, all other auxiliary steel members, hooks, rods, etc. for supporting the duct work with the base frame/truss work shall also be provided by the bidder. For vertical ducts running outside the building, bidder to take support from building columns and beams. Further, all other auxiliary			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. No.: CS-6401-001-2		VOLUME-I CHAPTER-M5 AIR CONDITIONING & VENTILATION SYSTEM
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC															
	<div> <div></div> <div>steel members, hooks, rods, etc. for supporting the duct work with the beam & columns shall also be provided by the bidder.</div> </div>																
6.03.05	Splitters and dampers shall be provided for equipment/area isolation and for proportional volume control of system. The same shall be minimum 16 gauge GS sheet of quadrant type with suitable locking device, mounted outside of duct in accessible position.																
6.03.06	<p>Factory fabricated ducts:</p> <ul style="list-style-type: none"> i) All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. ii) Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards-Metal and Flexible-Second Edition-1995" SMACNA) iii) All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be factory fabricated by utilizing the machines and processes as specified in SMACNA or by equivalent technology. In equivalent method, the fabrication shall be done by utilizing the following machines and process to provide the requisite quality of ducts and speed of supply: <ul style="list-style-type: none"> a. Coil lines to ensure location of longitudinal seams at corners/folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct. b. All ducts, transformation pieces and fittings to be made on CNC profile cutters for required accuracy of dimensions, location and dimensions of notches at the folding lines. c. All edges to be machine treated using lock formers, flangers and roll-bending for turning up edges. d. Sealant dispensing equipment should be used for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified. Sealing of longitudinal joint is compulsory for the ducts over 2" w.g. static pressure iv) All transverse connectors shall be 4-bolt slip-on flange system with built-in sealant, if any. To avoid any leakage additional sealant shall be used. v) Factory fabricated ducts shall have the thickness of the sheet as follows: <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Sl. No.</th><th>Size of Duct</th><th>Sheet Thickness</th></tr> </thead> <tbody> <tr> <td>i)</td><td>upto 750 mm</td><td>0.63 mm</td></tr> <tr> <td>ii)</td><td>751 mm to 1500 mm</td><td>0.80 mm</td></tr> <tr> <td>iii)</td><td>1501 mm to 2250 mm</td><td>1.00 mm</td></tr> <tr> <td>iv)</td><td>2251 mm and above</td><td>1.25 mm</td></tr> </tbody> </table> 	Sl. No.	Size of Duct	Sheet Thickness	i)	upto 750 mm	0.63 mm	ii)	751 mm to 1500 mm	0.80 mm	iii)	1501 mm to 2250 mm	1.00 mm	iv)	2251 mm and above	1.25 mm	
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6.03.07	<p>Diffusers, Grills, Dampers & Intake Louvers:</p> <ul style="list-style-type: none"> (a) Supply air diffusers/grills with factory-fitted volume control dampers be provided for all air-conditioned areas. (b) Return air diffusers of air-conditioned areas shall be without volume control dampers. 																

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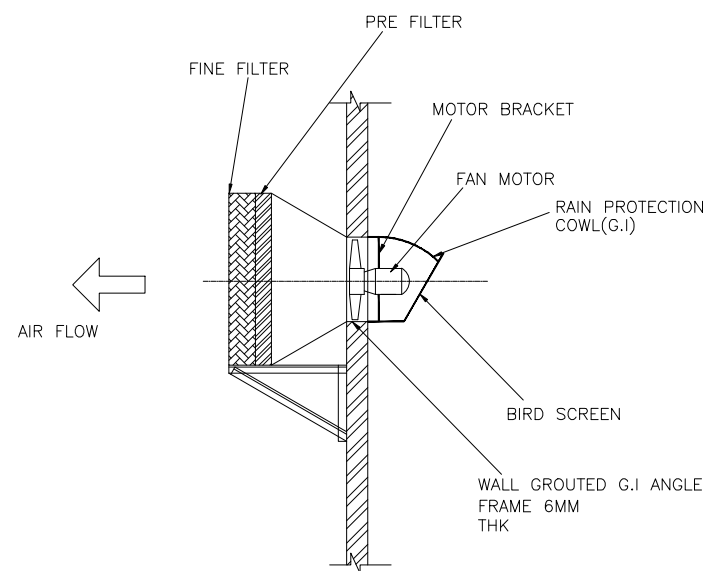
CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>(c) The diffusers/grills shall be of extruded Aluminum of minimum 1.2 mm thick with powder coating. The color of power coating shall be as per the interior Décor.</p> <p>(d) Supply air grills shall be of double deflection type and return air grills shall be of single deflection type.</p> <p>(e) The nozzle type diffusers shall be fabricated from minimum 1.5mm aluminium sheet. The base shall be fixed type. The nozzle shall be of volute design with the spout diameter being half the base dia. and designed for low noise and long throw. The nozzle shall be able to rotate to any angle within the base. The whole assembly shall be powder coated as per interior decor.</p> <p>(f) All volume control (VC) dampers shall be operated by a key from the front of the grills/diffusers and shall be of GI sheet.</p> <p>(g) The thickness of VC dampers shall be of minimum 20 gauge and thickness of louvers shall be of minimum 22 gauge.</p> <p>(h) Suitable vanes shall be provided in the duct collar to have uniform and proper air distribution. Bank of Baffles wherever required shall also be provided.</p> <p>(i) Fire dampers shall be motor operated type and shall have fire rating of minimum 90 minutes.</p> <p>(j) All plenum chambers of connections to fans, dampers etc shall be constructed in 18 gauge GS sheet and supported on MS angle frames.</p> <p>(k) All ducting surfaces coming in contact with corrosive fumes or gases shall be painted with three coats of epoxy paint over a coat of suitable primer.</p> <p>(l) Inlet/Exhaust air grills/louvers are required for all negatively pressure ventilated areas. Back draft dampers shall be provided for all areas pressurised under ventilation system.</p>			
7.00.00	Thermal and Acoustic Insulation			
7.01.00	<p>A) Application with Glass Wool</p> <p>(a.) All surfaces to be insulated both thermally and acoustically shall be thoroughly cleaned, dried and an adhesive (CPRX compound of Shalimar Tar Products or Equivalent) be applied @ 1.5 kg /sqm on the surface.</p> <p>(b.) Insulation material (either expanded polystyrene foam or Glass Wool/ Glass fiber or Equivalent) shall be struck to the surface. All the joints shall be sealed with bitumen.</p> <p>(c.) Insulation mass to be covered with 500 gauge polythene sheet with 50 mm overlaps and sealing all joints on hot side.</p> <p>(d.) Insulation Finish of types specified under shall be provided thereafter.</p> <p>B) Application with Nitrile Rubber:</p> <p>(a) All surfaces to be insulated shall be properly cleaned.</p> <p>(b) A suitable adhesive such as SR 998 or equivalent shall be applied over the surfaces to be insulated and insulation material surfaces.</p> <p>(c) Insulating material shall then be pasted onto the surfaces in a manner to avoid stretching and any air entrapment within.</p> <p>(d) Two layers of Glass Cloth with a suitable adhesive as SR 998 or equivalent shall be then applied over the insulating material to avoid surface weathering.</p> <p>C) Application with Polyurethane Foam & Polyisocyanurate Foam</p> <p>(a) All surfaces to be insulated shall be cleaned.</p> <p>(b) A suitable adhesive such as CPRX or Loid Bond 83 or equivalent shall be applied over the surface to be insulated and insulation material surfaces.</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS					
7.02.00	<p>(c) Insulating material with aluminum foil lamination shall then be pasted onto the surface in a manner to avoid stretching and any air entrapment within.</p> <p>(d) Two layers of Glass Cloth with a suitable adhesive as Loid Bond 130 shall be then applied over the insulating material, to avoid surface weathering.</p> <p>(e) Insulation Finish of types specified under shall be provided thereafter.</p>					
	Type of Insulation & Finish					
	Sl. No.	Surface	Insulation Material	Insulation Form	Thick (mm)	Finish (mm)
	1.	Supply & return air duct of A/C System	Resin bonded glass wool OR Closed Cell Elastomeric Nitrile Rubber OR Polyisocyanurate Foam	Roll /Slab sheet Slab	50 19 30	F-3 As per manufacturer std. F-3
	2.	Refrigerant (Suction and liquid lines)	Closed Cell Elastomeric Nitrile Rubber OR Rigid Polyurethane Foam	Tube Pipe Section	19 50	As per manufacturer std. F-1 (a)
3.	Acoustic insulation of duct	Resin bonded Glass wool	Slab	25	As per specifications	
7.03.00	Specification for insulation shall be as follows: -					
	Insulation Material	Code	Thermal conductivity (w/m°C)	Density Kg/m³		
	Resin bonded glass wool	IS:8183	0.049 at 50°C 0.043 at 50oC	i) 24 (For thermal insulation) ii) 48 (For acoustic insulation)		
	Mineral wool pipe section Min.Gr.2	IS:9842	0.043 at 50°C	144		
	Closed Cell Elastomeric Nitrile Rubber		0.036 at 20°C	40-60		
	Polyurethane Foam	IS12436	0.03 at 50°C	34 + 2		
	Polyisocyanurate Foam		0.03 at 50°C	34 + 2		
	Note: Insulation used for HVAC application shall be CFC/HCFC free					
7.04.00	The specification for various finishes shall be as follows					
	a)	Finish F-1 (with Resin Bonded Glass Wool/Resin Bonded Mineral Wool) Step-1 Wrapping of Poly-Bonded Hessain (PBH – to act as vapour seal) on outer surface of insulation with 50 mm overlap stitching and sealing of overlap with synthetic adhesive like CPRX or Equivalent compound. Step-2 The surface then shall be wrapped with 19 mm mesh 24 SWG GI wire netting, butting all the joints and laced down with 22 SWG lacing wire.				
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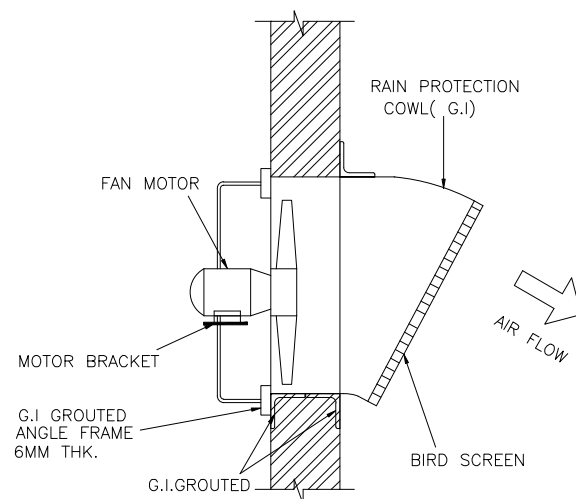
CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>																		
		<div><div><div><div><div>Step-3</div><div>Sand cement (4:1) plaster shall be applied in two layers totalling to 12.5 mm thick, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.</div></div></div><div><div>b)</div><div><div>Finish F-1(a) (With Polyurethane Foam & Polyisocyanurate Foam)</div><div>Wrapping of two layers of 7 mil 10x10 mesh glass cloth dipped in suitable adhesive such as SR 998 or Loid Bond 130 or equivalent.</div></div></div><div><div>c)</div><div><div>Finish F-2</div><div><div><div>Step-1</div><div>Insulation shall be covered with 500g polythene with 50mm overlap and sealing of overlap with synthetic adhesive like CPRX/ Loid Bond 83 or Equivalent compound.</div></div><div><div>Step-2</div><div>Same as Step-2 of Finish F-1 above.</div></div><div><div>Step-3</div><div>Same as Step-3 of Finish F-1 above.</div></div></div></div></div><div><div>d)</div><div><div>Finish F-3</div><div><div><div>Step-1</div><div>Same as Step-1 of Finish F-2 above</div></div><div><div>Step-2</div><div>The polythene shall be covered with 26 gauge Aluminium sheet and locking of joints with self-locking screws at a pitch of minimum 100 mm.</div></div></div></div></div><div><div>e)</div><div><div>Finish F-4</div><div><div><div>Step-1</div><div>Same as Step-1 of Finish F-1 above.</div></div><div><div>Step-2</div><div>Same as Step-2 of Finish F-1 above.</div></div><div><div>Step-3</div><div>Same as Step-3 of Finish F-1 above.</div></div><div><div>Step-4</div><div>Application of 3 mm thick coat of water proofing compound and wrapped with fibre glass RP tissue followed by final coat of 3 mm thick water proofing compound over the RP tissue.</div></div><div><div>Step-5</div><div>After the above treatment, 22G Aluminium sheet cladding, properly stitched at all joints shall be provided over the external surface.</div></div></div></div></div></div></div>																			
7.05.00	For all inspection covers and hatches on equipment, pump casing, valve bodies and flanges (100 mm and above), insulation shall be applied so as to facilitate removal without minimum damage to the insulation by encasing the insulation in 24 gauge GI box or 22 gauge Aluminium sheet metal boxes which are bolted together around the equipment. However continuity of the vapour seal between the static and removable portions of the insulation is to be maintained.																				
7.06.00	ACOUSTIC INSULATION <div><div><div>a)</div><div>All ducts up to a distance of 5 meters from PAC shall be acoustically lined from inside with 25 mm thick resin bonded glass wool of 48 Kg/Cu.M. density and 30 gauge perforated aluminium sheet having 5 mm dia perforation at 8 to 10 mm centre-to-centre distance. Insulation shall be fixed on wooden frame of 600 x 600 mm dimension.</div></div><div><div>b)</div><div>Fibre glass tissue sheet shall be applied over the outer surface of insulation before applying perforated aluminium sheet. Application of acoustic insulation shall be inline with the requirements specified above.</div></div></div>																				
8.00.00	Condensing Unit (Air-Cooled D-X type), if applicable: <table><tr><td>Type</td><td>:</td><td>Air cooled scroll type</td></tr><tr><td>Vibration isolators</td><td>:</td><td>Steel spring / Neoprene rubber cushy foot type with isolation efficiency not less than 85%.</td></tr><tr><td>Compressor</td><td>:</td><td></td></tr><tr><td>Type</td><td>:</td><td>The Compressor shall be scroll, serviceable, either hermatic type or semi-hermetic type with automatic capacity control (minimum 3 steps).</td></tr><tr><td>Type of drive</td><td>:</td><td>Motor driven</td></tr><tr><td>Refrigerant</td><td>:</td><td>The refrigerant shall be R-134a/ R-410A/R-407C or any other environment friendly refrigerant.</td></tr></table>			Type	:	Air cooled scroll type	Vibration isolators	:	Steel spring / Neoprene rubber cushy foot type with isolation efficiency not less than 85%.	Compressor	:		Type	:	The Compressor shall be scroll, serviceable, either hermatic type or semi-hermetic type with automatic capacity control (minimum 3 steps).	Type of drive	:	Motor driven	Refrigerant	:	The refrigerant shall be R-134a/ R-410A/R-407C or any other environment friendly refrigerant.
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CLAUSE NO.	TECHNICAL REQUIREMENTS																																						
	Accessories	:	High/Low pressure cutouts, oil pressure switches, relief valves, pressure gauges at each stage, lube oil and control oil pressure gauges, suction & discharge stop valves, Muffler, Crank case heaters, oil filters, magnetic oil separators, temperature indicators for lube oil/heaters, oil level indicators, safety thermostat for crank case heater, vibration isolators, etc.																																				
	Capacity	:	Minimum capacity shall be suitable for the identified/selected at evaporating temperature and condensing temperature and shall be indicated.																																				
9.00.00	Air Handling Unit (AHU), if applicable: <p>Each AHU shall consist of casing, fan impeller section, cooling coil section, damper section, steel frame with anti-vibration mountings (AVMs) having minimum 85% vibration dampening efficiency and flame retardant, water proof neoprene impregnated flexible connection on fan discharge. Isolation dampers at the suction and discharge of each AHU shall be provided in case return air duct is directly connected to AHU. However, in case AHU room is used for return air, isolation dampers are required to be provided only at AHU discharge of each AHU. Pre-filter at the suction and fine (micro-vee type) at the discharge of each individual AHU, and heater section in the common discharge of AHUs. NRD shall be provided at outlet of each AHU when multiple AHU used for a common plenum.</p> <p>The casing of AHUs shall be of double skin construction. Double skin sandwich panels (inside and outside) shall be fabricated using minimum 0.63 mm (24G) galvanized steel sheet (thickness of galvanization as per manufacturer's standard), with 25mm thick polyurethane foam insulation of minimum 38 Kg/Cum density in between. Suitable reinforcements shall be provided to give structural strength to prevent any deformation/buckling.</p> <p>Sloping condensate drain pan shall be made of minimum 1.2 mm thick Stainless Sheet Steel. It shall be isolated from bottom floor panel through 25mm thick heavy duty treated for Fire (TF) quality expanded polystyrene or polyurethane foam. Drain pan shall extend beyond the coil.</p> <p>Cooling coil (min. 4 row deep) shall be made of seamless copper tubes with aluminium fins firmly bonded to copper tubes and shall be provided with suitable drains and vents connections.</p> <p>All filter plenum shall be provided with a walking platform inside the plenum chamber for filter cleaning purpose. Inspection door shall be provided at the plenum chamber and a removable type ladder shall be attached to plenum.</p>																																						
10.00.00	Centrifugal fan for AHU, if Applicable: <table><tr><td>a)</td><td>Fan Type</td><td>:</td><td colspan="2">Double Width Double Inlet (DWDI) Centrifugal Type</td></tr><tr><td>b)</td><td>Fan impeller</td><td>:</td><td colspan="2">Backward curved blades</td></tr><tr><td>c)</td><td>Casing material</td><td>:</td><td colspan="2">GI /Mild steel with minimum thickness of 3 mm.</td></tr><tr><td>d)</td><td>Impeller material</td><td>:</td><td colspan="2">Carbon steel</td></tr><tr><td>e)</td><td>Shaft</td><td>:</td><td colspan="2">EN 8 Steel</td></tr><tr><td>f)</td><td>Fan bearings</td><td>:</td><td colspan="2">Self-aligning type, permanently lubricated, heavy duty with a design life of 10,000 operating hours.</td></tr><tr><td>g)</td><td>Critical speed</td><td>:</td><td colspan="2">First critical speed of rotating assembly shall be at least 25% above the operating speed.</td></tr></table>				a)	Fan Type	:	Double Width Double Inlet (DWDI) Centrifugal Type		b)	Fan impeller	:	Backward curved blades		c)	Casing material	:	GI /Mild steel with minimum thickness of 3 mm.		d)	Impeller material	:	Carbon steel		e)	Shaft	:	EN 8 Steel		f)	Fan bearings	:	Self-aligning type, permanently lubricated, heavy duty with a design life of 10,000 operating hours.		g)	Critical speed	:	First critical speed of rotating assembly shall be at least 25% above the operating speed.	
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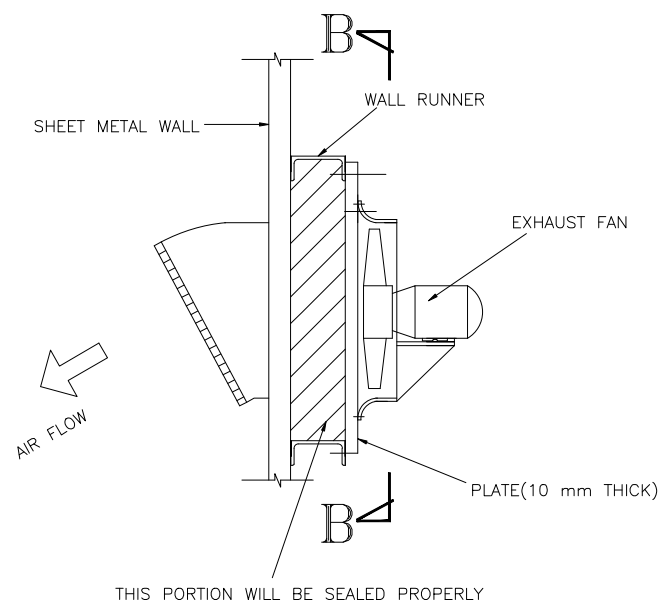
CLAUSE NO.		TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>	
		h)	Drive	:	Motor driven with removable belt guard. Motor rating (at 50 deg.C ambient) shall be at least fifteen percent (15%) above the maximum load demand of drives at the design duty point.
11.00.00		PLANT CONTROL (for Package Air Conditioning/Cassette/Hi-wall Split Air Conditioning and Ventilation System): Control and interlocks for these types of units shall be as per manufacturer's standard practice. Brief scheme of controlling the operation, detailed description of the control system for safe and efficient operation of the plant shall be elaborated and got approved by employer. Separate emergency local stop push buttons shall be provided for each drive of A/C system and ventilation system.			
12.00.00		PAINTING:			
12.01.00		All the Equipments shall be protected against external corrosion by providing suitable painting.			
12.02.00		The surfaces of stainless steel, Galvanized steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. The Contractor shall clean the external surfaces and internal surfaces before Erection by wire brushing and air blowing. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting, etc. as per the agreed procedure.			
12.03.00		For all the steel surfaces (external) exposed to atmosphere (outdoor installation), one(1) coat of red oxide primer of thickness 30 to 35 microns followed up with three (3) coats of epoxy paint, with 25 microns as thickness of each coat, shall be applied. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.			
12.04.00		For all the steel surfaces inside the building (indoor installation), One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with two (2) coats synthetic enamel paint, with 25 microns as thickness of each coat shall be applied. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.			
12.05.00		For centrifugal fans/axial/Roof extractor fans - Casing shall have hot dip/ spray galvanization (minimum 60-micron DFT).			
12.06.00		However for all parts coming in contact with acid fumes (in Battery rooms), a coat of epoxy resin-based zinc phosphate primer of minimum thickness 30 to 35 microns followed up with undercoat of epoxy resin-based paint pigmented with Titanium dioxide of minimum thickness of 25 microns shall be applied and a top coat consisting of one coat of epoxy paint of approved shade and color with glossy finish of minimum thickness of 25 microns.			
12.07.00		Touch up painting shall be as per standard industrial practice.			
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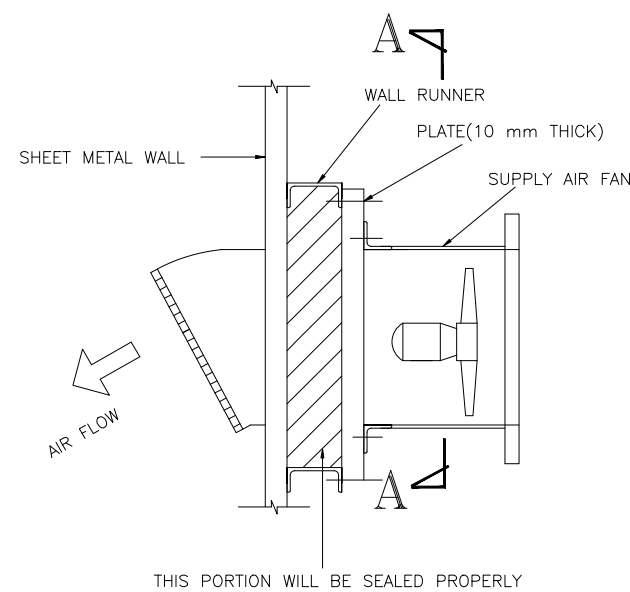
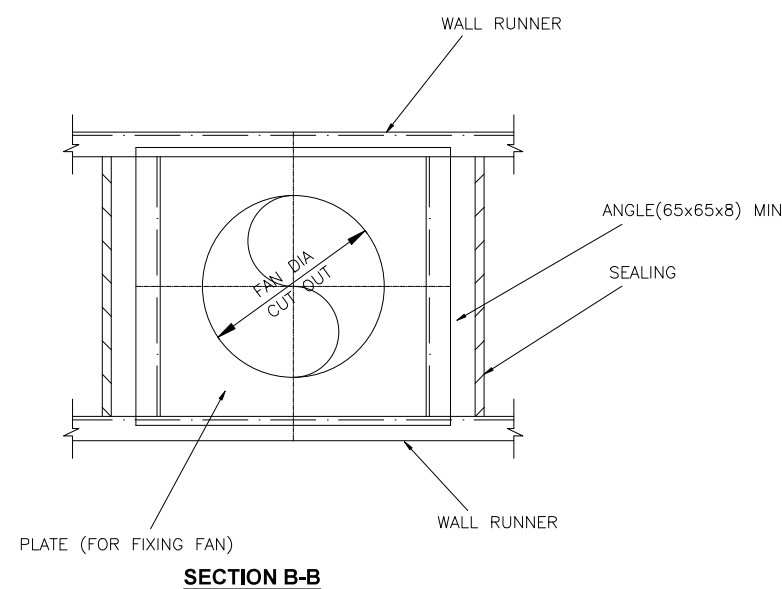
WALL MOUNTED SUPPLY AIR FAN



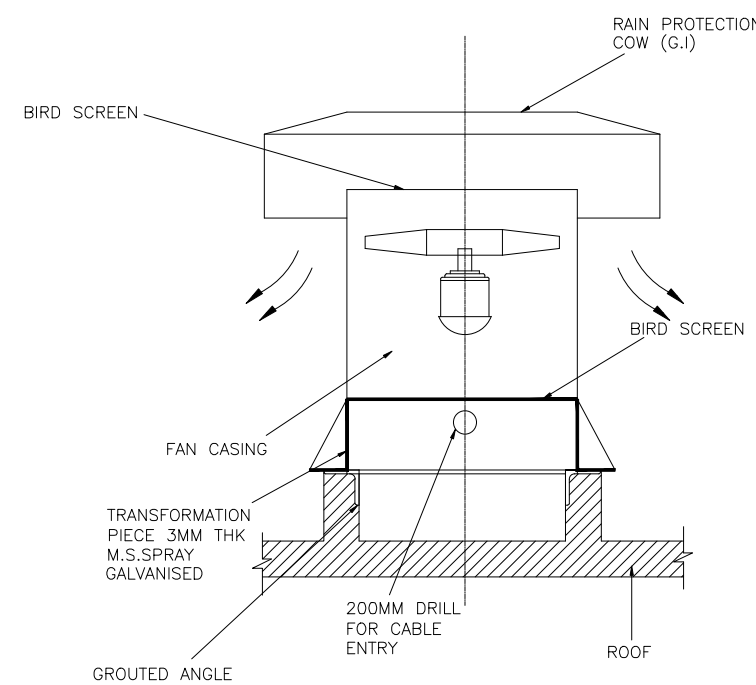
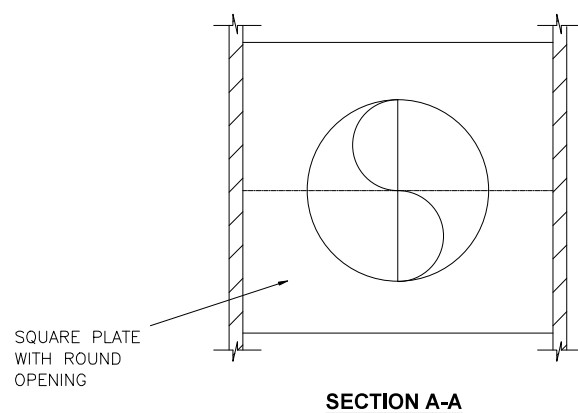
WALL MOUNTED EXHAUST AIR FAN



EXHAUST AIR FAN FIXED ON METAL WALL/CLADDING



SUPPLY AIR FAN FIXED ON METAL WALL/CLADDING



SECTION ELEVATION OF ROOF EXHAUSTER

NOTES :

1. ALL DIMENSIONS ARE IN mm.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH TECHNICAL SPECIFICATION.

FOR TENDER PURPOSE ONLY

NTPC Limited.
(A GOVT. OF INDIA ENTERPRISE)
ENGINEERING DIVISION


PROJECT: GREAT NICOBAR ISLAND GAS POWER PROJECT

TITLE: FIXING DETAIL OF WALL MOUNTED AXIAL FANS AND ROOF EXTRACTOR FAN


SIZE: A1 SCALE: DRG.NO. 6401 -000-POM-A-058

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD.	C	M	E	CHKD.	APPD.	DATE	SIZE	SCALE	DRG.NO.	REV.
A	FOR TENDER PURPOSE ONLY										A1		6401 -000-POM-A-058	A


PART-B
VOLUME – I
CHAPTER – M6
COMPRESSED AIR SYSTEM

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	COMPRESSED AIR SYSTEM			
1.00.00	SYSTEM DESCRIPTION			
1.01.00	The compressed air (Instrument/Service air) system shall consist of Air compressors & their motor drives, Air Drying (ADPs) Plants, air receivers, instrumentation and control, control panels, interconnecting compressed air piping, instrument air piping network, service air piping network.			
1.02.00	IA/SA compressors & drives, instruments, control panels, ADPs, air receivers shall be located indoor. Electric hoists with monorail beam shall be provided for handling air compressors. Further, if air compressors, air drying plants, air receivers, etc. are not possible to be placed at ground floor of main plant control building, then separate compressor house (monorail beam with electric hoist) shall be provided by Contractor.			
1.03.00	Air from air compressors shall be dried in air drying plants and delivered to the air receivers. From the compressed air piping header at the downstream of air receivers, instrument air piping shall be tapped and distributed as per requirement.			
1.04.00	From the compressed air piping header at the downstream of air receivers, service air piping shall be tapped and distributed as per requirement.			
1.05.00	Compressor house (if required) shall be steel framed structure with brick wall up to windowsill height & single skin metal panel cladding above it.			
2.00.00	EQUIPMENT DESCRIPTION:			
2.01.00	The minimum requirements of design and construction features of various components of Compressed air system (screw type air compressor, air dryer, air receiver, etc.) are described below.			
3.00.00	SCREW AIR COMPRESSORS			
3.01.00	CODES AND STANDARDS			
3.01.01	The design, manufacture, testing and performance of the various components of the Rotary Screw type Air Compressors shall comply with the requirements of relevant codes (IS-5456, IS-10431 [Part -1], ASME PTC-9, IS-6206, IS-5727, ISO-1217 and CAGI).			
3.01.02	Other International Standards like American/BS/DIN/equivalent or superior to above mentioned standards are acceptable. Where IS specification is not available, the equipment shall conform to one such International Standard, which shall be indicated in the proposal.			
3.02.00	DESIGN AND CONSTRUCTION			
3.02.01	The compressor shall be oil free multistage, horizontal, air-cooled rotary screw type, heavy duty, rugged construction. Their speed shall be so selected as to result in low maintenance and trouble-free operation under specified conditions.			
3.02.02	The rotor and shaft shall be made of forged steel. The stator (casing) shall be of Cast-Iron (IS-210 grade) Construction with integral jacket cooling. The rotors shall be dynamically balanced to reduce vibration.			
3.02.03	The seal rings and retainers shall be of stainless-steel construction and be free for radial self adjustment along the rotor shafts.			
3.02.04	Bearings shall be high precision antifriction type (IS- 25 Grade 84). The axial thrust load shall be minimized by dividing the axial load of compression on the main and auxiliary bearings through suitable balancing arrangement.			
3.02.05	Any superior material & type (as per proven practice and relevant standard) of various components of screw compressor is also acceptable.			
3.02.06	Lubrication system shall be as per manufacturer standard practices.			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS-6401-001-2	VOLUME-I CHAPTER - M6 COMPRESSED AIR SYSTEM	PAGE 1 OF 6


CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.03.00	Gear Box		
3.03.01	Gears shall have a rating of AGMA-12 or equivalent. Speed increasing gears between the motor and compressor stages shall consist of a common helical gear driving the pinion of each stage. Helical timing gears shall be mounted on the rotor shafts to maintain accurate relative rotor position.		
3.04.00	PERFORMANCE REQUIREMENT		
3.04.01	Air Compressors (screw) shall be designed for continuous operation with high efficiency to satisfy the performance requirement.		
3.04.02	The power rating of the driver shall be selected such that a minimum margin of 10% is available over the power required to deliver rated capacity against rated pressure.		
3.04.03	As more than one compressor with drive is specified, satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, keeping noise level within permissible limits for a number of compressors working simultaneously in the same room.		
5.00.00	AIR RECEIVERS		
5.01.00	Capacity of each of the air receivers shall be of minimum 2 m ³ .		
5.02.00	Receivers shall be vertical cylindrical vessel with dished ends.		
5.03.00	The design pressure and temperature shall be minimum 10 Kg/cm ² (g) and 50 deg.C respectively. Receivers shall be designed in accordance with Section VIII, Division 1 of ASME Code or equivalent.		
5.04.00	Air receivers are to be provided with gasketed inspection manhole of minimum 500 mm diameter with cover plate, lifting handle, davit cap etc.		
5.05.00	Receivers shall be of welded construction with minimum number of joints. Longitudinal seam in adjacent sections shall not be in same line. Welding shall be as per relevant codes. Filler material to have composition & structure as that of material welded. Welding electrodes to be approved by Employer. Electrodes to be dried before use.		
5.06.00	Relief valves shall be provided to suit compressor capacity and set pressure of the same shall be at least 10% above working pressure. The spring in relief valve shall not reset for any pressure more than 10% above or below the design set pressure.		
5.07.00	Each receiver shall be provided with pressure indicator, temperature indicator and drain connection with electrically operated automatic drain trap arrangement with isolation and bypass valves. The drain trap shall be timer based. Manual draining facility shall also be provided in the drain trap.		
5.08.00	The material of construction of shell, dished ends, flanges, etc of the air receivers shall be of carbon steel as per IS:2062 or equivalent.		
6.00.00	INTAKE AIR FILTER AND SILENCER		
6.01.00	Filters with multiple elements quick removal type for easy cleaning shall be provided at suction of each air compressor and also be of heavy-duty dry type.		
6.02.00	The filters shall be complete with integral silencers. Separate silencers, if specified, shall be provided. The filtering elements shall be easily removable for cleaning.		
6.03.00	The filters shall be designed for an efficiency of not less than 99% for particles 2 microns and larger.		
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CLAUSE NO.		TECHNICAL REQUIREMENTS			
7.00.00		AIR DRYING PLANTS			
7.01.00		One number Air drying plant shall be provided for each air compressor envisaged for instrument and service air application. Drying shall be by adsorption process through a desiccant medium.			
7.02.00		Air Drying (ADP) Plant shall be "Heat of (HOC) Compression type".			
7.03.00		Regeneration of desiccant shall be achieved by "Heat of compression" method without any air purge loss.			
7.04.00		Hot unsaturated compressed air shall be used for regeneration of exhausted desiccant.			
7.05.00		Each ADP shall be provided with two adsorber towers each sized for design drying cycle of minimum 8 hours. After this period, the adsorber tower which was under drying mode shall be put under regeneration/reactivation mode while the other tower will take over the drying duty. The change of drying mode to reactivation mode or vice-versa shall be automatic with provision for manual operation also. The change over from one mode to another shall be through automatic solenoid operated valves.			
7.06.00		In HOC type drier, the reactivation shall be achieved by the heat of the compressed air itself. The hot unsaturated compressed air from the outlet of last stage of compressor shall be passed through the adsorber tower. The moist air shall be cooled in dehumidifier and passed through the second adsorber for final drying. The design reactivation cycle/period of the tower shall be less than 8 hours including cooling period for desiccant.			
7.07.00		Each ADP shall be provided with two (2) numbers of 100 percent capacity pre-filters and two (2) numbers of 100 percent capacity after-filters at the upstream & downstream of towers. The filtering media shall be of ceramic candle type elements designed to withstand at least 50% of static pressure as differential pressure. However, as per manufacturer's standard & proven design, any superior material to the material specified is also acceptable. The pre-filters shall be provided with automatic electrically operated drain trap arrangements with isolation and bypass valves.			
7.08.00		The adsorber tower shall be designed with sufficient cross-sectional area resulting in low air velocity and pressure drop. Minimum 20% of desiccant depth shall be provided as free board in adsorber vessels. Adsorber vessels to be provided with suitable number of inspection/sight windows of "Persplex" for observation of adsorbent condition. Desiccant filling and removal connections shall be provided for the adsorber vessels.			
7.09.00		The coolers/heat exchangers/ dehumidifiers of ADP shall be designed & constructed as per the requirements specified for "Intercoolers, After coolers & Oil coolers" above.			
7.10.00		All pressure vessels such as pre-filters, after-filters, adsorber vessels, heaters, heat exchangers/de-humidifiers / coolers etc associated with ADP shall be designed in accordance with Section VIII, Division 1, of ASME Code or equivalent. The pressure vessels shall be provided with airtight gasketed manholes/handholes and relief valves.			
7.11.00		Quantity of desiccant to be calculated shall take into account residual moisture content at the end of regeneration cycle.			
7.12.00		Desiccant shall be activated alumina only and adsorption capacity and density of the same shall not be more than 8% and 900 kg/m ³ respectively.			
7.13.00		In case of Heat of compression type, adsorbers shall be sized so that even when the compressor is operating at part load, complete regeneration shall be achieved within the cycle time and quality of air (dew point) shall be maintained throughout the design cycle period.			
7.14.00		Complete ADP equipment shall preferably be mounted on a skid.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
7.15.00	Required sample connections in piping be provided for sampling of air at desired locations.		
7.16.00	Non-lubricated two way / three way / four way valves ball valves with pneumatic actuators be provided.		
7.17.00	The material of Construction for various components of ADP shall be as per manufacturer's proven standard.		
7.18.00	HOC dryers of single rotating drum type design using packed dessicant with in-built regeneration and adsorption compartments are also acceptable in place of specified twin-tower type dryers, if the design ensures specified performance guarantee. In case, the Contractor offers such a type, the same shall be of proven design and shall meet the conditions stipulated under "proven-ness criteria" in relevant sub-section of Part-A, of Technical Specification. The control & instrumentation requirements specified is applicable for such design also.		
8.00.00	CONTROL PHILOSPHY		
8.01.00	GENERAL		
8.01.01	The minimum requirements are specified herein and the same shall be elaborated by contractor. The Contractor shall include controls & instrumentation to facilitate safe, reliable and efficient operation for the system. The controls, protection, interlock and instrumentation system offered by the contractor shall be subjected to approval of the Employer during post award engineering stage.		
8.01.02	Any of the compressor and Air drying Plant may be selectable for "shutdown", "working" or "standby" duty.		
8.01.03	On tripping of working equipment, the standby equipment shall come into operation automatically in case of very low air pressure in the system.		
8.01.04	All abnormal conditions used for tripping the compressor or any other equipment shall be provided with pre-trip audio-visual indication/annunciation in the control panel.		
8.01.06	The following indications shall be made available in the control panels for repeating the same in main plant Control System / Panels. (a) Status of each compressor (b) Instrument air pressure low/high (c) Service air pressure low/high (d) Dew point of instrument air (e) Status of each ADP		
8.01.07	Lube oil pressure and temperature in the oil circuit of compressor shall be automatically controlled.		
8.01.08	Unless otherwise mentioned in the relevant electrical sub-section, automatic motor overload control system shall be included to permit continuous operation of compressors at minimum ambient air without exceeding the name plate rating of the motor.		
8.02.00	Screw Compressor		
8.02.01	Each compressor shall be in the control panel to operate either in Base duty (Auto Load-Unload) or Standby duty (Auto On-Off) mode.		
8.02.02	In "Base duty" mode, whenever air supply from compressors exceeds the demand, control system shall operate the load-unload circuit at a predetermined set pressure, throttle the inlet valve and open the blow off valve. The compressor shall run in unloaded condition. When system pressure drops due to more demand, the load-unload circuit shall operate again to bring the compressor to 100% load after closing the blow -off valve.		
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8.02.03	In "Stand-by" mode the compressor shall automatically assist base load compressors during periods of peak air demand. When air pressure in the system reaches a pre-set lower limit, compressor should start in unloaded condition and the compressor shall be fully loaded. When the pressure in the system rises to pre-set high value, the compressor shall be unloaded and shall run in idling mode for a specific period (set by a timer). The compressor may be loaded to full load in case of drop in system pressure or compressor may be stopped in case the system pressure does not drop and compressor continues to idle for more than a pre-set time.			
8.02.04	The control system shall provide warning to the operator that a hot-start condition exists for the motor driver and adequate cool-down period has not occurred after the motor was shut down.			
8.02.05	The alarms and shutdown scheme mentioned below are suggestive and shall be provided as per manufacturer's standard practice meeting the safe operational requirement of the equipment/system for each compressor:			
	(a)	"Air temperature high" at inlet to last stage	Alarm & trip	
	(b)	"Low lube oil pressure"	Alarm & trip	
	(c)	"High Lube oil supply temperature"	Alarm & trip	
	(d)	"High oil filter differential pressure"	Alarm	
	(e)	"Low lube oil level in lube oil sump"	Alarm	
	(f)	"High inlet air filter differential pressure"	Alarm & trip	
8.03.00	Air Drying Plant			
8.03.01	Sequential operation of the adsorber towers & air compressors shall be controlled automatically with a provision for manual takeover.			
8.03.02	Change-over of tower from drying mode to regeneration mode shall happen automatically if the dew point is high at the outlet of ADP sensed by the dew point (using aluminium oxide probe) meter/sensor. Automatic operation during regeneration, starting and stopping of blowers, starting and stopping of heaters, etc shall be timer controlled. During the process, in case, operation is taken over manually from the panel through push button or selector switch, the sequential operation shall start with the manual initiation for each of the steps.			
8.02.03	The control system shall provide the (as minimum) alarms, "High Reactivation air temperature", "Low Reactivation air temperature", "Low air pressure at the outlet of ADP" and "High dew point at the outlet of ADP", etc. Adequate number of temperature elements etc. shall be provided for measurement and monitoring of the same.			
8.02.04	For rotary drum type Air drying plant, control philosophy as per manufacture's standard and proven practice is also acceptable.			
9.00.00	PAINTING			
	All the equipments shall be protected against external corrosion by providing suitable painting.			
	The surface of SS, galvanized steel, Gun metal, Brass, Bronze and non-metallic components shall not be applied with any painting.			
	The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting etc as per standard procedure. All Painting shall be done as per approved painting scheme of the vendors/Manufacture which shall be submitted by bidder and as approved by Employer.			
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10.00.00	Also refer “Schematic Drawing of Compressed Air System (6401-001-POM-A-005)” for instrument & service air application, annexed to this chapter.									
11.00.00	<p>Piping & Valves:</p> <table><tr><td></td><td>Material of Construction</td></tr><tr><td>Piping</td><td>ASTM A-53 type E Gr. B galvanized.</td></tr><tr><td>Valves</td><td>Galvanized carbon steel OR Gun metal (for sizes 50 NB and below)</td></tr></table>					Material of Construction	Piping	ASTM A-53 type E Gr. B galvanized.	Valves	Galvanized carbon steel OR Gun metal (for sizes 50 NB and below)
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<div>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</div> <div>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS-6401-001-2</div> <div>VOLUME-I CHAPTER - M6 COMPRESSED AIR SYSTEM</div> <div>PAGE 6 OF 6</div>										

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PROJECT		GREAT NICOBAR ISLAND GAS POWER PROJECT (108 MW)			
TITLE					
SCHEMATIC DRAWING OF COMPRESSERD AIR SYSTEM					
SIZE	SCALE	DRG.NO.			REV.
A1		6401 -001-POM-A-005			A

PART-B
VOLUME – II
ELECTRICAL

ELECTRICAL

ELECTRICAL

B – 0	GENERAL ELECTRICAL REQUIREMENTS
B – 01	GENERATOR AND AUXILIARIES
B – 02	MOTORS
B – 03	NOT USED
B – 04	TRANSFORMERS AND ASSOCIATED EQUIPMENTS
B – 05A	MV SWGR (SWITCHGEAR)
B – 05B	NOT USED
B – 06	LT SWITCHGEARS AND LT BUSDUCTS
B – 07	NOT USED
B – 08	HT LT AND CONTROL CABLES
B – 09	DG SETS
B – 10	CABLING, EARTHING AND LIGHTNING PROTECTION
B – 11	LIGHTING
B – 12	FIRE PROOF CABLE PENETRATION SEALING SYSTEM
B – 13	SUBSTATION AUTOMATION SYSTEM
B – 14	NOT USED
B – 15	ELECTRICAL HOIST, CRANE AND ELEVATOR
B – 16	BATTERY CHARGER
B – 17	SWITCHYARD ELECTRICAL
B – 18	NOT USED
B – 19	BATTERY
B – 20	NOT USED
B – 21	NOT USED
B – 22	BUSDUCTS
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B-24	ROOF TOP SOLAR

SUB-SECTION-B – 0

GENERAL ELECTRICAL REQUIREMENTS

CLAUSE NO.	TECHNICAL REQUIREMENTS
<p>1.00.00</p> <p>1.01.00</p> <p>1.02.00</p> <p>1.03.00</p> <p>1.04.00</p> <p>1.05.00</p> <p>1.06.00</p> <p>1.07.00</p> <p>1.08.00</p>	<p>GENERAL REQUIREMENTS</p> <p>For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted and saline environment. However, for equipment in air-conditioned areas, design ambient temperature shall be 35 deg.C, if 2x100% air conditioning system is provided.</p> <p>All equipment's shall be suitable for rated frequency of 50Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification. The step-up voltage level for the project shall be 33 KV and subsequently evacuated through 132 KV. Each gas engine generator unit will be connected to its own step-up transformers for feeding power into the 33kV switchgear. Power from 33kV shall then be stepped up to 132kV level using 33kV/132kV Tie Transformer for evacuation to remote substations. The overall system shall be designed considering voltage variation of +/- 10% and fault level of 40 kA for 33kV and 132KV system.</p> <p>Contractor shall provide fully compatible electrical system, equipment's, accessories, and services for the entire station/plant in his scope as well as those specifically required by the Employer.</p> <p>All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and International Codes & Standards, especially the Indian Statutory Regulations.</p> <p>The auxiliary AC supply arrangement shall be at 415V level. It shall be designed to limit voltage variations as given below under worst operating condition:</p> <p>b) 415 V/240 V +/- 10%</p> <p>c) 220V/48V DC -15% to +10%</p> <p>The voltage level for motors shall be as follows:</p> <p>a) Up to 0.2 KW : Single phase 240V AC / 3 phase 415V AC</p> <p>b) Above 0.2 KW and up to 200 KW : 3 phase, 415V AC</p> <p>Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard.</p> <p>The preferred AC control supply voltage shall be 110V for all 415 V non-breaker controlled feeders. Control supply voltages other than above may be offered by bidder based on the bidder's standard proven practice.</p> <p>The designed fault level for various voltage levels shall have the following minimum values:</p> <p>132 KV and 33 KV systems - 40 kA rms for 1 second</p>
<p>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</p> <p>SUB-SECTION B-0 GENERAL ELECTRICAL SPECIFICATION</p> <p>PAGE 1 OF 11</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS
<p>1.09.00</p> <p>1.10.00</p> <p>1.11.00</p> <p>1.12.00</p> <p>1.13.00</p> <p>1.14.00</p> <p>2.00.00</p> <p>2.01.00</p> <p>3.00.00</p> <p>3.01.00</p>	<p>415 V systems - 50 kA rms for 1 second</p> <p>The nominal voltage of DC system(s) shall be 220V. DC batteries shall be designed for continuous float operation with trickle charge, hence all the associated components like batteries, battery chargers, DC motors, relays, contactors, timers etc. shall be suitable for continuous operation at the maximum continuous battery float voltage including suitable temperature correction factors.</p> <p>The Contractor shall furnish calculations of maximum loading and fault levels under the most onerous conditions for the various equipment/systems as defined elsewhere in the specification to prove adequacy of their parameters. In case any equipment or system is found to be inadequate, it shall be changed/ modified without any additional financial liability to the Employer.</p> <p>Transformer impedances, and tolerances thereon, shall be optimized so that the auxiliary system voltages under various grid and loading conditions are always within permissible limits and equipment are not subjected to unacceptable voltages during operation and starting of largest motors. The vector groups of the transformers shall be so selected that all the buses of a particular voltage level shall have same vector within the plant.</p> <p>In fire hazardous areas like gas/ liquid fuel storage/ handling areas, lighting fixtures, and switchgears shall be flame proof.</p> <p>The responsibility of coordination with electrical agencies /TAC/Pollution control board and obtaining all necessary clearances shall be of the contractor.</p> <p>Provenness of the Equipment, system, being offered by the bidder should satisfy the criteria Indicated in the "Provenness criteria" indicated elsewhere in the specification.</p> <p>ELECTRICAL SCHEME FOR ELECTRICAL POWER DISTRIBUTION</p> <p>The scheme for Electrical Power Distribution for the project as conceived by the Employer is indicated in tender SLD. (Refer Single Line Diagram enclosed with the specification documents enlisted in the Part-E, Section-VI of technical specification). The scheme with minor variations to above may also be offered if they meet the redundancies indicated in the above drawings and sizing criteria specified.</p> <p>The overall system shall be such that failure of any one auxiliary like transformer, DC battery, Battery charger or DG set shall not reduce the plant's generating capability or affect the safe shut down requirements of the plant.</p> <p>SIZING & DESIGN</p> <p>Generator</p> <p>Three phase, horizontal mounted, indoor installed, Thermal Class 155 (F) winding insulation.</p> <p>a) Generator and its excitation system shall have a capability at least matching the declared maximum continuous rated output of the associated engine at all power factors between 0.80 lagging and 0.90 leading with +3% to -5% frequency variation, terminal voltage variation of +/- 5% and combined voltage & frequency variation of 5%. It shall be ensured</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>that when the Generator is working at this capability, no part of the Generator shall attain a temperature in excess of the temperature limits specified for Thermal Class 130 (B) insulation as per IEC-60034.</p> <p>b) Also the generator and its excitation system shall be capable of continuous stable operation without any excessive temperature rise at the peak output of the associated engine [110%] at all power factors between 0.80 lagging and 0.90 leading with +3% to -5% frequency variation, terminal voltage variation of +/- 5% and combined voltage & frequency variation of 5%. Temperature of different parts may exceed those permissible for Thermal Class 130 (B) insulation under such operating conditions but shall be lower than those permissible for Thermal Class 155 (F) insulation as per IEC-60034</p>		
3.02.00	<p>Generator Transformer</p> <p>The Generator Transformer shall be three phase GT's and shall have On Load Tap Changer with the minimum range of +/- 10% with each step of 1.25%. The rating of the Generator Transformer shall be suitable for continuous stable operation of unit at the rated nominal output at all power factors between 0.80 lagging and 0.90 leading.</p>		
3.03.00	<p>Generator Busduct</p> <p>The continuous rating of the Generator busducts shall be such that the maximum peak output of the unit, at any ambient temperature between 0 deg C and 50 deg. C, can be delivered at the rated power factors and allowable generator voltage variations without exceeding the permissible temperature rise limits as specified for these equipment's.</p>		
3.04.00	<p>Transformers</p> <p>All the transformers shall be sized based on the maximum load expected to be fed by them under most onerous conditions or as per the rating indicated in the Aux Power Supply Drawing No-6401-999-POE-J-001. All transformers, except Generator Transformer (GT), Tie Transformer (TT) are classified as Auxiliary transformers.</p> <p>All Auxiliary transformers shall be sized to have 10% margin at design ambient conditions after considering final load requirements, including owner's load (if applicable), at peak load conditions and the No Load Voltage Correction Factor.</p> <p>No Load Voltage Correction Factor (= Transformer No Load voltage/ rated bus Voltage) shall be used for sizing of all transformers i.e.</p> <p>The transformer size = the calculated size X no load voltage correction factor (0.433/0.415).</p>		
3.04.01	<p>Auxiliary Transformers</p> <p>Adequate number of auxiliary transformers shall be provided to meet the demand on, 415V systems under most onerous conditions, with the criteria that each 415 V switchgear / MCC / DB shall be fed by 2x100% transformers /feeders, and these shall be rated to carry the maximum load including owner's load (if applicable) expected to be imposed.</p>		
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CLAUSE NO.

TECHNICAL REQUIREMENTS

3.05.00

MV Switchgears (GIS)

a) The switchgear boards shall have a single front, single tier, fully compartmentalized, metal enclosed construction complying with clause No. 3.102 of IEC 62271-200, comprising of a row of free-standing floor mounted panels. The Service Class Continuity of Switchgears shall be LSC 2B-PM (as per IEC 62271-200). The Switchgear shall have an Internal Arc Classification of IAC FLR 40kA 1 sec.

b) All MV incomers from transformers and ties between switchgears shall be through bus ducts or adequately rated cables.

c) The sizing Criteria for a Typical MV Switchboard shall be determined by the size of the transformer feeding the board. As a design Philosophy the Board continuous Current shall be selected as $(1.1) * (\text{Full load current at rated voltage on the Transformer's secondary})$ at 50 deg. C Ambient.

d) The various outgoing feeders shall be Feeders for Generator transformers, Auxiliary Transformers, Tie transformers and Supply feeders. While sizing the outgoing feeder the rating is calculated based on the following:

Transformer feeder:	Transformer kVA/ primary $[\text{Voltage} * 1.732] * 1.1$ (at least)
Supply feeder:	800Amp minimum
Incomer feeders:	Generally same as the Board rating
Bus Couplers:	2/3 of the Incomer Feeder rating.

e) Standard MV Switchgear Modules and their Selection Criteria
MV feeders shall be categorized into standard Modules. The module defines the feeder type, Protections, Feeder schematics and metering and monitoring requirements. The Standard Modules are listed in table below:

S No	Module Type	Application	Applicability
1	DB	Transformer Feeder	Transformer feeder < 5 MVA
2	DBF	Transformer Feeder with Differential Protections	Transformer feeder ≥ 5 MVA
3	DC	Incomer Feeder	MV Incomer Module
4	DD	Bus Coupler Feeder	Bus Coupler Module for MV Boards
5	DE (Outgoing)	Supply Feeder	Outgoing feeders except to transformers

3.06.00

LV Switchgears

CLAUSE NO.	TECHNICAL REQUIREMENTS		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.06.00	<p>Cables and Bus Ducts</p> <p>The minimum rating of cable/ bus ducts shall meet the following criteria:</p> <p>All the cables and bus ducts feeding switchboards from transformers shall be sized based on transformer rating. All the cables and bus ducts feeding transformers shall be sized based on current ratings of transformer at the minimum voltage tap of the transformer. All other cables/bus-ducts shall be sized based on the load demand under most onerous conditions.</p> <p>Cables shall be selected to limit maximum voltage drop at equipment terminals during normal operation and starting conditions well within permissible values. Cables shall be derated for the site ambient and ground temperatures, grouping and soil resistivity and cable laying configuration.</p> <p>All HT cables shall be of unearthed grade. Bidder shall furnish detailed cable selection/sizing criteria for Employer's approval.</p>		
3.07.00	<p>Earthing & Lightning Protection System</p> <p>The earthing system for plant shall be designed for a life expectancy of at least forty (40) years, for a system fault current of 40 kA for 1.0 sec. The minimum rate of corrosion of steel (over calculated diameter) for selection of earthing conductor shall be 0.12mm per year.</p> <p>Grounding and lightning protection for the entire power plant, switchyard and other areas or buildings covered in the specification shall be provided in accordance with IS 3043, IEC 62305, IEEE 80 and IEEE 665.</p>		
3.08.00	<p>D.C. Systems</p> <p>Complete DC system, comprising of batteries, battery charges, relays, contactors, timers etc. shall be suitable for continuous operation at the maximum continuous float voltage including suitable temperature correction factors.</p> <p>The battery sizing shall be done based on different types of continuous and intermittent loads including motor starting (wherever applicable) under complete blackout condition, for the duration specified to meet the system requirement.. All intermittent loads shall be considered with minimum 1 minute duration. Nameplate ratings of DC motors shall be used in sizing.</p> <p>The battery shall be sized considering a minimum electrolyte temperature of 15 °C along with temperature correction factors as per relevant standard. An ageing factor of 1.25 shall be considered for Ni-Cd type battery only. The no. of cells, end cell voltage shall be considered based on the minimum and maximum voltage window and cable drop etc. as per system requirement.</p> <p>Each system shall comprise of two nos. of batteries and two nos. of float-cum-boost chargers each rated for 100% capacity. DC scheme shall ensure that each critical consumer is fed from two different bus sections. DCDBs shall provide adequate number of feeders on each section.</p> <p>Boost/ fast charging time shall be as per worst operating condition and would satisfy technical requirements recommended by battery manufacturer. Each battery charger must be capable of supplying all the continuous D.C. loads (fed through both section of DCDB) plus the trickle charging current of both the batteries. In addition, each charger must have sufficient surplus</p>		
<p>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</p>		<p>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</p>	<p>SUB-SECTION B-0 GENERAL ELECTRICAL SPECIFICATION</p> <p>PAGE 7 OF 11</p>

CLAUSE NO.

TECHNICAL REQUIREMENTS

capacity for running of the largest D.C auxiliary so that the battery is not drained during testing of the same. Battery charger should also be capable of boost/ fast charge the battery from completely discharged condition to fully charged condition without imposing any limitations under worse operating conditions.

The various DC Systems envisaged along with minimum battery bank ratings to be adopted are indicated in the following table.

Area	DC Voltage	Load	Minimum Battery Bank Rating
Unit [common for all units]	220 V	Total DC load of the unit at an acceptable voltage for at least 30 minutes	As per system requirement
switchyard	220 V batteries	<p>(a) Emergency lighting in Switchyard control room for a period of 3 hour plus</p> <p>(b) All continuous DC loads of relay & control panels/PLCC panels for a duration of 3 hours plus</p> <p>(c) Interlocking coils of isolators/earth switches shall be considered including requirement of three future line bays for a duration of 3 hours plus</p> <p>(d) loads in worst of the following conditions</p> <p>(i) simultaneous operation of the maximum number of breakers & associated equipment's in case of bus fault in the switchyard.</p> <p>(ii) Operation of Breaker failure relay (LBB relay)</p>	625AH lead acid Plante type/410 AH Ni-Cd (KPH type)
PLCC System for Switchyard	48 V	supply total DC load of the PLCC system at an acceptable voltage for at least 3 hours	425AH lead acid Plante type/390 AH Ni-Cd (KPL type)

DC Health Monitoring Systems for Main Plant (220 V) and switchyard (220V and 48V) shall be provided to monitor the condition of each battery cell of 220V battery banks on-line on 24x7 basis. With DC Health Monitoring System, it shall be possible to measure & analyze the individual cell and battery parameters so that any damage to battery shall be prevented by pro-active maintenance. The location of cell monitoring systems shall be away from the battery bank. All the cards used for BHMS system shall have conformal coating.

3.09.00

Diesel Generator Set

For safe shut down of the plant under emergency condition and in case of total power failure, Diesel Generating shall be provided. DG set shall be capable of meeting 100 % of essential

CLAUSE NO.	TECHNICAL REQUIREMENTS																																														
4.00.00	<p>load requirements of all generating unit without exceeding the permissible running voltage drop. Additionally, it shall be possible to start the largest rating motor connected to emergency switchgear at 50% prestart loading condition without exceeding the permissible starting voltage drop criteria. Some of the vital station auxiliaries/systems like battery chargers of switchyard, auxiliary supplies of instrument/plant air compressors, emergency air conditioning and ventilation system loads shall also be fed from DG set supply. The emergency air conditioning and ventilation system requirements pertaining only to the Plant areas (like Control Room, Control equipment Room, UPS Room as per requirement) shall be provided the DG backup.</p> <p>During Grid black-out condition, it shall be ensured that only the essential auxiliaries of the plant are fed from Diesel generator & non- essential loads are automatically tripped.</p> <p>In addition to above DG sets, one standby DG set with rating identical to Main DG set shall also be provided, as a backup, to cater the load requirements of the unit at a time.</p>																																														
	<p>ISLANDING SCHEME</p> <p>The plant shall be designed to operate in islanding mode of operation by tripping all the lines and generators except for one pre-selected unit, which shall run with the available plant load under such condition.</p>																																														
5.00.00	<p>INSULATION LEVEL</p> <p>The insulation level for the transformer windings and bushings shall be as follows:</p>																																														
	<table> <tr> <th rowspan="2">Highest System Voltage</th><th colspan="2">WINDING</th><th colspan="2">BUSHING</th></tr> <tr> <th>Rated Power Freq. withstand Voltage (kVrms)</th><th>Rated lightning impulse withstand voltage (kVp)</th><th>Rated Power freq. withstand voltage (kV rms)</th><th>Rated lightning impulse withstand voltage (kVp)</th></tr> <tr> <td>0.433 KV</td><td>3</td><td>-</td><td>3</td><td>-</td></tr> <tr> <td>3.6 kV</td><td>10</td><td>40</td><td>11</td><td>40</td></tr> <tr> <td>7.2 kV</td><td>20</td><td>60</td><td>22</td><td>60</td></tr> <tr> <td>12 kV</td><td>28</td><td>75</td><td>30</td><td>75</td></tr> <tr> <td>17.5 kV</td><td>38</td><td>95</td><td>42</td><td>95</td></tr> <tr> <td>24kV</td><td>50</td><td>125</td><td>55</td><td>125</td></tr> <tr> <td>36kV</td><td>70</td><td>170</td><td>77</td><td>170</td></tr> </table>				Highest System Voltage	WINDING		BUSHING		Rated Power Freq. withstand Voltage (kVrms)	Rated lightning impulse withstand voltage (kVp)	Rated Power freq. withstand voltage (kV rms)	Rated lightning impulse withstand voltage (kVp)	0.433 KV	3	-	3	-	3.6 kV	10	40	11	40	7.2 kV	20	60	22	60	12 kV	28	75	30	75	17.5 kV	38	95	42	95	24kV	50	125	55	125	36kV	70	170	77
Highest System Voltage	WINDING		BUSHING																																												
	Rated Power Freq. withstand Voltage (kVrms)	Rated lightning impulse withstand voltage (kVp)	Rated Power freq. withstand voltage (kV rms)	Rated lightning impulse withstand voltage (kVp)																																											
0.433 KV	3	-	3	-																																											
3.6 kV	10	40	11	40																																											
7.2 kV	20	60	22	60																																											
12 kV	28	75	30	75																																											
17.5 kV	38	95	42	95																																											
24kV	50	125	55	125																																											
36kV	70	170	77	170																																											
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2		SUB-SECTION B-0 GENERAL ELECTRICAL SPECIFICATION PAGE 9 OF 11																																											

CLAUSE NO.		TECHNICAL REQUIREMENTS				
		72.5 kV	140	325	155	325
		145kV	275/38*	650	305	650
		* In case of non-uniformly insulated.				
6.00.00	NEUTRAL GROUNDING					
6.01.00	Neutral earthing equipment shall be designed duly considering the maximum permissible operating voltage of the generator, voltage rise on load throw off (after detection of earth fault) field suppression time, ferro-resonance, etc. The generator shall be grounded through distribution transformer with secondary loading resistor, limiting the earth fault current to value not less than capacitive current to restrict the over voltages caused due to capacitive currents. The neutral earthing equipment shall be rated to carry this current for at least 5 minutes considering the Generator Terminal Voltage under maximum field forcing conditions.					
6.02.00	33kV and 132kV side of all Tie Transformers shall be solidly Earthed					
6.03.00	LV Side of all LT Transformers (415V) shall be solidly earthed through bolted links.					
6.04.00	220V DC system shall be kept ungrounded.					
6.05.00	Diesel generator shall also be kept ungrounded (earthing through PT).					
7.00.00	EHV cable & accessories (132 KV)					
	EHV cables connecting Tie Transformer to 132kV GIS shall be sized based on current ratings of transformer at the minimum voltage tap of the transformer and laying condition specified elsewhere in the specification. The cable screen shall be designed for solidly grounded system for the system fault level of 40kA for 1 sec. The BIL of the cable shall be 650 kVp.					
9.00.00	FAULT LEVEL					
	Equipment through fault withstand capabilities under worst operating conditions duly considering negative tolerances on transformer, generator & maximum fault levels of source etc. shall be as follows:					
	i)	Generator Transformer	-	3 seconds		
	ii)	All other transformers	-	2 seconds		
	iii)	Generator busduct (higher of generator or system & motor fault contribution)	-	1 second		
	iv)	Switchgears	-	1 second		
	v)	Cables to the feeders protected by breakers		Main protection fault clearing time with 0.12 second minimum		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	vi) Cables of all other feeders	As per MCCB operating time	
	vii) 132KV systems	-1 second	
	(** Note) Thermal withstand design time duration. The indicated values of time durations are used in transformer design for ensuring thermal stability of the transformers and are to be proven through calculations.		
10.00.00	MOTORS		
	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance):		
	(a) From 50KW & up to 110KW	:	11.0
	(b) From 110 KW & up to 200 KW	:	9.0
	Starting voltage requirement: permissible starting voltage for motor shall be as follows:		
	(a) Up to 85% of rated voltage for ratings below 110 KW		
	(b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW		
11.00.00	All the plant and equipment's/systems supplied under the contract shall be designed following "Fail Safe" concept in case of failure of Power Supply like Electric Power, Hydraulic pressure, Pneumatic pressure, vacuum etc. the system shall be designed in such a way that the equipment shall always move/remains (as applicable) to safest position as per system requirement to ensure safety of Man and Machinery.		
12.00.00	Latest Cybersecurity guidelines laid down by CEA/Government of India shall be followed while designing Substation Automation System for switchyard and ABT systems.		
13.00.00	Dielectric epoxy based coating covering entire finished floor and checkered plates shall be provided in all MV switchgear (33 KV) rooms and also in switchgear rooms having both MV (33 KV) and LV switchgears. dielectric epoxy based coating or insulating mats as per IS: 15652 shall be provided. For 33 KV switchgear rooms (if applicable), dielectric strength for insulating floor shall be 65 KV ac rms. The minimum thickness of insulation coating shall be 3000 microns for 33 KV switchgear rooms (if applicable) or as per the lab certificate fulfilling the dielectric strength requirement, whichever is higher. Dielectric test reports as per IS-2584 from a NABL accredited laboratory shall be submitted. Further, test reports for adhesion, tensile strength, scratch hardness, shore hardness, abrasion resistance shall be submitted in line with requirement of relevant national/international standard. The coating shall be high gloss finish and top color of coating shall be decided during the detailed engineering. Arc flash boundary and golden yellow safe boundary shall be provided. Bidder shall submit the procedure of coating for NTPC approval. Also, the bidder shall conduct dielectric testing in a NABL accredited laboratory on a sample prepared during application at site		
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SUB-SECTION-B – 01

GENERATOR AND AUXILIARIES

CLAUSE NO.	TECHNICAL REQUIREMENTS		
GENERATOR & AUXILIARIES			
1.00.00	GENERAL REQUIREMENTS		
1.01.00	This chapter has to be read in conjunction with sub-section B-0 "General Electrical Specification" of Technical specification Section-VI, Part-B and Sub-Section IIB Electrical system/Equipment of Technical Specifications Section-VI, Part-A.		
1.02.00	All equipment shall be suitable for rated frequency of 50Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.		
1.03.00	Contractor shall provide fully compatible electrical system, equipment, accessories and services.		
1.04.00	Standard	:	IEC-60034 IEEE1129, IEEE115
1.05.00	Paint Shade:		RAL 5012
1.06.00	All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.		
2.00.00	TYPE AND RATING		
2.01.00	Type: Three phase, horizontal mounted, indoor installed, Thermal Class 155 (F) for Stator and Rotor winding insulation.		
2.02.00	GENERATOR RATING		
2.02.01	Generator and its excitation system shall have a capability at least matching the declared maximum continuous rated output of the associated engine at all power factors between 0.80 lagging and 0.90 leading with +3% to -5% frequency variation, terminal voltage variation of +/- 5% and combined voltage & frequency variation of 5%. It shall be ensured that when the Generator is working at this capability and no part of the Generator shall attain a temperature in excess of the temperature limits specified for Thermal Class 130 (B) insulation as per IEC-60034.		
2.02.02	Also the generator and its excitation system shall be capable of continuous stable operation without any excessive temperature rise at the peak output of the associated engine at all power factors between 0.80 lagging and 0.90 leading with +3% to -5% frequency variation, terminal voltage variation of +/- 5% and combined voltage & frequency variation of 5%. Temperature of different parts may exceed those permissible for Thermal Class 130 (B) insulation under such operating conditions but shall be lower than those permissible for Thermal Class 155 (F) insulation as per IEC-60034.		
2.02.03	Rated Parameters:		
	1.	Terminal voltage	11 KV
	2.	Power Factor	0.80 (lagging)
	3.	Frequency	50 Hz
3.00.00	OPERATIONAL REQUIREMENTS FOR GENERATOR		
	1.	Voltage Variation	+/-5% continuously at rated power factor. Reduced MVA operation at 110% of the rated Voltage. (to be indicated by the Contractor)
	2.	Frequency Variation	47.5 HZ to 51.5 Hz.
	3.	Combined voltage and frequency variation	5%
	4.	Power factor variation	0.80 (lag) to 0.90 (lead)
	5.	Operation under unbalanced	As specified in IEC 60034-1
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>Load</p> <p>6. Operation under unsymmetrical short circuit Negative sequence current I_2 expressed in per unit of rated current for a duration of 't' second such that the value of $I_2^2 t$ shall comply to IEC 60034-1</p> <p>7. Voltage Wave form The Total Harmonic Distortion (T.H.D) shall be within the limit specified in IEC 60034-1.</p> <p>8. Short Circuit withstanding capacity Capable of withstanding of 3 phase short circuit at the generator terminals when operating at rated MVA and power factor with 5 % over voltage for a period of not less than 3 seconds.</p> <p>9. Line Charging Capability Not less than 30% of its rated MVA at zero pf.</p> <p>10. Generator Neutral Earthing Non-effectively earthed through a distribution transformer, loaded with a resistor. The core design to permit the flow of earth fault current of at least 15 amperes for one (1) second without major core damage</p> <p>11. Impulse level & Surge Protection To be suitable for test voltage of 4U+5 KV. (where U is rated line to line voltage in KV). Lightning arrestor surge arrestor and surge capacitor of suitable rating shall be provided for the protection of generator winding.</p>		
4.00.00	<p>DESIGN AND CONSTRUCTIONAL FEATURES</p> <p>1) General</p> <p>a) All components of the generator to be designed to avoid resonance at any of the frequency in the operating range and their multiples.</p> <p>b) All components requiring inspection and maintenance to be designed for easy access and replacement.</p> <p>c) Earthing brushes shall be provided. It should be possible to increase the brush pressure, preferably, even while generator is working. In case any other arrangement for shaft earthing offered by Contractor, the same shall be accepted. Rotor earth fault monitoring shall be provided.</p> <p>d) Suitable generator drying arrangement shall be provided.</p> <p>2) Generator Instrumentation The following minimum instruments shall be provided for each generator. For the requirements regarding type, make etc. of instruments and sensors, refer stipulations under relevant Sub-sections of Control & Instrumentation.</p> <p>A) Resistance temperature detectors (RTD)</p> <p>a) Temperature Detectors Resistance temperature detectors (RTD) to be duplex four / three wire type 100 ohms platinum, calibrated as per DIN standard and located at points where highest temperature is likely to occur during operation. The bidder may also offer thermo-couple (TC) or duplex RTDs. In case simplex RTDs are provided they shall be double in quantity of those specified as below.</p> <p>b) Number and location i) Atleast Six (6) detectors, two (2) per phase and uniformly distributed along the circumference of the stator and located at the hottest possible zones</p>		
<p>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</p>	<p>SUB SECTION: B-01 GENERATOR & AUXILIARIES</p>	<p>PAGE 2 OF 4</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
		ii)	Atleast Two (2) detectors per bearing for measurement of Bearing temperature.
	c)	Termination of RTD leads	At terminal box after grouping of signals.
	d)	Location	Terminal box for RTD's shall be at an easily accessible position so as to enable maintenance/testing of the devices when the machine is under operation.
	e)	Terminal box construction	Dust and vermin proof (IP54)
	f)	Interface	All the above temperature measurement devices shall be connected to DDCMIS.
5.00.00	GENERATOR EXCITATION SYSTEM		
5.01.00	A complete generator excitation and voltage regulating system shall be provided with the generator. The Generator excitation system shall be standalone system. All panels of excitation system shall be in single suite. It shall have provision of connection to Generator MMI through network interface. However it shall also be able to operate the Generator excitation system without this interface.		
5.02.00	Characteristics	The excitation system shall have matching characteristics suitable for satisfactory parallel operation with other generators in the plant.	
5.03.00	Fail safe requirement	The various change over relays and other equipment associated with supply system other than AVR control supply, electronic circuits of either channel etc., shall be such that the loss of their control supply does not lead to the excitation system outage.	
5.04.00	Equipment design & sizing criteria		
5.04.01	Redundancy	The excitation system shall have two (2x100%) AVR channels including complete independent power supplies and controls. Each channel shall be equipped for 'Auto Operation' with the facility for selecting either channel in 'Auto' or 'Manual' mode.	
5.04.02	Margin	Each excitation system channel shall be designed to continuously carry currents of at least 10% above the field current requirement at generator MCR condition.	
5.05.00	Excitation system ceiling voltage	> 1.5 times rated load excitation voltage.	
5.06.00	Technical features	Voltage regulator shall have the following provision of limiters to ensure the machine operation within the defined capability limits.	
5.07.00	In addition, two (2no) 15 inches laptop shall also be supplied to facilitate programming of DAVR and downloading of records locally. Suitable communication port, cables, interfacing software etc shall be provided. The configuration of the laptop shall be finalized during detailed engineering. The requisite license/ dongles shall be provided.		
6.00.00	TYPE TESTS AND TEST REPORTS		
	(a.) All equipment to be supplied shall be of type tested design. The Contractor shall submit for Owner's approval the reports of all the type tests (as listed out in relevant clauses) carried out within last ten years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.		
	(b.) In case the Contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract at no additional cost either		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>at third party lab or in presence of client/owners' representative and submit the reports for approval. The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor.</p> <p>(c.) All routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.</p> <p>(d.) The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.</p> <p>6.01.00 LIST OF TYPE TESTS</p> <p>Type test report for the following test shall be furnished:</p> <p>6.01.01 GENERATOR</p> <p>a) Instantaneous short circuit test to determine transient and sub-transient reactance parameters and to ensure stability of winding during sudden short circuit condition.</p> <p>b) Determination of negative sequence and zero sequence reactance and resistance.</p> <p>c) Determination of voltage waveform factor and Total Harmonic Distortion factor.</p> <p>d) Short circuit heat run test</p> <p>6.01.02 Excitation system</p> <p>(a) Exciter (If applicable)</p> <p>Temperature rise test at peak rating of excitation system. Ceiling duty condition shall also be demonstrated.</p> <p>(b) Converter Assembly</p> <p>Temperature rise test at peak rating of excitation system. Ceiling duty condition shall also be demonstrated.</p> <p>(d) Input and output surge withstand capability test:</p> <p>The Oscillatory SWC tests shall be conducted as per ANSI / IEEE C37.90.1-2002 and/or</p> <p>The Fast transient SWC tests shall be conducted as per ANSI / IEEE C37.90.1-2002 / IEC 60255-22-04-2008.</p>		
<p>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</p>	<p>SUB SECTION: B-01 GENERATOR & AUXILIARIES</p>	<p>PAGE 4 OF 4</p>

SUB-SECTION-B – 02

MOTORS

CLAUSE NO.	TECHNICAL REQUIREMENTS																						
	MOTORS																						
1.00.00	GENERAL REQUIREMENTS																						
1.01.00	<p>This chapter has to be read in conjunction with sub-section B-0 "General electrical specification" of Technical specification Section- VI, Part-B and Sub-Section-IIB Electrical system/Equipment of Technical Specifications Section-VI, Part-A"</p> <p>Degree of Protection</p> <p>Degree of protection for various enclosures as per IEC60034-05 shall be as follows :-</p> <table><tr><td>i)</td><td>Indoor motors</td><td>-</td><td>IP 55</td></tr><tr><td>ii)</td><td>Outdoor motors</td><td>-</td><td>IP 55 (Additional Canopy to be provided)</td></tr><tr><td>iii)</td><td>Cable box-indoor area</td><td>-</td><td>IP 55</td></tr><tr><td>iv)</td><td>Cable box-Outdoor area</td><td>-</td><td>IP 55</td></tr></table>			i)	Indoor motors	-	IP 55	ii)	Outdoor motors	-	IP 55 (Additional Canopy to be provided)	iii)	Cable box-indoor area	-	IP 55	iv)	Cable box-Outdoor area	-	IP 55				
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2.00.00	CODES AND STANDARDS																						
	<table><tr><td>1)</td><td>Three phase induction motors</td><td>:</td><td>IS15999/IEC:60034</td></tr><tr><td>2)</td><td>Single phase AC motors</td><td>:</td><td>IS 996/ IEC:60034</td></tr><tr><td>3)</td><td>Crane duty motors</td><td>:</td><td>IS:3177, IS/IEC:60034</td></tr><tr><td>4)</td><td>DC motors/generators</td><td>:</td><td>IS:4722, IS/IEC:60034</td></tr><tr><td>5)</td><td>Energy Efficient motors</td><td>:</td><td>IS 12615, IEC:60034-30</td></tr></table>			1)	Three phase induction motors	:	IS15999/IEC:60034	2)	Single phase AC motors	:	IS 996/ IEC:60034	3)	Crane duty motors	:	IS:3177, IS/IEC:60034	4)	DC motors/generators	:	IS:4722, IS/IEC:60034	5)	Energy Efficient motors	:	IS 12615, IEC:60034-30
1)	Three phase induction motors	:	IS15999/IEC:60034																				
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5)	Energy Efficient motors	:	IS 12615, IEC:60034-30																				
3.00.00	TYPE																						
3.01.00	<p>AC Motors:</p> <p>a) Squirrel cage induction motor suitable for direct-on-line starting.</p> <p>b) Continuous duty LT motors upto 50 KW Output rating (at 50 deg.C ambient temperature), shall be super Premium Efficiency class-IE4, 50-200 KW shall be of Premium Efficiency class – IE3, conforming to IS 12615, or IEC:60034-30. HT motors shall have minimum design efficiency of 95 %. However, tolerance on this efficiency value shall be applicable as per IEC 60034</p> <p>c) Motor operating through variable frequency drives shall be suitable for inverter duty with VPI insulation. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.</p>																						
3.02.00	DC Motors - Shunt wound.																						
4.00.00	RATING																						
	<p>(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.</p> <p>(b) Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.</p>																						
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
5.00.00	<p>TEMPERATURE RISE</p> <p>Air cooled motors (AC &DC)</p> <p>70 deg. C by resistance method for thermal class 155(F) insulation.</p> <p>Water cooled</p> <p>80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for thermal class 155(F) insulation.</p>				
6.00.00	<p>OPERATIONAL REQUIREMENTS</p>				
6.01.00	<p>Starting Time</p>				
6.01.01	<p>For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.</p>				
6.01.02	<p>For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.</p>				
6.01.03	<p>For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.</p>				
6.01.04	<p>Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.</p>				
6.02.00	<p>Torque Requirements</p>				
6.02.01	<p>Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor rated torque.</p>				
6.02.02	<p>Pull out torque at rated voltage shall not be less than 205% of rated torque. It shall be 275% for crane duty motors.</p>				
6.03.00	<p>NOT USED</p>				
7.00.00	<p>DESIGN AND CONSTRUCTIONAL FEATURES</p>				
7.01.00	<p>Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.</p>				
7.02.00	<p>All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). The method of movement of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below</p> <p>(a) Fuel oil area : Group – IIB</p> <p>(b) Hydrogen generation : Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA /IEC60034)</p>				
<table><tr><td>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</td><td>SUB SECTION-B-02 MOTORS</td><td>PAGE 2 OF 6</td></tr></table>		GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB SECTION-B-02 MOTORS	PAGE 2 OF 6
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
7.03.00	<p>Winding and Insulation</p> <p>(a) Type : Electrolytic grade Copper conductor, Non-hygroscopic, oil resistant, flame resistant Insulation.</p> <p>(b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature. However , conveyor motors shall be suitable for 3 consecutive hot starts</p> <p>(c) 11kV, 6.6 KV & 3.3 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Presure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15.</p> <p>(d) 240VAC, 415V AC & 220V DC motors : Thermal Class (F) or better</p>				
7.04.00	Motors rated above 1000KW shall have insulated bearings/housing to prevent flow of shaft currents.				
7.05.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.				
7.06.00	Noise level for all the motors shall be limited to 85 dB(A) except for BFP motor for which the maximum limit shall be 90dB(A) (Tolerance limits as per IS/IEC shall be applicable on specified values). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting vibration pads. Contractor shall ensure the adequate size of vibration pads for mounting of suitable vibration sensors.				
7.07.00	In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with 3 numbers duplex RTDs connected to 1 no of dual input TT and 2 nos of Single input TT with display. However, for air compressor, being high speed drive, each motor bearing shall be provided with minimum two numbers of duplex RTDs connected to two numbers dual input transmitters with display unit.				
7.08.00	Motor body shall have two earthing points on diagonally opposite sides.				
7.09.00	<p>11 KV motors shall be offered with:</p> <p>i) Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.</p> <p style="text-align: center;">OR</p> <p>ii) Dust tight phase segregated double walled (metallic as well as insulated barrier) Terminal box–PSTB shall be suitable for fault level of 50KA/40KA for 0.12 seconds (Fault level shall be as per system fault level for 11 KV system defined elsewhere in the specification). Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material for single core cables) shall be provided.</p>				
<table><tr><td>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</td><td>SUB SECTION-B-02 MOTORS</td><td>PAGE 3 OF 6</td></tr></table>		GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB SECTION-B-02 MOTORS	PAGE 3 OF 6
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
7.10.00	3.3/6.6 KV motors shall be offered with dust tight phase segregated double walled (metallic as well as insulated barrier) Terminal box. Alternately Elastimold type Terminal box should also be accepted as per OEM standard proven practice. Contractor shall provide termination kit for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA/500MVA for 0.12 sec for 3.3/6.6KV respectively. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.				
7.11.00	The spacing between gland plate & centre of bottom terminal stud shall be as per Table-I.				
7.12.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.				
7.13.00	The motors shall be suitable for bus transfer schemes provided on the 11kV, 6.6 KV, 3.3 kV /415V systems without any injurious effect on its life.				
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.				
7.15.00	NOT USED.				
8.00.00	NOT USED.				
9.00.00	NOT USED.				
10.00.00	TYPE TEST				
10.01.00	HT MOTORS				
	<p>LIST OF TYPE TESTS TO BE CONDUCTED</p> <p>The following type tests shall be conducted on each type and rating of HT motor</p> <ul style="list-style-type: none">(a) No load saturation and loss curves upto approximately 115% of rated voltage(b) Measurement of noise at no load.(c) Momentary excess torque test (subject to test bed constraint).(d) Full load test(subject to test bed constraint)(e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp.,coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose. <p>LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED</p> <p>The following type test reports shall be submitted for each type and rating of HT motor</p> <ul style="list-style-type: none">(a) Degree of protection test for the enclosure followed by HV and no load run test.(b) Terminal box-fault level withstand test for each type of terminal box (phase side only) of HT motors only.(c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15(d) Surge-withstand test on inter-turn insulation shall be as per clause no. 4.2 of IEC 60034, part-15				
<table><tr><td>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</td><td>SUB SECTION-B-02 MOTORS</td><td>PAGE 4 OF 6</td></tr></table>		GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB SECTION-B-02 MOTORS	PAGE 4 OF 6
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
10.02.00	<p>LT Motors</p> <p>LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED</p> <p>The following type test reports shall be submitted for each type and rating of LT motor of above 100 KW only</p> <div><div></div><div>1. Measurement of resistance of windings of stator and wound rotor.</div><div>2. No load test at rated voltage to determine input current power and speed</div><div>3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)</div><div>4. Full load test to determine efficiency power factor and slip</div><div>5. Temperature rise test</div><div>6. Momentary excess torque test.</div><div>7. High voltage test</div><div>8. Test for vibration severity of motor.</div><div>9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section)</div><div>10. Test for degree of protection and</div><div>11. Overspeed test.</div><div>12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1</div></div>		
10.03.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.		
10.04.00	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.		
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB SECTION-B-02 MOTORS	PAGE 5 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS																																
	<p style="text-align: center;">TABLE - I</p> <p style="text-align: center;">DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS</p> <table><tr><th>Motor MCR in KW</th><th>Minimum distance between centre of bottom terminal stud and gland plate in mm</th></tr><tr><td colspan="2">As per manufacturer's practice.</td></tr><tr><td>UP to 3 KW</td><td></td></tr><tr><td>Above 3 KW - upto 7 KW</td><td>85</td></tr><tr><td>Above 7 KW - upto 13 KW</td><td>115</td></tr><tr><td>Above 13 KW - upto 24 KW</td><td>167</td></tr><tr><td>Above 24 KW - upto 37 KW</td><td>196</td></tr><tr><td>Above 37 KW - upto 55 KW</td><td>249</td></tr><tr><td>Above 55 KW - upto 90 KW</td><td>277</td></tr><tr><td>Above 90 KW - upto 125 KW</td><td>331</td></tr><tr><td>Above 125 KW-upto 200 KW</td><td>385/203 (For Single core cables only)</td></tr></table> <p>For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.</p> <p>PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:</p> <p>NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:</p> <table><tr><th>Motor MCR in KW</th><th>Clearance</th></tr><tr><td>UP to 110 KW</td><td>10mm</td></tr><tr><td>Above 110 KW and upto 150 KW</td><td>12.5mm</td></tr><tr><td>Above 150 KW</td><td>19mm</td></tr></table>			Motor MCR in KW	Minimum distance between centre of bottom terminal stud and gland plate in mm	As per manufacturer's practice.		UP to 3 KW		Above 3 KW - upto 7 KW	85	Above 7 KW - upto 13 KW	115	Above 13 KW - upto 24 KW	167	Above 24 KW - upto 37 KW	196	Above 37 KW - upto 55 KW	249	Above 55 KW - upto 90 KW	277	Above 90 KW - upto 125 KW	331	Above 125 KW-upto 200 KW	385/203 (For Single core cables only)	Motor MCR in KW	Clearance	UP to 110 KW	10mm	Above 110 KW and upto 150 KW	12.5mm	Above 150 KW	19mm
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SUB-SECTION-B – 03

NOT USED

SUB-SECTION-B – 04

TRANSFORMERS AND ASSOCIATED EQUIPMENTS

This chapter has to be read in conjunction with sub-section B-0 "General electrical specification" of technical specification Section- VI, Part-B and Sub-Section-II B Electrical system/Equipment of Technical Specifications Section-VI, Part-A.

1.00.00 POWER TRANSFORMERS, AUXILLARY OIL FILLED TRANSFORMERS

1.01.00 TYPE & RATINGS (for continuous duty)

Sr. No.	TRANSFORMER	Tie Transformer (TT)	Generator Transformer (GT)	Auxiliary Transformer (including LT Outdoor)
i)	Rating (MVA)	As per system requirement/SLD/Sub section B-0, B-04		
ii)	Voltage Ratio (kV)	132/33	Generation Voltage/ 33	As per system requirement/SLD/B-0
iii)	Winding	2	2	2
iv)	Nos. of Phase	Three		
v)	Vector Group	As per system requirement/SLD/ B-0, B-04		
vi)	Cooling	ONAN/OFAF (80%/100%)	ONAN	ONAN
vii)	Tap Changer	As per system requirement/ Sub section B-0, B-04/SLD		
viii)	Impedance	As per system requirement/Sub section B-0, B-04/SLD		
	At 75°C			
	a) Principal Tap			
	b) Other Taps			
ix)	Permissible Temperature rise over an ambient of 50 deg C (irrespective of tap)			
	a) Top Oil by thermometer	50 °C	35 °C	50 °C (40 deg. C for up to & including 2.5MVA and 33KV rating)
	b) Winding by resistance	55 °C	40 °C	55 °C (45 deg. C for up to & including 2.5MVA and 33KV rating)
x)	Insulation level	As per chapter B-0, B-04 Part-B		
xi)	Earthing (Copper Flat)	Solidly Earthed	Solidly Earthed	As per system requirement/ Sub section B-0, B-04/SLD
xii)	Termination, SC withstand time & Fault Level	As per system requirement/ Sub section B-0, B-04/SLD a) Generator Transformer, Tie Transformer - 3 seconds (**) b) All other transformers- 2 seconds (**) - The indicated values of time durations are used in transformer design for ensuring thermal stability of the transformers and are to be proven through calculations.		

xiii)	Noise level	As per NEMA TR-1
xiv)	Loading Capability	Continuous operation at rated MVA on any tap with voltage variation of +/-10%, also transformer shall be capable of being loaded in accordance with IS 2026 part-7/ IEC 60076 part-7. In addition, GT shall be able to operate at full load for at least ten (10) minutes without exceeding the calculated winding hot spot temperature of 140°C in the event of complete failure cooling equipment applicable.
xv)	Air Core Reactance	At least 20% for HV winding for GT, TT
xvi)	Flux Density	Not to exceed 1.9 Wb/sq. m. at any tap position with +/-10% voltage variation from voltage corresponding to the tap. Transformer shall also withstand following over fluxing conditions due to combined voltage and frequency fluctuations:
		a) 110% for continuous rating.
		b) 125% for at least one minute.
		c) 140% for at least five seconds.
		Bidder shall furnish over fluxing char. up to 150% & 170 % for GT, TT

Note: -

1). Not used.

2). Not used.

3). LT Auxiliary transformers shall be 3 phase, 4 wire system with additional LVN bushing for equipment earthing.

1.02.00 NOT USED.**1.03.00** NOT USED.**1.04.00 CODES AND STANDARDS**


Transformers	IS:2026, IEC:60076, IS 1180
Bushings	IS:2099, IEC:60137
Insulating oil	IEC:60296
Bushing CTs	IS:2705, IEC 61869
Indian Electricity Act 2003, BEE Guideline & CEA notification	

1.05.00 OPERATIONAL REQUIREMENT**1.05.01 Transformers**

- a) Generator transformers, Tie Transformers shall be suitable for back charging. It shall be capable of being charged from HV side and kept charged continuously with no load on the LV side without any adverse impact on the transformer life.

Cooling requirements

- i) For GTs, Auxiliary Transformers: The radiators shall be detachable type, mounted on the tank. Each radiator shall be provided with a drain plug/valve at the bottom, an air release plug at the top, shut off valve at each point of connection to the tank.
- ii) TT: - Transformers shall be provided with detachable type tank mounted radiator banks with 100% cooling capacity. Cooling fans shall not be directly mounted on radiator bank which may cause undue vibration,

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<p>also fan shall be protected by galvanized wire guard. Each radiator bank shall have lifting lug, air release plug, top & bottom filling/shut-off valves, oil pumps (as applicable) & oil flow indicator (as applicable), filter valves, drain valve/plug etc. The number and capacity of cooling fans with radiator bank shall be such that outage of any fan does not reduce the continuous rating. Automatic operation/control of fans shall be provided (with temp. change) from contacts of winding temp. indicator.</p> <p>iii) The radiators shall be made of Hot Dipped Galvanized Steel conforming to ISO 12944-5:2018, Table D.1, System no. G5. 05 of paint and coating of the Table D.1.</p> <p>b) Other Requirement</p> <p>i) Phase to Earth clearances (132 kV): 1300 mm min.</p> <p>ii) Phase to Earth clearances (34.5 kV): 320 mm min.</p> <p>c) OLTC (as applicable)</p> <p>i) Local control, both manual and electrical</p> <p>ii) Remote electrical control with necessary relays (as required)</p> <p>iii) Safety interlocks and protection</p> <p>iv) Remote Tap position signal</p> <p>v) Tie-in resistors requirement, if any, may be confirmed and provided.</p> <p>d) Not used.</p> <p>e) LT Auxiliary outdoor transformers up to and including 2500 KVA, 33 kV shall have maximum losses of STAR-2 rating or better as per latest BEE guideline. The outdoor transformer up to 2500 KVA, 33 kV shall also comply with latest IS:1180.</p>	
1.05.02	Not used.	
1.06.00	DESIGN AND CONSTRUCTIONAL FEATURES	
1.06.01	NTPC may at their discretion have design review done to check the design of the transformers by NTPC/their consultant.	
1.06.02	<p>Tank</p> <p>a) Tank shall be of welded construction & fabricated from tested quality low carbon steel of adequate thickness.</p> <p>b) The main tank body including tap changer, radiators (except for Auxiliary transformers) shall be capable of withstanding full vacuum. Tank shall be provided with suitable lifting lugs, minimum 4 jacking pads & haulage holes</p>	
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for wheeling in all four directions. The GT Tank shall be preferably Bell type. Bell Type Tank bolted joint shall be at about 500 mm above bottom of the tank and shall have 4 nos. of lifting pads on bell Tank cover so as to lift it for rim gasket replacement.

- c) GT, TT & transformers located at Transformer yard shall be mounted on detachable type bi-directional rollers for rail gauge of 1676 mm. Auxiliary transformers shall have suitable bi-directional skids, however auxiliary transformers above 2 MVA shall be provided with four no. of bi-directional detachable flat rollers. Suitable locking arrangement shall be provided to prevent accidental movement of transformer.
- d) At least two adequately sized inspection openings, one at each end of the tank for easy access to bushings and earth connections & suitable manhole shall be provided.
- e) The base of each tank shall be so designed that it shall be possible to move the complete transformer unit by skidding in any direction without damage when using plates or rails and the base plate shall have following minimum thickness. (For GT, TT only)

Length of tank	Minimum Thickness (mm)
Flat bases Over 2.5 m but less than 5m	20
Flat bases Over 5 m but less than 7.5m	26
Flat bases Over 7.5 m	32

1.06.03

Core

Transformer	Requirement
GT, TT	Core shall be high grade, non-ageing, cold-rolled, super grain-oriented silicon steel laminations known as Hi B grade steels or equivalent. The insulation of core to tank, tank to clamp and clamp to core shall be able to withstand a voltage of 2 kV rms for 1 min in air. To facilitate testing of above during pre-commissioning stage, the core/clamp earthing has to be done outside the tank with suitable bushings.
Auxiliary Transformers	Core shall be high grade non-ageing cold rolled super grain oriented silicon steel laminations of M4 grade or better quality. The core isolation shall be able to withstand a voltage of 2 kV (rms.) for 1 minute in air.

1.06.04

Insulating oil

No inhibitors shall be used in the transformer oil. The oil supplied with transformers/reactor shall be new and previously unused and must conform to following while tested at supplier's premises and shall have following parameters.

S. No.	Property	Permissible values
1.	Kinematic Viscosity, mm ² /s	≤ 12 at 40 ° C ≤ 1800.0 at (-)30 ° C
2.	Flash Point, ° C	≥ 140° C
3.	Pour point, ° C	≤ (-)40 ° C
4.	Appearance	Clear, free from sediment and suspended matter
5.	Density kg/dm ³ at 20 ° C	≤ 0.895
6.	Interfacial Tension N/m at 25° C	≥ 0.04
7.	Neutralization value, mgKOH/g	≤ 0.01
8.	Corrosive sulphur	Non-Corrosive
9.	Water content mg/kg	≤ 30 in bulk supply ≤ 40 in drum supply
10.	Anti-oxidants additives	Not detectable
11.	Oxidation Stability -Neutralization value, mgKOH/g -Sludge, % by mass	≤ 1.2 ≤ 0.8
12.	Breakdown voltage As delivered, kV After treatment, kV	≥ 30 ≥ 70
13.	Dissipation factor, at 90° C And 40 Hz to 60 Hz	≤ 0.005
14.	PCA content	≤1%
15.	Impulse withstand Level, kVp	≥ 145
16.	Gassing tendency at 50 Hz after 120 min, mm ³ /min	≤ 5

Subsequently oil samples shall be drawn at:

Sr. No.	Parameters	Before filling in main tank at site & tested for	Prior to energization at site for following properties & acceptance norms:	Applicability
i)	BDV	60 kV (min)	60 kV (min)	Applicable for all Transformers
ii)	Moisture content	10 ppm (max.)	10 ppm (max.)	
iii)	Tan delta at 90 deg. C	0.005 (max.)	0.05 (max.)	Applicable for GT, TT
iv)	Interfacial tension	0.04 N/m(min)	0.035 N/m (min)	

1.06.05

Windings


The conductors shall be of Electrolytic grade copper. All Windings of 66 kV and below shall have uniform insulation. The contractor shall ensure that windings are made in dust proof & conditioned atmosphere. All windings shall have thermally upgraded paper covering insulation.


Winding paper moisture shall be less than 0.5%.


1.06.06

Oil preservation

Main tank and OLTC (if applicable) shall be provided with conservator tanks of adequate capacity for expansion of oil from minimum ambient to 100 deg. C.

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.06.07	<p>GT and equipment rated 7.5 MVA and above shall be provided with air bag breathing through indicating type cobalt free silica gel breather with transparent enclosure (refer fittings clause for breather type applicable for GT, TT). However conventional type conservator with indicating type cobalt free breather (transparent enclosure) shall be offered for transformer below 7.5 MVA.</p> <p>For GT, TT Conservator Protection Relay (CPR)/Air cell puncture detection relay shall be externally installed on the top of conservator to give alarm in the event of lowering of oil in the conservator due to puncture of air cell in service.</p> <p>Bushings</p> <p>(a.) The electrical & mechanical characteristics of bushings shall be in accordance with IS: 2099, IS: 3347, IS: 12676 & IEC: 60137.</p> <p>(b.) Bushings below 52 kV shall be with porcelain insulator and shall be of oil communicating / OIP (non-oil communicating type) / epoxy RIP type. All condenser bushings shall be non-communicating type.</p> <p>(c.) Bushings from 52kV up to 420 kV class (including 52 kV and 420 kV class), shall be RIP (Resin Impregnated Paper) Type with composite insulator. It shall be provided with Tap for Capacitance and Tan delta test. All composite resin impregnated bushings (RIP) shall be provided with provision for long term storage to protect from moisture and rodents. The oil side shall be provided with tank which can be filled with oil. Tank shall have necessary provision for oil filling, level gauge etc. Suitable covering to be provided on air side to protect from any damage. The arrangement shall be suitable for storage in horizontal/ vertical direction in outdoor location.</p> <p>(d.) The oil end dimension of RIP bushing shall be same for all bushings of similar voltage rating.</p> <p>(e.) All condenser bushings shall be non-communicating type.</p> <p>(f.) Condenser type bushings shall be provided with:</p> <ul style="list-style-type: none"> i) Oil level gauge ii) Oil filling plug iii) Tap for capacitance and Tan delta test <p>(g.) Clamps & fittings shall be of hot dip galvanized steel.</p> <p>(h.) Bushing & fittings shall be provided with vent pipes that shall be connected to route any gas collection through the Buchholz relay.</p> <p>(i.) No arcing horns shall be provided on the bushings.</p> <p>(j.) LV Bushing palm shall be Silver/Tin plated.</p> <p>(k.) Not used.</p>		
1.06.08	<p>Bushing CTs</p> <p>Shall be of adequate rating for protection as required, WTI etc. All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.09	<p>permitted. All CT terminals shall be provided as fixed type terminals on the M. Box to avoid any hazard due to loose connection leading to CT opening or any other loose connection in power circuit. In no circumstances Plug In type connectors shall be used for CT & Power connection.</p> <p>Tap changer (as applicable)</p> <ul style="list-style-type: none"> i) Measurement for Tan delta values of OCTC & OLTC to be done before installing in the 132 kV & above class transformer. ii) The OLTC chamber oil shall not come in contact with main tank oil. iii) Tap Changer drive marshalling box shall be provided for GT, TT, transformers (as applicable). iv) For GT, TT tap changer shall be provided with an analog signal (4-20 mA) for tap position of transformer. 			
1.06.10	<p>Marshalling box/ CCC (Cooler Control Cabinet)</p> <ul style="list-style-type: none"> i) For transformers 1 no. M. Box shall be provided for each unit. ii) Not used. iii) M. Box shall be of stainless steel (SS-316 or better), at least 2.5 mm thick, dust and vermin proof provided with proper lighting and thermostatically controlled space heaters. The degree of protection shall be IP 55. Marshalling Box of all transformers shall be preferably Tank Mounted. One dummy terminal block in between each trip wire terminal shall be provided. At least 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber. The gasket used shall be of neoprene rubber. Also Marshalling Box, CCC gland plate shall be at least 450 mm above ground level. iv) GT, TT shall be provided with two auxiliary power supplies, 415V, three phase, 4 wire shall be drawn from two separate boards for the M. Box/cooler control cabinet-CCC. In case of one power supply failure, loads shall be automatically transferred to other. The supplier shall derive AC feeders for OLTC cabinet (if applicable) after suitable selection at M. Box. No components (except heater & it's switch, light & sockets) shall be mounted on side & top wall of Marshalling Box e.g. relay, timer, contactors, MCBs. TBs etc. v) Each cooling fan and pump motor (as applicable) shall be provided with isolating switch, starter, thermal overload, single phase preventer and short circuit protection. For TT, all power contactor used for pump (as applicable) & fan motors shall be latch type. vi) The Automatic operation/control of fans/pumps (as applicable) shall be provided (with temp. change) from contacts of winding temp. Indicator. vii) For transformer, wiring scheme shall be engraved in a stainless steel plate with viewable font size and the same shall be fixed inside the Marshalling Box door. viii) TB shall be stud type for all CT & Power connections with ring type lugs. 			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>ix) Not used.</p> <p>x) Terminal block numbering for transformer shall be made in line with tender drawing no. 0000-203-PVE-B-001 respectively.</p> <p>1.06.11 Valves</p> <p>(a.) All valves up to and including 50 mm shall be of gun metal or of cast steel. Larger valves may be of gun metal or may have cast iron bodies with gun metal fittings.</p> <p>(b.) Sampling & drain valves should have zero leakage rate.</p> <p>1.06.12 Gaskets</p> <p>a) For GT, TT all the gasket shall be weather proof & hot oil resistant of 'O' ring of Nitrile rubber for all valves, flanges, HV, LV & Neutral Turrets, Bushings, Tank rim, etc. For this, all the flanges shall be machined. However, GT, LV turret to Tank joint shall be provided with "Fluor elastomers" cord gasket.</p> <p>b) For Auxiliary Transformers gasket shall be fitted with weatherproof, hot oil resistant, rubberized cork gasket.</p> <p>c) Not used.</p> <p>d) If gasket is compressible, metallic stops shall be provided to prevent over compression.</p> <p>e) The gaskets shall not deteriorate during the life of transformer if not opened for maintenance at site. All joints flanged or welded associated with oil shall be such that no oil leakage or sweating occurs during the life of transformer. The quality of these joints is considered established, only if the joints do not exhibit any oil leakage or sweating for a continuous period of at least 3 months during the guarantee period. In case any sweating / leakage is observed, contractor shall rectify the same & establish for a further period of 3 months of the same. If it is not established during the guaranteed period, the guaranteed period shall be extended until the performance is established.</p> <p>1.06.13 Transformer Transportation</p> <p>Transportation shall be N₂/Dry Air/Oil filled. GT, TT shall be transported with sufficient number (minimum two nos.) of impact recorders with necessary arrangement to maintain N₂/Dry air pressure (as applicable) during transit and storage.</p> <p>1.06.14 PAINTING</p>			
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PARTS NAME	TYPE OF PAINT	NO.OF COATS	TOTAL DFT
Inside of tank and accessories (except CCC, M Box)	Oil & heat resistant fully glossy white	One coat	At least 30 micron
External surface of transformer and accessories (except radiators)	Chemical resistant epoxy zinc phosphate primer, MIO (Micaceous iron oxide) as intermediate paint followed by polyurethane finish paint (RAL 5012 Blue)	One coat each	At least 100 micron
External Radiator surface	ISO 12944-5:2018, Table D.1, System no. G5.05 of priming and painting with high quality full glossy outer finish paint (RAL 5012 Blue)	As per ISO 12944-5:2018, Table D.1, System no. G5.05	As per ISO 12944-5:2018, Table D.1, System no. G5.05
Internal Radiator surface	Hot oil proof, low viscosity varnish and subsequent flushing with transformer oil	---	---

1.07.00 Monitoring System of GT, TT

The supervision, control and communication of various operating conditions and condition monitoring of GT, TT shall be done through SAS/DCS/plant control system.

1.08.00 Neutral Earthing Arrangement

- i) In case of Generator Transformers, neutral shall be solidly grounded via 2 nos. copper flats.
- ii) The neutral of transformers shall be brought through insulated support from tank to the ground level at a convenient point with copper flat, for connection to ground network (as applicable). However neutral may be connected to NGR (Neutral Grounding Resistor) as per system requirement.

1.09.00 NGR (Neutral Grounding Resistor) (As per system requirement)

1.	Resistance at 50°C	As per system requirement
2.	Rated current	600A for 10 seconds
3.	Application	Neutral Grounding of Transformers as per system requirement
4.	Service	Outdoor
5.	Resistor material & connection	Punched stainless steel grid element type

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC
6.	Max allowable temp rise over amb. of 50°C	350 deg. C	
7.	Mounting	As per system requirement	
8.	Power frequency level	As per system requirement	
9.	Stacking	Various sections comprising the neutral grounding resistor shall be capable of being stacked one above the other.	
10.	Enclosure	NGR shall be housed in a 2.5 mm thick sheet steel enclosure & DOP IP-33. A heating circuit with Thermostat to be provided inside the enclosure to control humidity.	
11.	Mounting Structure	The Contractor shall supply and erect a galvanized structure to support the NGR enclosure so that the base of the enclosure shall be at a minimum height of 2.4M above ground level.	
1.10.00 FITTINGS Following fittings shall be provided with Transformers covered under this specification.			
a) b) c) d) e) f)	-Conservator for main tank with MOG (with low oil level alarm contact), drain valve & indicating type Cobalt free breather with transparent enclosure (maximum height 1400 mm above rail level) etc. Aircell (for GT and transformers 7.5 MVA & above). -Conservator for OLTC tank with Oil level gauge, indicating type Cobalt free Breather & drain valve.		
	-Bucchoz relay (magnetic type), double float type with alarm and trip contacts (with plug & socket type arrangement), along with suitable gas collecting device. - Oil surge relay to be provided for OLTC.		
	- For 2 MVA & above rating transformer/reactor, minimum two numbers of spring-operated PRD (with trip contacts with plug & socket type arrangement) with suitable discharge arrangement for oil shall be provided. Armored cable be used between PRD to Marshalling box. PRD shall have DOP of IP-67. Plug-in type connector shall be provided for proper sealing for terminating cables/ glands. - For transformers below 2 MVA, diaphragm type explosion vent shall be provided.		
	OTI & WTI shall be 150 mm dial type with alarm and trip contacts with max. reading pointer & resetting device. (maximum height 1500 mm above rail level) For GT, TT WTI shall be provided for all windings, also PT-RTD with 4-20 mA signals shall be provided with OTI & WTI of these transformers.		
	Top & bottom filter valves with threaded male adapters, bottom sampling valve, drain valve/sludge removal valve at the bottom most point of the tank.		
	Air release plug, bushing with metal parts & gaskets, terminal connectors		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>																				
	<table><tr><td></td><td>on bushings (as applicable).</td></tr><tr><td>g)</td><td>Prismatic/toughened glass oil gauge for transformers and OLTC chamber.</td></tr><tr><td>h)</td><td>Followings items are as applicable:- Bi-directional wheel & skids, M. Box, OLTC, OCTC, Bushing CTs, Insulating Oil, Cooling equipment, Valve Schedule Plate.</td></tr><tr><td>i)</td><td>Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs, additional 4 nos. lifting lugs for bell tank cover, inspection cover, manhole, Bilingual R&D Plate, Terminal marking plates, two earthing terminals etc.</td></tr><tr><td>j)</td><td>Bolts & nuts (exposed to atmosphere) shall be galvanized steel/SS.</td></tr><tr><td>k)</td><td>Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed.</td></tr><tr><td>l)</td><td>1 no. Rapid Pressure Rise relay for each GT, TT.</td></tr><tr><td>m)</td><td>OLTC conservator breather shall be provided with conventional non-carcinogenic indicating type breather.</td></tr><tr><td>n)</td><td>-Online moisture removal system (1 for each TT) - For each GT, TT: - Conservator aircell rupture relay.</td></tr><tr><td colspan="2">The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the transformers) are deemed to be included.</td></tr></table>				on bushings (as applicable).	g)	Prismatic/toughened glass oil gauge for transformers and OLTC chamber.	h)	Followings items are as applicable:- Bi-directional wheel & skids, M. Box, OLTC, OCTC, Bushing CTs, Insulating Oil, Cooling equipment, Valve Schedule Plate.	i)	Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs, additional 4 nos. lifting lugs for bell tank cover, inspection cover, manhole, Bilingual R&D Plate, Terminal marking plates, two earthing terminals etc.	j)	Bolts & nuts (exposed to atmosphere) shall be galvanized steel/SS.	k)	Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed.	l)	1 no. Rapid Pressure Rise relay for each GT, TT.	m)	OLTC conservator breather shall be provided with conventional non-carcinogenic indicating type breather.	n)	-Online moisture removal system (1 for each TT) - For each GT, TT: - Conservator aircell rupture relay.	The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the transformers) are deemed to be included.	
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1.11.00	Testing Requirements																						
1.11.01	<p>Apart from the type test listed in this specification, following components to be supplied shall be of tested design and submit the reports for approval.</p> <p>(a.) All type tests on 132 KV and above Bushings as per IEC 60137.</p> <p>(b.) All type test on OLTC as per IEC 60214 (wherever applicable)</p> <p>(c.) Neutral Grounding Resistors (as applicable)</p> <p>(d.) Tank Vacuum and Pressure test (For GT and Auxiliary Transformers)</p>																						
1.11.01a	<p>Type tests criteria for auxiliary oil filled transformers rated up to 16 MVA, 11 kV (only type test report has to be submitted)</p> <p>A) The Type Test reports should be of a transformer which is generally similar to the transformer being offered as per IEC 60076-5, Annexure-B and also identical to the offered transformer in the following aspects:</p> <p>i) Voltage ratio</p> <p>ii) MVA/KVA rating</p> <p>iii) Percentage Impedance</p>																						
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	<div>iv) Internal design v) Type of tap changer equipment vi) Cooling arrangement vii) Temperature rise viii) Individual and total loss values of the offered transformer shall be same as that indicated in the GTP of transformer for which Type Test Reports are submitted.</div> <div>B) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.</div>																																												
1.11.02	Each transformer shall be completely assembled with all fittings & accessories meant for the particular transformer before offering for inspection & testing by Employer.																																												
1.11.03	ROUTINE / TYPE TESTS ON TRANSFORMERS :																																												
	I) ROUTINE TEST																																												
	<table><tr><th>S. N.</th><th>Transformer Type</th><th>TT (3-PH)</th><th>GT (3-PH)</th><th>Auxiliary Trans.</th></tr><tr><td></td><td>Voltage Class</td><td>132 kV Class</td><td>34.5 kV Class</td><td>Um ≤ 72.5kV</td></tr><tr><td>1.</td><td>All routine test in accordance with IEC 60076 shall be carried out in all the transformers.</td><td>√</td><td>√</td><td>√</td></tr><tr><td>2.</td><td>Measurement of Voltage Ratio & phase displacement (as per IEC 60076-1)</td><td>√</td><td>√</td><td>√</td></tr><tr><td>3.</td><td>Measurement of winding resistance on all the taps (as per IEC 60076-1)</td><td>√</td><td>√</td><td>√</td></tr><tr><td>4.</td><td>Vector group and Polarity Check (as per IEC 60076-1)</td><td>√</td><td>√</td><td>√</td></tr><tr><td>5.</td><td>Magnetic Balance and Magnetizing Current Test</td><td>√</td><td>√</td><td>√</td></tr><tr><td>6.</td><td>Measurement of no-load current with 415 V, 50 Hz AC supply</td><td>√</td><td>√</td><td>√</td></tr></table>	S. N.	Transformer Type	TT (3-PH)	GT (3-PH)	Auxiliary Trans.		Voltage Class	132 kV Class	34.5 kV Class	Um ≤ 72.5kV	1.	All routine test in accordance with IEC 60076 shall be carried out in all the transformers.	√	√	√	2.	Measurement of Voltage Ratio & phase displacement (as per IEC 60076-1)	√	√	√	3.	Measurement of winding resistance on all the taps (as per IEC 60076-1)	√	√	√	4.	Vector group and Polarity Check (as per IEC 60076-1)	√	√	√	5.	Magnetic Balance and Magnetizing Current Test	√	√	√	6.	Measurement of no-load current with 415 V, 50 Hz AC supply	√	√	√				
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S. N.	Transformer Type	TT (3-PH)	GT (3-PH)	Auxiliary Trans.
	Voltage Class	132 kV Class	34.5 kV Class	Um ≤ 72.5kV
7.	Measurement of no load losses and current at 90%, 100% & 110% of rated voltage (as per IEC 60076-1)	√	√	√
8.	Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps	√	√	√
9.	Insulation resistance measurement & Polarization Index (As per IEC 60076-1)	√	√	√
10.	core isolation (core-clamp, clamp-tank, core-tank)	√	√	X
11.	Measurement of capacitance & tan delta between winding to earth and between windings. (For 33 kV & above class transformer, tan delta should not exceed 0.5% at 20 °C, also refer Note-iii below)	√	√	√
12.	Dielectric tests shall be carried out as per IEC 60076-3.	√	√	√
13.	Applied Voltage Withstand Test (as per IEC 60076-3)	√	√	√
14.	Lightning impulse (Full & Chopped Wave) test on windings (as per IEC 60076-3)	√	X	X
15.	Lightning impulse test on Neutral terminals.	X	X	X

S. N.	Transformer Type	TT (3-PH)	GT (3-PH)	Auxiliary Trans.
	Voltage Class	132 kV Class	34.5 kV Class	Um ≤ 72.5kV
16.	Switching impulse test (as per IEC 60076-3)	X	X	X
17.	IVPD test as per IEC 60076-3 shall be conducted (for U1 & U2 level refer Note & Table given below)	√	X	X
18.	LTAC test as IEC 60076-3 (also refer Table given below)	√	X	X
19.	Induced overvoltage test	√	√	√
20.	Repeat no load current/loss measurement & IR after completion of all electrical test	√	√	√
21.	Oil leakage test on completely assembled transformer along with unit coolers/ radiators (as per relevant clause of this sub section)	√	√	√
22.	Jacking test followed by D.P. test	√	√	√
23.	Frequency Response Analysis test	√	√	X
24.	Marshalling Box/Cable box: It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.	√	√	√
25.	Insulation resistance measurement on wiring of Marshalling Box.	√	√	√
26.	Temperature Rise test at a tap corresponding to maximum losses and at minimum 110 % of rated current of corresponding tap. Gas chromatography shall be conducted	X	√**	X

S. N.	Transformer Type	TT (3-PH)	GT (3-PH)	Auxiliary Trans.
	Voltage Class	132 kV Class	34.5 kV Class	Um ≤ 72.5kV
	on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IEC:61181. Infra-red thermography shall be done during temp rise test, same needs to be measured during last hour of oil rise stabilization. Result shall be recorded for future reference.			
27.	Measurement of power taken by the fans and oil pumps	X	X	X
28.	Measurement of insulation power factor and capacitance of bushings	√	X	X
29.	Tan delta of bushing at variable frequency (Frequency Domain Spectroscopy)	√	X	X
30.	Check of the ratio and polarity of built-in current transformers	√	√	X
31.	Short duration heat run test (Not applicable for unit on which temperature rise test is performed)	√	X	X
32.	Not used.	X	X	X
33.	Measurement of dissolved gases in dielectric liquid	√	√	X
34.	Test on On-load tap changer (Tap changer fully assembled on the transformer)	√	√	X
35.	Appearance, construction, and dimension check	√	√	√

II) TYPE TEST (#)

S. N.	Transformer Type	TT (3-PH)	GT (3-PH)	Auxiliary Trans.
	Voltage Class	132 kV Class	34.5 kV Class	Um ≤ 72.5kV
1.	Not Used	X	X	X
2.	Lightning impulse(Full & Chopped Wave) test on windings (as per IEC 60076-3)	X	√	√
3.	Lightning impulse test on Neutral	√	√	√*
4.	Short circuit test (special test) as per IEC 60076-5. In addition, For GT, TT :- i) DGA & FRA shall also be conducted before & after S.C. test. ii) Physical inspection of transformer to be done before S.C. Test in presence of NTPC inspector and photographs to be taken for reference.	√	√	√
5.	Temperature Rise test at a tap corresponding to maximum losses. Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599). For ST, DGA results shall be	√	X	√

S. N.	Transformer Type	TT (3-PH)	GT (3-PH)	Auxiliary Trans.
	Voltage Class	132 kV Class	34.5 kV Class	Um ≤ 72.5kV
	interpreted as per IEC 61181.			
6.	Zero sequence impedance measurement test (Special test)	√	√	X
7.	Measurement of power taken by the fans & pumps (as applicable)	√	X	X
8.	Measurement of harmonics of no load current (special test)	√	√	X
9.	Measurement of acoustic noise level as per NEMA TR-1 (special test)	√	√	√
10.	Measurement of transferred surge on LV due to HV lightning impulse and IV (as applicable) lightning impulse	X	√	X
11.	Not used	X	X	X
12.	Not used.	X	X	X

NOTE:-

- (#) All the type/special tests & temperature rise test shall be conducted after performing Short Circuit Test. If Tank Vacuum & Pressure Test is to be carried out then it shall be conducted before SC test.
- (√) mark indicates test to be carried out and (X) mark indicates test need not to be carried out.
- The power factors should not exceed 0.5% (at 20 °C). However, in case of deviation from limiting values the same shall be resolved in line with IEEE Std-62.
- (*) this test is applicable on Transformer neutral earthed thru NGR.
- For IVPD Test U1 & U2 are as follows: -
 - U1(Enhancement Voltage) = $1.8U_m/\sqrt{3}$, U2(PD measurement voltage)= $1.6U_m/\sqrt{3}$ (for $U_m < 400$ kV)
- **During Infra-red thermography test of GT, the temperature of any part of tank shall be limited to 110 deg C.
- For TT: Dynamic short circuit withstand test shall be conducted on one unit of each type and rating of transformers, to validate the design and quality, unless such test has been successfully conducted as per Indian Standard 2026 part 5 within last ten years on transformer of similar design. Criteria for similar design shall be as per Annexure J of Central Electricity Authority's "Standard Specifications and Technical Parameters for Transformers and Reactors (66kV and above)", in line with latest "Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022".

Table-1	
Test	IVPD
Max allowed change in PD after voltage enhancement	100 pC
The background noise level shall not exceed 50 pC.	

Table-3 Test Voltage for LTAC

Highest System Voltage (Um)	145 kV
U1 (LTAC Voltage level)	275 kV

1.11.04 **Not used.**1.11.05 **TANK TESTS****(a) Routine tests****(1) Oil leakage test on assembled transformers**

All tank and oil filled compartment shall be tested for oil tightness by being completely filled with oil of viscosity not greater than that of specified oil at the ambient temperature and applying pressure equal to the normal pressure plus 35 kN/m² measured at the base of the tank. The pressure shall be maintained for a period of not less than 6 (six) hours during which time no sweating shall occur. For GT, TT this test shall be repeated as a pre-commissioning test at site for 24 hours.

(2) Vacuum test

For TT tank shall be subjected to the specified vacuum. The tank designed for full vacuum shall be tested at an internal pressure of 3.33 kN/m² absolute (25 torr) for one hour. The permanent deflection of the plate after the vacuum has been released shall not exceed the values specified below:


Horizontal Length of Flat Plate (in mm)	Permanent deflection (in mm)
Up to and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.5
2001 to 2250	11.0
2251 to 2500	12.5
2501 to 3000	16.0
Above 3000	19.0

(2) Pressure Test

For TT tank shall be subjected to a pressure corresponding to twice the normal head of oil or to the normal pressure plus 35 kN/m² whichever is lower, measured at the base of the tank and maintained for eight hour. The permanent deflection of the plates after the excess pressure has been released shall not exceed the figure specified above for vacuum test.

(b) Type tests

For GT and Auxiliary Transformers Vacuum and Pressure tests shall be type tests. Pressure and Vacuum tests shall be carried out as per procedure mentioned in the above Tank tests-routine

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	<p>test clause for TT. However, Pressure test shall be conducted for one hour duration only.</p> <p>1.11.06 NEUTRAL GROUNDING RESISTANCE (NGR) TESTING (as applicable)</p> <p>(a.) The following routine tests shall be conducted on each resistor provided with transformer covered in this section.</p> <p>(1.) Ohmic value measurement (For resistance & reactance separately). (2.) Insulation resistance measurement before & after HV test (3.) HV test for 1 min. at a voltage corresponding to the insulation level of the resistor.</p> <p>(b.) DOP test on enclosure (routine test): It shall not be possible to insert a 2.5mm dia steel wire into the enclosure from any direction without using force.</p> <p>(c.) Short time current test along with temperature rise test (type test).</p> <p>(d.) Degree of protection test for IPX3 on enclosure (type test).</p> <p>1.12.00 Commissioning Checks</p> <p>Apart from general & prescribed commissioning checks following additional checks shall also be performed on GT, TT: -</p> <ol style="list-style-type: none"> 1. FRA Test 2. Core isolation test 3. DGA test <p>1.13.00 Initial Operation for Transformers</p> <p>a) Continuously observe the transformer operation at no load for 24 hrs. w.r.t. Voltage, no load current, temperature rise and noise.</p> <p>b) Gradually put the transformer on load, check and measure increase in temperature in relation to the load and check the operation with respect to temperature rise and noise level etc.</p> <p>c) For GT, TT Infrared thermography shall be done after 12 hours of full load operation and results will be recorded for future reference.</p> <p>1.14.00 Installation and movement of spare GT on site</p> <p>The spare transformer shall be erected and prepared for long term storage as well as for the rapid transfer of this unit into a service position as approved by the Owner.</p>	
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1.15.00	TRANSPORTATION <p>The contractor shall be responsible to select and verify the route, mode of transportation and make all necessary arrangement with the appropriate authorities for the transportation of the equipment. All metal blanking plates and covers which are specifically required to transport the transformer shall be considered part of the transformer and handed over to NTPC after completion of the erection. The total duration of storage at site with dry gas shall be limited to three (03) months after which transformer/reactor shall be processed and filled with oil.</p> <p>The scope of any necessary modification/ extension/ improvement to existing road, bridges, culverts etc. shall be included in the scope of the bidder.</p> <p>NOTE: Despite all condition monitoring done by the Owner, the Contractor shall be responsible to obtain all required inputs such as DGA to evaluate the Transformer. The guarantee and costs of any repair done under the guarantee shall not be affected by any condition monitoring done or not done by the Owner during the guarantee period. A full DGA test shall be completed at the end but before expiry of the guarantee period.</p>			
1.16.00	Not used.			
2.00.00	NOT USED.			
3.00.00	MAINTENANCE, TESTING & MONITORING EQUIPMENTS			
1.	Not used.			
2.	Oil BDV Measurement kit.	Automatic oil testing unit for checking BDV of transformer oil upto 80kV.	1 No.	
3.	Oil tan delta and resistivity measurement kit.	Suitable for measurement of Volume resistivity, Di-electric constant, Watt loss, loss factor with elevated temperature read out for transformer oil.	1 No.	
4.	Nitrogen Dew point meas. instrument.		1 No.	
5.	FRA Test Kit		1 No.	
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6.	Capacitance & Tan delta measurement Equipment (with cables etc.)	0-10kV (Fully Automatic)	1 No.
7.	Transformers turns ratio Kit	Display of ratio & phase angle deviation.	1 No.
8.	Winding Resistance measurement kit		1 No.
9.	Off Line laboratory model oil DGA kit.		1 No.
10.	Hydraulic jacking system	Suitable for lifting / wheel rotation for heaviest oil filled Transformer.	1 No.
11.	On Line Moisture Removal System	TT	One for each TT
12.	Not used.		
13.	Oil Purifying Equipment	1,000 Litres / hr.	1 No.
14.	Vacuum pump with motor, pipes & accessories	Free air displacement of 3040L/min, Ultimate pressure of 0.7PA & Blank off vacuum of 0.01torr.	1 No.
15.	Not used.		
16.	Oil tanker, wheel mounted, 5kL capacity	5kL Capacity	2 Nos.
17.	Not used.		

3.01.00 NOT USED**3.02.00 ON LINE MOISTURE REMOVAL SYSTEM**

Each TT shall be equipped with "Online Moisture Removal System". The system shall be fitted in an enclosure. Oil Moisture measurement probe shall be provided with "Online Moisture Removal System". Alarm / status information shall be appropriately wired up to the M. box through for monitoring in SAS/DCS/plant control system.

3.03.00 FREQUENCY RESPONSE ANALYSER**3.03.01 TECHNICAL PARAMETERS**

a)	Test Method	:	Sweep Frequency Response Analysis
b)	Frequency Range	:	10 Hz to 10 MHz
c)	Provision of selection of user defined frequency range within above frequency range.		
d)	Accuracy	:	(+/-)1 dB
e)	Operating Voltage	:	230 V, 50 Hz
f)	Built in self-calibration.		
g)	Equipment shall be able to display and plot frequency Vs magnitude and frequency Vs phase angle curves.		
h)	Equipment shall be complete in all respect with all-necessary cables, printer, Floppy/CD drive etc.		
i)	Suitable for use at 50 deg. C ambient temperature & 85% relative humidity.		
j)	The instruments & cable shall be designed to ensure repeatable measurement confirming to relevant international standard.		

3.03.02 GENERAL TECHNICAL REQUIREMENT FOR FRA

Employer intends to do condition assessment of transformers using the frequency response technique. The equipment should broadly consist of variable frequency voltage source, network analyzer, necessary software and cabling, Equipment shall be portable and shall be capable of onsite use.

3.04.00 HYDRAULIC JACKING SYSTEM

This shall be minimum four jack systems having motor operated synchronous operation suitable for lifting/wheel rotation of heaviest Oil filled power transformers in this package. System shall be complete in terms of piping, hydraulic system and associated auxiliaries.

3.05.00 CAPACITANCE & TAN DELTA MEASURING EQUIPMENT


3.05.01 Capacitance & tan delta measuring equipment (with cables etc.) (0-10 kV) (fully automatic) with necessary software, display arrangement & transportation accessory.

3.06.00 HIGH VACUUM TYPE OIL PURIFYING EQUIPMENT

3.06.01 TECHNICAL PARAMETERS

a) Capacity	1,000 litres/hr
b) Type	Weather proof mobile and outdoor type high vacuum oil filtration plant.
c) Processing temperature (direct heating of oil prohibited)	60 °C (max.)
d) Capability of plant on a single pass basis	
i) Removal of moisture	From 100 ppm to 3 ppm
ii) Removal of dissolved gas content	From 10% by vol. to 0.1% by Vol.
iii) Improvement of dielectric strength	From 20 kV to 70 kV
e) Filtration pore diameter	0.5 microns or less

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	f) Vacuum pumping system	Two independent vacuum pumping combination, one for degassing chamber and other for transformer oil evacuation and creating high vacuum in tank. The blank off vacuum of each pumping system shall be 10 ⁻³ torr or less.	
	g) Operating voltage	440/400 Volt, 50 Hz, 3 phase, 4 wire supply.	
3.07.00	OIL TAN DELTA AND RESISTIVITY MEASUREMENT KIT		
	<div>a) Suitable for measurement of Volume Resistivity, Di-electric constant, Watt loss, loss factor with elevated temperature read out for transformer oil.</div> <div>b) AC and DC voltage to be switched internally for tan delta and resistivity measurement respectively.</div> <div>c) The kit should be microprocessor based with display of test voltage and measured values.</div> <div>d) RS 232 computer interface and test report-printing facility.</div> <div>e) Oil cell and heating chamber to be supplied along with the test set.</div>		
3.08.00	OIL BDV MEASUREMENT KIT		
	<div>a) Automatic oil testing unit for checking BDV of Transformer oil up to 80kV.</div> <div>b) The kit should be suitable for laboratory use.</div> <div>c) The kit should be fully automatic with sequence control.</div> <div>d) Separate voltmeter for calibration of kit should be supplied.</div> <div>e) The results should be stored in memory for subsequent retrieval.</div> <div>f) Separate printer should be available for printing test results.</div> <div>g) The kit should be able to test oil as per BS5730, IEC156, ASTM test standard.</div> <div>h) Basic accuracy desirable is 3%.</div>		
3.09.00	TRANSFORMER TURNS RATIO (TTR) MEASUREMENT KIT		
	<div>a) Microprocessor controlled fully automatic test set.</div> <div>b) Automatic measurement and digital display of ratio, phase angle deviation.</div> <div>c) Automatic polarity indication.</div> <div>d) Light weight and portable.</div> <div>e) Three-phase ratio and excitation current meter.</div> <div>f) Automatic data storage of tests and reports generation.</div>		
3.10.00	VACUUM PUMP WITH MOTOR, PIPES & ACCESSORIES FOR EVACUATING VACCUM IN TRANSFORMER		
3.10.01	Technical Parameters		
	<div>a) Free air displacement: Minimum 3000 L/min,</div> <div>b) Ultimate pressure : 0.7PA</div> <div>c) Blank off vacuum : 0.01 torr</div>		
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	B-04: TRANSFORMERS AND ASSOCIATED MAINTENANCE, MONITORING & TESTING EQUIPMENTS PAGE 23 OF 26

CLAUSE NO.	TECHNICAL REQUIREMENTS	
3.11.00 –	<p>NITROGEN DEW POINT MEASUREMENT INSTRUMENT</p> <p>a) Dew point range: -50°C to +20 °C b) Accuracy : $\pm 3^{\circ}\text{C}$ c) Operating Temperature range: 0°C to +50 °C d) Data storage & transfer facility via RS 232/ Equivalent port e) Instrument & probe shall be supplied along with casing.</p> <p>3.12.00 WINDING RESISTANCE MEASUREMENT KIT</p> <ol style="list-style-type: none"> 1. Microprocessor controlled fully automatic operation. 2. Wide range of test current (minimum current of 50A). 3. Suitable for operation in EHV Switchyard condition. 4. Protection circuit for suppression of induced voltage kickback. 5. Display of resistance vs time curve. 6. Computer and printer interface. 7. Lightweight and portable. 8. The kit should safely dissipate the energy stored in the transformer after test. <p>3.13.00 OFF LINE LABORATORY MODEL OIL DGA KIT</p> <p>3.13.01 Power supply : 240 V $\pm 15\%$, 50Hz $\pm 5\%$, AC, Single Phase</p> <p>3.13.02 Compatibility : IEC-60567/ASTM D 3612 Method-C (with auto-sampler)</p> <p>3.13.03 Main Frame : Complete with gas extraction, injection port; column, oven, TCD-Detector, gas flow regulation, measurement system & related electronics, PC with latest configuration, Color Monitor, Printer.</p> <p>(a.) Injection System:</p> <p>Dual column injection system with provision for introducing sample range from 1 to 5 ml. The sample volume must be reproducible such that successive runs agree within 1 mm or 1% (which ever is larger) on each component peak height.</p> <p>(b.) Injection Temp:</p> <p>50°C to 400°C in 1 °C increment.</p> <p>(c.) Drier :</p> <p>Ahead of sample inlet to remove complete moisture with removal of components.</p> <p>(d.) Oven :</p> <p>Should have sufficient space to house the analytical columns & reference columns. The oven shall be equipped with precise temperature control and measurement system to maintain the columns within $\pm 1^{\circ}\text{C}$ of the specified temperatures even during temperature programmed runs. The oven should be capable of maintaining temperatures 10°C above ambient to 400°C.</p> <p>It should have also the following features:</p> <p>(e.) Column over heat protection: user can set up to 400°C.</p> <p>(f.) Temperature Programmer: Rate from 1°C to 45 °C/min. 3 ramps with initial and final holds.</p> <p>(g.) Automatic cooling under process control.</p>	
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ± 5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B	B-04: TRANSFORMERS AND ASSOCIATED MAINTENANCE, MONITORING & TESTING EQUIPMENTS PAGE 24 OF 26

- (h.) 6 port valve: A six way flanged PTFE of equivalent plug to permit the use of either the absorption or partition column and for reversing the carrier flow and another six port valve for gas sampling.

Note: Any other valve configuration depending upon the types of columns configuration offered may also be supplied.

- (i.) Columns :

10 ft x 1/8"	Poropak N (80/100 mesh)
3 ft x 1/8"	Molecular sieve 13 x (45/60 mesh)

- (j.) Detection Limits

H ₂	10 PPM
C ₂ H ₄ , C ₂ H ₆ , C ₂ H ₂ , C ₃ 's	1 PPM
CO ₂ , CO	25 PPM

Note: Any other column configuration suitable for the complete analysis of the transformer oil may be supplied.

- (k.) Detector: Thermal conductivity detector or equivalent in range, sensitivity and stability.

- (l.) TCD : It should have the following features :

- (1.) Operating temp. : 100°C to 350°C in 1 °C increment.
- (2.) Linearity: above 105 range

- (m.) Carrier gas flow system: The equipment shall be equipped with EPC to provide a flow of carrier gas through columns at a flow that is constant to 1% throughout even during temperature programming.

- (n.) Auto Sampler: System shall be able to extract gas automatically and transfer to GC unit.

3.13.04 The equipment shall be equipped with dual flow, dual column system. The inlet pressure and flow rate of the carrier gas should be controlled by electro pneumatic control as well as through data processor with digital and screen display of the pressure and the flow rates.

3.13.05 Equipment should have provision of operation with PC (with latest configuration) with Interface IEEE 488-GPIB or RS 232 c Serial Interface of LAN card. The computer should be with latest configuration having Deskjet Colour Printer with IFT Colour Monitor.

3.13.06 Software : The system should have the current windows based software with function of calibration, recalibration, Data storage, re-slope, display of recommended condition.

3.13.07 Accessories: All other accessories required for independent operation of the equipment.

i. Operation Manual

ii. Service Manual

iii. For routine maintenance of the equipment other requirements :

- The equipment must be installed/commissioned and also demonstrated for all features specified by the supplier/their authorized agent.


3.13.08 1 no. of oil sampling vessel shall be provided.

3.13.09 Certified Calibration gas standard(for calibration of gas Chromatograph)


CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>																														
	<table><tr><td colspan="2">Composition:</td></tr><tr><td>H2</td><td>100 PPM</td></tr><tr><td>CH4</td><td>100 PPM</td></tr><tr><td>CO</td><td>100 PPM</td></tr><tr><td>CO2</td><td>1000 PPM</td></tr><tr><td>Ethylene</td><td>100 PPM</td></tr><tr><td>Ethane</td><td>100 PPM</td></tr><tr><td>Acetylene</td><td>10 PPM</td></tr><tr><td>Propane</td><td>100 PPM</td></tr><tr><td>Propylene</td><td>100 PPM</td></tr><tr><td>To be supplied in 3 liter water capacity carbon steel or aluminum cylinder filling pressure:</td><td>120 Kg/Cm² (approximately) or 0.5 liters aluminium container, 20 Kg/Cm2</td></tr><tr><td>Stability</td><td>The standard supplied should have at least 1 Year stability</td></tr><tr><td>Certificate</td><td>The standard should carry a certificate which is should be traceable to NIST standard.</td></tr><tr><td>Preparation Tolerance</td><td>±20%</td></tr><tr><td>Certification Accuracy</td><td>±2%</td></tr></table>				Composition:		H2	100 PPM	CH4	100 PPM	CO	100 PPM	CO2	1000 PPM	Ethylene	100 PPM	Ethane	100 PPM	Acetylene	10 PPM	Propane	100 PPM	Propylene	100 PPM	To be supplied in 3 liter water capacity carbon steel or aluminum cylinder filling pressure:	120 Kg/Cm ² (approximately) or 0.5 liters aluminium container, 20 Kg/Cm2	Stability	The standard supplied should have at least 1 Year stability	Certificate	The standard should carry a certificate which is should be traceable to NIST standard.	Preparation Tolerance	±20%	Certification Accuracy	±2%
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3.14.00	OIL TANKER, WHEEL MOUNTED, 5 KL CAPACITY																																	
3.14.01	The tanker manufacturing shall be as per BS-2594.																																	
3.14.02	The oil tanker shall be capable of withstanding vacuum of 10mbar and 0.4kg/cm2 pressure.																																	
3.14.03	Painting Requirements																																	
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3.14.04	Four numbers of gate valve shall be provided on one pair of opposite sides of the tank attached on top & bottom of the tank.																																	
3.14.05	Oil level gauge is to be provided on the tank to see the level of oil.																																	
3.14.06	The tanker is to be mounted on tubeless wheeled platform for easy movement.																																	
3.14.07	Suitable arrangement for hauling the tanker in either forward/reverse direction is to be provided.																																	
3.14.08	Circular manhole is to be provided at middle of the roof of the tanker.																																	
3.14.09	Provision for Nitrogen filling to be provided along with nitrogen pressure gauge for measuring upto 1kg with least count of 0.01.																																	
3.14.10	Indicating Type Cobalt free silica gel breather (transparent body) shall be provided.																																	
3.15.00	NOT USED.																																	
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SUB-SECTION-B – 05A

MV SWGR (SWITCHGEAR)

CLAUSE NO.	TECHNICAL REQUIREMENTS																																															
1.00.0	GENERAL TECHNICAL REQUIREMENTS																																															
1.01.00	<p>The Technical specifications cover the detailed requirements for design, manufacturing supply, installation, testing and commissioning of Metal Enclosed SF6 Gas Insulated 33KV Switchgear. The switchgear shall be an indoor gas-insulated metal enclosed cubicle design confirming to IEC 62271-200 with Single bus bar system configuration (as shown in Tender SLD) having following:</p> <ul style="list-style-type: none">➤ Separate compartment for critical equipment (Busbar, Disconnecter/Earthing Switch/Circuit Breaker) to be provided. Minimum two compartments for each GIS panel/ bay.➤ All critical equipments (Busbar, Disconnecter/Earthing Switch, Circuit Breaker shall be hermetically sealed.➤ Busbar, Disconnecter/Earthing Switch and circuit breaker/Interrupter shall be placed inside gas environment. <p>Requirement for protection, control & monitoring and metering are specified in other relevant chapters in the Technical specification. The control & monitoring, protection and metering panels shall be installed in the 33KV GIS room / 132KV control room.</p> <p>The GIS offered shall confirm in all respects the high standard of engineering, design and workmanship and shall be completed with all the components necessary for its effective and trouble free operation. Such components shall be deemed to be with the scope of the bidder irrespective of whether they are specifically mentioned in this specification or not.</p>																																															
2.00.00	CODES AND STANDARDS																																															
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		(SF ₆) taken from electrical equipment and specification for its re-use
XV)	IEC 60529	Degrees of protection provided by enclosures (IP Code)
XVI)	IEC 60617-DB	Graphical symbols for diagram
XVII)	IEC 60688	Electrical Measuring Transducers for converting a.c. Electrical Quantities to Analogue or Digital signals.
XVIII)	IEC 60694	Common specifications for high-voltage switchgear and control gear standards
XIX)	IEC 60859	Cable connections for gas-insulated switchgear
XX)	IEC 60947	Low-voltage switchgear and control gear
XXI)	IEC 61000	Electromagnetic compatibility (EMC)
XXII)	IEC 61128	Alternating current disconnectors. Bus-transfer current switching by disconnectors.
XXIII)	IEC 61129	Alternating current earthing switches. Induced current switching
XXIV)	IEC 61634	High-Voltage Switchgear and Control gear-Use and Handling of Sulphur Hexafluoride (SF ₆) in High-Voltage Switchgear and Control Gear
XXV)	IEC 62271	High-voltage Switchgear and Control gear. All applicable parts.
XXVI)	IEC 61850	Communication network and systems in substation
XXVII)	IEC 60870	Tele-control equipment & Systems
XXVIII)	IS 5	Colours for ready mixed paints and Enamels
XXIX)	IS 12360	Voltage Bands for Electrical Installations Including Preferred Voltages and Frequency
XXX)	IS: 722	AC electricity meters.
XXXI)	IS: 996	Single phase small AC and universal electrical motors.
XXXII)	IS: 1248	Direct Acting indicating analogue electrical measuring instruments and Accessories.
XXXIII)	IS: 2544	Porcelain post insulators for systems with nominal voltages greater than 1000 Volts.
XXXIV)	IS: 2705	Current transformers.
XXXV)	IS: 3156	Voltage Transformers
XXXVI)	IS: 3427	Metal enclosed switchgear and control gear
XXXVI I)	IS: 5082	Specification for wrought aluminum and aluminum alloy bars, rods, tubes and selections for electrical purposes.
XXXVI II)	IEC: 61850	Communication Standard for Numerical relays
XXXIX)	IEC: 61131-3	Automation Standard for Numerical relays
XL)	IS: 9431	Specification for indoor post insulators of organic material for system with nominal voltages greater than 1000 volts upto and including 300 kV
XLI)	IS: 9921	A.C. disconnectors (isolators) and Earthing switches for voltages above 1000 V
XLII)	IS: 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.
XLIII)	IS: 13118	Specification for high voltage AC circuit breakers.
XLIV)	IEC: 60099-4	Metal oxide surge arrester without gap for AC system

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3.00.00	XLV)	IEC: 62271-100	High voltage alternating current circuit breakers.	
	XLVI)	IS/IEC: 62271-200	High voltage metal enclosed switchgear and control gear.	
	XLVII)	IEC: 60947-7-1	Terminal blocks for copper conductors	
	XLVIII)	IS :513 (2008)	Cold Rolled Low Carbon Steel Sheets and Strips	
	XLIX)	IS:15652/IS :2584	Dielectric epoxy-based coating for electrical purposes	
	The components and devices which are not covered by the above standards shall conform to, and comply with, the latest applicable standards, rules, codes and regulations of the internationally recognized standardizing bodies and professional societies as may be approved by the Employer. The manufacturer shall list all applicable standards, codes etc. and provide copies thereof for necessary approval.			
	TECHNICAL PARAMETERS			
	a) SYSTEM PARAMETERS			
	1	Nominal System voltage	33 kV	
	2	Highest System voltage	36 kV	
	3	Rated Frequency	50 Hz (+3% -5%)	
	4	Number of phases/ poles	Three	
	5	System neutral earthing	Solid earthing	
	6	Class indoor/outdoor	Indoor	
	7	Rated Short circuit	40 kA (rms) for 1 sec	
8	Rated insulation level			
	i. Rated power frequency withstand voltage (rms value)	70 kV		
	ii. Rated lightning impulse withstand voltage (peak value)	170 kVp		
9	Rated supply voltage Closing and Opening devices and auxiliary circuits	220 V DC (Control Supply) 240 V AC (Aux. Supply)		
10	IAC Rating	IAC AFLR 40KA for 1Sec.		
11	Maximum ambient air temperature	50 Deg C		
12	Minimum Creepage Distance	Suitable to withstand BIL at rated SF ₆ gas pressure		
13	Dynamic withstand rating	100 kA		
14	Seismic Level	Refer Project Information chapter (Part-A)		
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b) BUS BARS

1.	Continuous current rating at 50°C ambient:	As Per tender SLD
2.	Material	High Conductivity Copper (Both vertical and Horizontal)
3.	Temper Rise allowed above ambient	As per IEC/IS

c) SWGR. CUBICLE CONSTRUCTIONAL REQUIREMENTS

1.	Type of Construction	Metal enclosed, Fully compartmentalized, SF6 Insulated, for indoor application.	
1.	Cable entry		
	a)	Power Cables	Bottom
	b)	Control Cables	Bottom


d) CIRCUIT BREAKERS


1.	The circuit breakers current rating shall be selected from the load current given in SLD which is at an ambient of 50° C.		
2	Type	Vacuum type Anti pumping Electrical & Mechanical	
3	Number of poles	3	
4	Highest system voltage	36 kV	
5	Rated frequency:	50 Hz + 3% -5%	
6	Breaking current	40 kA	
7	Rated short time withstand current	40 kA	
8	Rated Operating Duty	O-0.3 S-CO-3 Min – CO	
9	Mechanical Endurance	M2 Class	
10	Rates duration of Short Circuit	3 seconds	
11	Class indoor/outdoor	Indoor	
12	No. of Auxiliary	6NO + 6nc Contacts for Contacts for Employer's use (If required NO and NC are not available, auxiliary relays to be used)	


e) Disconnecter/Earth Switch:


1	Type	SF6 gas insulated (3Position/2Position as per requirement)
2	Number of poles	3
3	Highest system voltage	36 kV
4	Rated normal current	As per system requirements


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	5	Rated frequency	50 Hz + 3%-5%		
	6	Mechanical Endurance	M1 class		
	7	No. of Auxiliary	6 NO + 6 NC Contacts for Contacts for Employers use (if required NO and NC are not available, auxiliary relays to be used for multiply the contacts)		
	f) CURRENT TRANSFORMER				
	1.	Class of Insulation	Class E or better		
	CT sizing calculation shall be done during detailed engineering based on system requirement.				
	g) VOLTAGE TRANSFORMERS				
	1.	Class of insulation	Class E or better		
	2.	Rated Voltage Factor	1.2 continuous & 1.9 for 30 sec		
	4.00.00	DESIGN AND CONSTRUCTIONAL FEATURES			
4.01.00	The GIS shall be of compact and of modular design. The modular design should allow the maintenance/replacement of the circuit breaker or cable connection compartment without interrupting the main horizontal bus bar operation. Switchgear shall be arranged to permit future extension at both the ends without necessarily dismantling any major parts of the equipment.				
4.02.00	All high voltage components shall be hermetically enclosed and safe to touch. The switchgear shall be a sealed pressure system as per IEC with leakage rate of less than 0.1% per year.				
4.03.00	The bus bar as well as feeder shall be single phase or three phase encapsulated type. The enclosure shall be made of aluminium alloy/stainless steel with adequate thickness and mechanical strength to have minimum corrosion and lesser weights.				
4.04.00	The switchgear shall be designed for use with SF6 gas complying with the recommendation of IEC 60376 at the time of the first charging with gas. All SF6 gas supplied as part of the contract shall comply with requirements of IEC 60376 as a minimum.				
4.05.00	The degree of protection shall be at least IP65 for gas compartments. For the supporting frame and other compartments, adequate/appropriate degree of protection (IP3X or better) to be provided to meet the environmental requirements as mentioned in Project information Part-A and also in clause 6.00.00 of this chapter.				
4.06.00	Each bay shall be divided into functionally separate gas compartments (busbar, disconnectors/earth switches, circuit breaker etc) by gas tight partitions.				
4.07.00	Automatic pressure relief shall be incorporated in the basic design of the enclosures as a precaution against explosion in the event of an internal arc fault. It shall ensure that personnel who may be present will not be endangered. Pressure relief shall be provided for all gas filled compartments.				
4.08.00	The number and position of expansion joint or flexible connections if applicable, are to be determined by the manufacturer to ensure that the complete installation will not be subject to				
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4.09.00	any expansions stresses which could lead to distortion or premature failure of any piece of the SF6 equipment, support structures or foundations. Gas section barrier including seals to the conductor and enclosure wall shall be gastight and shall be capable of withstanding the maximum pressure differential that could occur across the barrier that can exist under normal operating or maintenance conditions and in case of internal arc fault with a safety factor ≥ 2.0 .			
4.10.00	Switchgear panels, Bus bars, Disconnectors/Earth switch Circuit Breaker and other equipment shall have following features:			
4.11.00	Conductor: High conductivity copper for the horizontal bus bars, vertical droppers and connectors to the fixed end of isolating contacts.			
4.12.00	Insulator: Insulator Shall be track-resistant, high strength, non-hygroscopic, non-combustible type and suitable to withstand stresses due to over-voltages and short circuit current.			
4.13.00	Bus bars: Bus bars and connections shall be manufactured from high conductivity copper and same shall be housed in SF6 gas compartment. The Bus Bar Coupling arrangement for connecting two panels shall be housed in SF6 gas or other suitable arrangement as per the manufacturer's practice. If it is not coupled inside SF6 Gas, the details shall be furnished by the Contractor for approval by Employer. Proven track record of the arrangement shall be provided. To absorb thermal expansion and contraction movements, suitable compensation joints must be fitted if necessary. It must be possible to earth all bus bar sections in a make-proof way. Contractor shall furnish calculation during detailed engineering stage to establish the adequacy of support insulator and bus bar sizes for the declared continuous & short time current ratings.			
4.14.00	Circuit Breakers The circuit breaker module shall have two main components, interrupter unit and operating mechanism. Interrupter unit shall be housed in SF6 gas compartment. The circuit breaker shall be suitable to combat the arc quenching efficiently during breaking with high value of short circuit current without any harm to operating personnel and breaker itself. The circuit breaker shall meet the following requirements: a) The breaker shall be controlled locally and/ or remotely as required. Facilities shall be provided for mechanical tripping of breaker and manual charging of closing spring to cater to emergency condition. b) Closing coils shall operate satisfactorily in the control voltage range of 85 - 110% and tripping coil shall operate satisfactorily in the control voltage range of 70%-110%. c) Suitable mechanical inter lock shall be provided to prevent inadvertent earthing of any live part. d) Each feeder shall have local Remote selection. The arrangement of the circuit-breaker in the panel should be such that in the event of any requirement both the operating mechanism and the arcing chambers can be removed and reinstalled from the front or back. The Closing & tripping of the breakers from remote/local shall be possible. e) In the event of failure of auxiliary motor supply the disconnector and circuit breaker should be able to operate manually from panel front. f) The operating mechanism shall be spring operated type installed in compact separate free standing aluminum/steel housing. The entire operating mechanism shall be completely isolated from SF6 gas compartment. The operating mechanism shall have			
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	<p>vibration free and almost maintenance free components. The switching operation shall continue operating even after control power supply fails.</p>	
4.15.00	<p>Disconnecter/Earth Switch Disconnecter shall be of the single pole group operated type housed in the gas compartment confirming to IEC-62271-102-</p> <p>Disconnectors shall be able to switch capacitive charging current and bus transfer current. They shall be mechanically coupled with the position indicator. Manual operation shall also be possible.</p>	
4.16.00	<p>Instrument Transformer Current and potential transformers shall confirm to IEC 61869. Current and potential transformers shall be cast-resin insulated. The primary and secondary terminals shall be marked indelibly and easily approachable for termination and testing etc. All transformers must be suitable for continuous operation for 20% overload and for service under all rated and fault conditions.</p> <p>i) Current Transformers Current transformer shall be of Toroidal/ring core type construction. The CT ratio, ratings, class of accuracy, VA burden, number of cores, etc shall be finalized during detailed engineering stage based on the system requirement. Current transformer shall be mounted on the circuit breaker compartment, flanges or, on the cable connection housing. Variable number of cores and secondary winding shall be provided depending upon requirement.</p> <p>ii) Potential Transformers PT shall be inductive type, cast resin insulated voltage transformers in metal enclosed safe to touch design. PT shall be located outside the gas compartments. Bus PT shall be connected to bus through disconnector switch. Line PT can be plugged directly on the cable connection or connected through separate cable. PT shall have one or more secondary windings as per requirement. Modules or touch proof metal clad plug in type directly on bus bar/cable connection housing with secondary terminals kept accessible outside for metering as well as for protection and synchronization. The PT ratio, ratings, class of accuracy, VA burden, etc shall be finalized during detailed engineering stage.</p>	
4.17.00	<p>Surge Arrestor The surge arrestors shall confirm in general to latest IEC-60099-4. The surge arrester shall have minimum following duty requirements:</p> <ul style="list-style-type: none"> i) The surge arrester shall be of heavy duty station class and gapless (Metal oxide) type without any series or shunt gaps. ii) The surge arresters shall be capable of discharging over-voltages occurring during switching of unloaded transformers, reactors and long lines. iii) The reference current of the arresters shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage. <p>Constructional Features:</p>	
<div style="display: flex; justify-content: space-between; padding: 5px;"> GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2 SUB SECTION B-05(A) 33 KV GIS SWITCHGEAR Page 7 of 10 </div>		


CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.18.00	<p>i) The nonlinear blocks shall be of inferred metal oxide material. These shall be provided in such a way as to obtain robust construction, with excellent mechanical and electrical properties even after repeated operations.</p> <p>ii) The arrestor enclosure shall be vertically or horizontally mounted to suit the layout of the switchgear as suggested by the manufacturer.</p> <p>iii) The main earthing connection from the surge arrestor to the earth shall be provided. The size of the connecting conductor shall be such that all the energy is dissipated to the earth without getting overheated.</p> <p>Power Termination Modules</p> <p>Termination modules shall be for cables only. Cable connections shall be accessible from the bottom. Cable connections should preferably be located inside the gas chamber. Alternatively, terminations may be placed outside the gas chamber with touch proof cable termination, provided that the cable compartment offers adequate protection to ensure long-term reliability under continuous exposure to corrosive environments.</p>			
4.19.00	<p>Local Control Cabinets</p> <p>Intelligent local digital modules shall be provided with extensive diagnostic and monitoring features. They shall have local control, indication and monitoring of breaker with associated disconnectors and earth switches. The interlock shall be provided to prevent any incorrect switching sequence and enable the breaker, disconnectors, earth switches to be operated without risk either from local control cabinet or from remote control room.</p>			
4.20.00	<p>Sealing Arrangements: All power parts like bus bar compartment, breaker compartment etc must be electrically connected through bushing type insulators or other sealing arrangement in order to perform sealing and segregation and should not have SF6 gas communication.</p> <p>Earthing Arrangement</p> <p>All metallic non-current carrying parts of the switchgear shall be bonded together and connected to the switchgear earth busbar. Internal earth bus shall be provided which has a capacity to withstand short circuit currents for one second and all enclosures shall be connected to this bus.</p>			
4.21.00	<p>Cable Entry</p> <p>i) Touch proof cable termination shall be provided. Necessary cable termination kit shall also be provided by the Contractor. All high voltage XLPE cables shall be terminated by Contractor. All necessary cable connectors shall be supplied as per system requirement.</p> <p>ii) Capacitive Voltage Dividers in the bushings leading to the cable termination should allow safe testing and indication of the cable and the dead state at the Switchgear end. These dividers must be a fixed integral part of the system. The indicators shall preferably be mounted on the front side of the panels. These live line indicators shall be used for checking charged condition of the power cables while performing maintenance.</p>			
4.22.00	<p>SF6 monitoring</p> <p>SF6 gas pressure / density monitoring for low pressure alarm shall be provided. The SF6 gas pressure measurement gauges shall be suitably placed so as to be visible from walkway. The switchgear manufacturer shall indicate the basic insulation level at 1 bar gas pressure.</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>The current rating of the feeders shall be maintained at this pressure without interrupting the supply of power. All SF6 stainless steel/Al tank enclosures shall have independent temperature-compensated pressure switches/pressure monitoring devices. The gas compartments must be well sealed both mutually and to their surroundings. Suitable arrangement shall be provided for monitoring, alarming and tripping of various stages of SF6 gas pressure.</p>			
4.23.00	<p>Identification Plates</p> <p>Each panel to be identified on front as well as back side by large engraved plate giving detailed feeder description on the fixed portion of the panel. Identification labels/painted (Not stickers) plates to be provided inside each panel.</p>			
4.24.00	<p>Safety Requirements</p> <p>The switchgears shall be designed to offer adequate level of safety to operating/ maintenance personnel. Means shall be provided to prevent access to the live part to avoid accidents during service as well as maintenance period. Contractor shall bring out the safety means provided to achieve above. A detailed instruction plate suitable for wall mounting shall be provided for each switch gear room describing various safe operating procedure / safety precautions for safe operation and maintenance of switchgear.</p>			
4.25.00	<p>Gas Recycling Plant: All equipment necessary for filling, evacuating and recycling the SF6 gas into and from the switchgear equipment including maintenance activity in circuit breaker compartments shall be supplied by the vendor to enable any maintenance work to be carried out. The equipment shall be of sufficient capacity and rating and shall be provided with all necessary pipes, couplings, flexible tubes and valves for coupling to the switchgear equipment. Minimum 2 nos. 20kg SF6 gas cylinders to be provided.</p>			
5.00.00	<p>Dielectric epoxy-based coating for 33kV switchgear rooms:</p> <p>Dielectric epoxy-based coating shall be provided for all 33kV switchgear rooms as per clause No-13.00.00 of Part-B sub sec B-0.</p>			
6.00.00	<p>SPECIAL REQUIREMENTS</p>			
6.01.00	<p>Earthquake Condition</p> <p>Under the seismic conditions, stipulated in this specification (mentioned elsewhere), the 33kV GIS panels shall meet the following requirements:</p> <ul style="list-style-type: none">a. The physical alignment of 33kV GIS panels along with incoming and outgoing feeder connections, supporting insulators & structures of bus bars should not get disturbed and there should not be any internal flashover and/or electrical fault.b. All relays, transducers, indicating instruments, devices in switchgears or in Remote control panels should not mal operate.c. Current carrying parts, supporting structure, earth connection etc. should not get dislocated and/or should not break or distort.			
6.02.00	<p>Saline Environment</p> <p>The 33 kV GIS switchgear shall be specifically engineered for installation in saline, high-humidity, and corrosive coastal environments with continuous exposure to salt laden air. The equipment shall be designed to ensure long-term reliability under continuous exposure to corrosive marine conditions. All components and assemblies including</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
7.00.00	fasteners/gaskets/fittings/bolts/nuts/spring washer/washer/hardware/angle/ismc /channel, etc shall be corrosion-resistant. The design shall minimize moisture ingress and corrosion risks, ensuring long-term reliability under coastal conditions.				
	Dispatch and Handling of equipment at site Care shall be taken for safe handling of equipment at site during transport, stacking, shifting to erection site, and erection at site in order to prevent damages to the equipment. The compartments of GIS assemblies should be supplied filled with SF6 gas at a positive pressure and hermetically sealed to protect the dielectric system during transportation as per manufacturer practice.				
	9.00.00 TESTS				
	9.01.00 Type tests The metal enclosed 33KV Gas Insulated Switchgear shall be of type tested design. During detailed engineering Contractor shall submit for Owner's approval the reports for all the type test as per relevant IEC/IS and carried out within last 15 years from the date of bid opening.				
	9.02.00 Routine Tests All acceptance and routine tests as per the specification and relevant standards shall be carried out. List of Routine Test: a) dielectric test on the main circuit b) tests on auxiliary and control circuits c) measurement of the resistance of the main circuit d) tightness test e) design and visual checks The manufacturer shall furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.				
10.0.00	COMMISSIONING CHECKS / TESTS Bidder shall submit commissioning test procedure including details of all commissioning check before commissioning the system at site Note:- This chapter has to be read in conjunction with sub-section B-0 "General electrical specification" of Technical specification Section-VI, Part-B and Sub-Section IIB Electrical system/Equipment of Technical Specifications Section-VI, Part-A and Part-E.				
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SUB-SECTION-B – 06

L.T. SWITCHGEAR & LT BUSDUCTS

CLAUSE NO.	TECHNICAL REQUIREMENTS 		
1.00.00	CODES AND STANDARDS		
	IS: 5	Colours for ready-mixed paints and enamels.	
	IS: 694	PVC insulated cables for working voltages up to and including 1100V.	
	IS: 722	A.C. Electricity Meters	
	IS: 1248	Electrical Indicating instruments	
	IS/IEC: 60947-1	Degree of protection provided by enclosures for low voltage Switchgear and Control gear	
	IS/IEC: 60947-2	A.C. circuit Breakers, MCCB, MCB, MPCB	
	IS: 2551	Danger Notice Plates	
	IS: 2629	Hot dip galvanising	
	IS: 2705	Current Transformers	
	IS/IEC: 60947-4-1	Contactors and motors starter for voltages not exceeding 1000 V AC or 1200 V DC	
	IS: 3043	Code of practice for earthing.	
	IS: 3072	Code of practice for installation and maintenance of Switchgear	
	IS: 3156	Voltage Transformers	
	IS: 3202	Code of practice for climate proofing of electrical equipment.	
	IS: 3231	Electrical relays for power system protection.	
	IS/IEC 60947	Air-Break Switches, air break disconnectors, air break disconnector and fuse combination units for voltages not exceeding 1000V AC or 1200 V DC.	
	IS/IEC 60947-1	General Requirements for Switchgear and Control gear for voltages not exceeding 1000 V.	
	IS: 5082	Wrought Aluminium and Aluminium alloys for electrical purposes.	
	IS: 6005	Code of practice of phosphating of iron and steel.	
	IS/IEC 60947-5-1	LV switchgear and Control gear Control current devices and switching element.	
	IS: 8623 / IEC: 61439-1/2	Low Voltage Switchgear & Control gear assemblies	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS: 8686	Static Relays	
	IS: 13703 / IEC: 60269	HRC Cartridge fuses	
	IS: 10118 (4 parts)	Code of practice for selection, installation and maintenance of switchgear and control gear.	
	IS: 11171	Specification for dry type transformers.	
	IEC: 60255	Electrical Relays	
	IEC: 61850	Communication networks and systems in substations	
	IS: 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals	
	IS: 12021	Specification of control transformers for switchgear and Control gear for voltage not exceeding 1000V AC.	
	IEC: 60947-7-1	Terminal blocks for Copper conductors	
	IS :513 (2008)	Cold Rolled Low Carbon Steel Sheets and Strips	
	2.00.00	TECHNICAL PARAMETERS	
2.01.00	Power Supply		
2.01.01	AC SYSTEM		
	1)	Voltage	415 V ± 10%,3 Phase, 4 wire, solidly earthed
	2)	Frequency	50 Hz +/- 5%
	3)	Combined variation (in volts & frequency)	10% absolute sum
	4)	Fault Level	50 kA(RMS)
2.01.02	DC SYSTEM		
	1)	System Voltage	220 V/110 V DC 2-Wire, Unearthed
	2)	Fault Level	20 kA
2.01.03	CONTROL SUPPLY VOLTAGE		
	1)	(i) Closing coil of circuit breaker	220 V DC/110 V DC
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.02.00 2.03.00 <			

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>	
2.05.00	1)	Material	CRCA 2mm: Load bearing Structure and Frame 1.6mm: Doors, covers etc 3mm for Gland Plates (CRCA/HR) 4mm for Gland plates (Non-Magnetic) –Single Core Cable Entry		
	2)	Type	Metal enclosed, indoor, floor-mounted, Free Standing Type		
	3)	Degree of Protection	IP:52 (below 1600 Amp.) (IP:42 for Busbar chamber, 1600 Amp & above, Gasketing arrangement shall be as per type tested design for IP 5X) As per IS/IEC:60947 IP65: Paddle Feeder and Travelling Tripper MCC IP55: Outdoor Panels enclosed in Stainless Steel Mounted on 500 mm Pedestal		
	4	Design	Complete Closed Door Design		
	5	Internal Arc Classification	50KA, 0.5 sec		
	6	Cable Alley Compartment	Form-4B as per IEC-61439		
	7	Gasket	Steel Reinforced EPDM /PU Foam/Neoprene gaskets		
	8)	Height	2450mm max		
	9)	Clearances	i)25 mm: (Ph-Ph)/(Ph-earth) for Horizontal/vertical busbars and circuit breaker chamber. ii)Inside the modules: Min 25mm.However, if clearances are >=10mm and <25mm shrouds/insulation barrier may be provided. Physical clearance less than 10mm shall not be allowed in any of the cases between Ph-Ph or Ph-E. iii)Incomer Rear Door and Busbar-400mm		
	CIRCUIT BREAKER				
	1)	Type	Air break spring charged stored energy type		
	2)	Operating duty	O-3 min-CO-3 min-CO		
	3)	Symmetrical interrupting	50 kA(RMS)		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>	
2.06.00	4)	Short circuit rating	105 kA(PEAK)	
	5)	Short Circuit Breaking current		
		a) AC Component	50 kA(RMS)	
		b) DC Component	As per IS/IEC 60947	
	6)	Short time withstand	50 kA(RMS) for 1 s	
	7)	No of aux. contacts	4 NO + 4 NC for DDCMIS interface 6NO+6NC Auxillary Contact(directly operated from breaker operated Mechanism)	
	8)	Antipumping Feature	Both Mechanical and Electrical	
	METERS			
	1)	Accuracy Class	2.0	
	2)	One min. power frequency withstand test voltage	2.0 kV(RMS)	
2.07.00	Current Transformers			
	1)	Type	Cast Resin Bar Primary / Nylon Casing	
	2)	Voltage class and frequency	650 V, 50 HZ	
	3)	Class of insulation	E or better	
	4)	Rated Secondary Current	1 A	
	5)	Accuracy class & burden		
		a) For protection	5P20, 5VA PS Class for REF	
		b) For metering	class 1.0, 5VA (min) class 0.2s, 5VA (min) for feeders indicated in SLD ,if any	
	6)	Instrument Security Factor (ISF) for metering CT	5	
	7)	Short time withstand		
	a) For CT Associated with circuit breaker	50 kA(RMS) for 1 sec		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>	
2.08.00		b) For CT Associated with MCCBprotected feeders	Prospective current of 50 kA(RMS) for the MCCB clearing time	
	8)	Dynamic withstand		
		a) For CTs Associated with circuit breaker	105 kA(PEAK)	
		b) For CT Associated with MCCB protected feeders	Prospective current of 105 kA(PEAK) as Limited by MCCB	
	BUSDUCT (NON-SEGREGATED, AIR INSULATED TYPE)			
	1)	Rating	As per requirement /Sizing Calculation	
	1)	Type	Non-Segregated	
	2)	One minute power frequency withstand voltage	2.5 kV	
	3)	One second short ckt withstand current	50 kA(RMS)	
	4)	Momentary dynamic current withstand	105 kA(PEAK)	
2.09.00	5)	Enclosure	3mm Al Alloy Rectangular(IP:55) Al sheet flange protection hood for outdoor	
	8)	Gasket	Steel Reinforced EPDM /PU Foam /Neoprene gaskets	
	9)	Conductor	Material: Alumunium Clearance:25 mm(Min)	
	10)	Steel Structure	Hot Dipped Galvanised	
	11)	Earthing	GI of Adequate Size along full length	
	BUSDUCT (SANDWICH TYPE)			
	1)	Type	Bus Trunking	
	2)	Rated Insulation voltage	1000V	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>
2.10.00	3)	One second short ckt withstand current	50KA(RMS)
	4)	Momentary dynamic current withstand	105KA(PEAK)
	5)	Power frequency withstand voltage	3.5kv
	6)	Impulse withstand voltage	8kV
	7)	Insulation	Class F
	8)	Conductor	Material: AL/Cu
	9)	Enclosure	CRCA/GI:1.6mm Al:2.5mm DOP:-IP:55
	10)	Gasket	Steel Reinforced EPDM /PU Foam/Neoprene gaskets
	11)	Earthing	GI of Adequate Size along full length
	Bidder to provide adequate interposing busduct arrangement or any other adequate measure to balance the capacitive voltage between three phases while connected with DG set at switchgear end.		
	VOLTAGE TRANSFORMERS		
	1)	Type	Cast Resin
	2)	Voltage Ratio	415 / 110 V for line PT 415/ $\sqrt{3}$ / 110/ $\sqrt{3}$ V for Bus PT
3)	Method of Construction	V-V	
4)	Accuracy Class	0.5 0.2 for feeders indicated in SLD ,if any	
5)	Rated Voltage factor	1.1continuous, 1.5 for 30 sec.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.11.00	6)	Class of insulation	E or better
	7)	One minute power frequency withstand voltage	2.5 KV
2.12.00	HRC FUSES		
	1)	Voltage Class	650 Volts
2.13.00	2)	Rupturing capacity	80 kA (rms) for AC ckt., 20 kA for DC ckt.
	CONTACTORS		
2.14.00	1)	Type	Air break electro magnetic
	2)	Utilising Category	AC3 of IS/IEC 60947 for non reversible AC4 of IS/IEC 60947 for reversible drives DC3 for DC contactor
2.15.00	3)	Operating Coil Voltage	(i)110V AC(-15%--+10%) Drop out voltage-less than 70% Guaranteed Drop out at 20% of rated voltage (ii)220V DC((-15%--+10%)
	Relays		
2.16.00	1)	Power frequency withstand voltage	2.5 kV for 1 sec. or 2.0 kV for 1 min.
	CONTROL TRANSFORMERS		
2.17.00	1)	Type	Dry / Cast Resin
	2)	Voltage Ratio	415 / 110 V with taps \pm 5% in steps of 2.5%
2.18.00	3)	Class of insulation	Class-B or better
	4)	One minute power frequency withstand voltage	2.5 kV
2.19.00	5)	Rating	1.5 X Adequate for application.
	LIGHTING TRANSFORMER / WELDING TRANSFORMER		
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2.16.00


2.17.00

2.17.00


1)	Type	Thermal Magnetic based(in built front adjustable releases
2)	Rated insulation level	690V
3)	Rated ultimate & Service S.C. breaking capacity	50 kA
4)	Rated making capacity	105 kA


CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>	
2.18.00	5)	Utilization category	A		
2.19.00	NOT USED				
2.20.00	MCB				
	1)	Rated voltage	415V/240V/110V AC 240V DC		
	2)	Current breaking Capacity	10 KA		
	3)	Characteristic Curve	C or above		
	AC & DC MCCB Box				
	1)	Construction	(i)Metal Enclosed Fixed Type CRCA:2mm structure :1.6mm enclosure Or (ii)Poly Corbonate (a) Halogen Free,flame Retardant(UL-94,V0) (b) Thickness:4mm (iii) UL224 sleeved Busbars		
	2)	Degree of Protection	Indoor: IP52 Outdoor: IP54		
	3)	Characteristic Curve	C or above		
	2.21.00	Earth Bus and Earthing			
	2.22.00	Material		GS/Cu/Al of Sufficient cross section Separate Copper Earth bus for Electronic Earthing of IMCs	
Internal Wiring and Control Terminal Blocks					
Control Terminal Blocks					
1)		Rating	650V grade , 10 A ,6.6 polyamide UL 94Separate Copper Earth bus for Electronic Earthing of IMCs		
2)		Type	Screw less ,push in technology(IEC 60947-7-1 and UL certified)		
3)	Spare		20%		
Internal Wiring					
1)	Rating	650 V grade ,FRLS, single core 2.5 sq. mm cu for CT connection			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>	
2.23.00			1.5 sq. mm cu for others		
	LOCAL/EMERGENCY PUSH BOTTON				
	1)	Construction	CRCA/Die Cast Al:1.6mm enclosure Or (ii)Poly Corbonate (a) Halogen Free,flame Retardant(UL-94,V0) (b) Thickness:4mm (iii) UL224 sleeved Busbars		
	2)	Degree of Protection	IP55 IP65(Dusty Area)		
	3)	Characteristic Curve	C or above		
3.00.00	4)	Contacts	Latched Type EPB 2NO+2NC		
	CONSTRUCTIONAL DETAILS OF SWITCHBOARDS				
	3.01.00	All switchboards shall be divided into distinct vertical sections (panels), each comprising of the following compartments:			
	(a.) BUSBAR COMPARTMENT				
	A completely enclosed bus bar compartment shall be provided for the horizontal and vertical bus bars. Bolted covers shall be provided for access to horizontal and vertical busbars and all joints for repair and maintenance, which shall be feasible without disturbing any feeder compartment. Auxiliary and power bus bars shall be in separate compartments. All moving and fixed contacts of each draw-out modules must be of rating more than 125% of MCCB/MPCB mounted inside the module.Each phase of vertical busbars shall be separated by phase barrier and same shall be sleeved (UL-224).				
(b.) SWITCHGEAR / FEEDER COMPARTMENT					
All equipment associated with an incomer or outgoing feeder shall be housed in a separate compartment of the vertical section. Two-tier breaker arrangement in a vertical section shall be offered for outgoing breaker feeders of rating up to 1600A. Fixed part of vertical busbar and moving part of draw-out modules for power connection shall be of Silver/Tinned plated Copper only. No live parts shall be accessible with equipment drawn out. The Module compartment door shall have external padlocking facility with MCC frame/fixed structure.					
A separate compartment shall be provided for relays and other control devices associated with a circuit breaker. For breaker-controlled motor feeders, an aux. relay shall be provided for taking Local push button station(EPB) “normally open (NO)” contact input from field and provide potential free output to DDCMIS to avoid probable mixing of switchgear control voltage with DDCMIS 24V DC voltage. This aux. relay shall have 2NO+2NC contacts. Canopy shall be provided over EPB.					
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL specification section – vi, part-B BID DOC NO: CS-6401-001-2		SUB SECTION B-06 LT SWITCHGEARS & LT BUSDUCTS	
				PAGE 11 OF 18	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.02.00	Wherever two breaker compartments are provided in the same vertical section, form 4B separation and separate vertical busbar chamber shall be provided. For Incomer panel suitable interlock shall be provided to prevent opening of rear cover, in case incoming supply is ON/Line is live and for Bus-coupler panel suitable interlock shall be provided to prevent opening of rear cover, in case either of the bus-section is in charged condition..			
3.03.00	All 415V air circuit breaker switchgear panels shall be of single-front type. MCCs and DBs shall be of single-front / double-front construction as per the requirements. All ACDBs, DCDBs and Solenoid Valve DBs shall be of fixed module type.			
3.04.00	For modules of size more than 300 mm, symmetric guides not less than 4 nos shall be provided for smooth removal or insertion of module. All identical module chassis of same size shall be fully interchangeable without having to carry out any modifications. Suitable interlock shall be provided in DCDB for prevention of opening of Isolator (Incomer) when the bus coupler is open and vice-versa.			
3.05.00	<p>All draw-out modules shall be provided with “Closed door operation” feature wherein movement of the module from “Isolated” position to “Test” position and to “Service” position & vice-versa and power ON / OFF operation of the module shall be possible only with the module door closed condition. Degree of protection of the panel shall be maintained in both “Service”, “Test” and “Isolated” positions. Module door shall open only when module is in “Isolated” position and “Power off” condition. Interlock shall be provided to prevent the change of module state from “Isolated” to “Test” position and to “Service” position or vice-versa, if Main Switch/MCCB/MPCB of the module is kept in ON condition. All the modules shall be of standard width only and no half width, quarter width etc sized modules shall be acceptable.</p> <p>It shall be possible to pad lock the module door irrespective of state of module i.e. “Service”, “Test” or “Isolated”. Module Operated Automatic safety shutter shall be provided to cover all the live power terminals, in case the module is taken out from the panel.</p>			
3.06.00	2 nos of Dummy modules of each size to fill in module being taken out for maintenance purpose shall be provided in each switchgear room in case module door is part of module. These Dummy Modules shall be fitted in switchboard as vacant modules having no cut out on back side and cable alley side. In case door is hinged to the panel, 2 nos of blanking plates of each size need to be provided.			
3.07.00	Minimum 10mm of gap shall be ensured between busbar and moving power contact tips while module is in “Test” position to ensure user safety.			
3.08.00	Interlock mechanism shall be provided with the voltage monitoring such that, it should not be possible to open the rear door of incomer and bus coupler modules when the incoming power source is in live condition. In case of any bypass/overriding of this interlock appropriate hooter at local and alarm to DCS shall be provided by the bidder.			
3.09.00	Air Circuit Breakers Modules shall be provided with “Closed door operation” feature wherein movement of the module from “Isolated” position to “Test” Position and then to “Service” position & vice-versa and power ON / OFF operation of the module shall be possible only with the module door closed condition. Degree of protection of the panel shall be maintained in both “Test” and “Service” positions. Module door shall open only when module is in “Isolated” position and “Power off” condition.			
3.10.00	Circuit-breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage, to cover the stationary isolated contacts when the breaker is withdrawn.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>	
3.11.00	The compartment door of fixed type modules shall be interlocked to prevent opening while the MCCB/MPCB in “ON” condition.		
3.12.00	Employer reserves the right to alter the cable entries, if required during detailed engineering, without any additional commercial implication.		
3.13.00	The Contractor shall provide adopter panel / dummy panel required to meet various configuration / arrangement of busbars/layout requirement adopted by the Contractor. The Switchboards fed from indoor transformer will be flange connected to the same and the same shall be located as close as desirable to the transformer.		
3.14.00	Wireless temperature monitoring system to be provided and same shall be integrated to DDCMIS/ separate HMI. Temperature sensors shall be installed in all relevant joints, contact joints etc. as per the standard OEM Practice, however Position of such sensors shall be decided at the time of detailed engineering.		
3.15.00	All insulating components being used in panel shall be Flame Retardant as per UL-94 V0 flammability standard.		
4.00.00	CONSTRUCTIONAL DETAILS OF AC & DC MCCB BOX		
4.01.00	Each DC MCCB Box shall comprise of the following : (a.) 1 no. 63 A DP MCCB as incomer (b.) 100 A fully insulated (PVC sleeved,UL224) busbars. (c.) 8 nos. 16A outgoing DP MCCB feeders. (d.) 1 no. auxiliary contactor for supply monitoring. (e.) 1 no. Blue LED indicating lamp-		
4.02.00	Each AC MCCB Box shall comprise of the following : (a.) 1 no. 63A TPN MCCB as incomer. (b.) 100 A, 3-phase, 4-wire, fully insulated (PVC sleeved,UL224) busbars. (c.) 9 nos. 16 A DP MCCB and 3 nos. 16 A TPN MCCB units as outgoing feeders. (d.) 3 nos. LED indicating lamps (R, Y, B) for incoming supply monitoring.		
5.00.00	POWER BUSBARS AND INSULATORS		
5.01.00	Two separate sets of vertical busbars shall be provided in each panel of double front MCCs / DBs. Interleaving arrangement for busbars shall be adopted for switchboards with a rating of more than 1600A.		
6.00.00	NUMERICAL RELAYS		
6.01.00	All Numerical relays shall be of types, proven for the application satisfying requirements specified elsewhere and shall be subject to Employer's approval. Numerical Relays shall have appropriate setting ranges, accuracy, resetting ratio, transient overreach and other		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	characteristics to provide required sensitivity for the intended application.		
6.02.00	All numerical relays shall be rated for control supply voltage as mentioned elsewhere under system parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Threshold voltage for binary inputs shall be suitably selected to ensure avoidance of mal operation due to stray voltages and preferably shall be more than 70% of the rated control supply voltage.		
6.03.00	One minute power frequency withstand test voltage for all numerical relays shall at least be 2kV (rms).		
6.04.00	All IEDs shall have freely programmable optically isolated binary inputs (BI) and potential free binary output (BO) contacts, the quantity of which shall be adequate to realize the associated interlocks / feedbacks. At least 2 binary inputs (BI) & 2 binary outputs (BO) shall be kept as Spares for Employer's future use.		
6.05.00	In case the offered IED does not have the required number of I/Os, the same can be achieved through external I/O device of same make complying with the requirement.		
6.06.00	Failure of a control supply and de-energization of a relay shall not initiate any circuit breaker / vacuum contactor operation.		
6.07.00	Disturbance Record waveforms, event records & alarms shall be stored in Non-volatile memory and failure of control supply shall not result in deletion of any of these data.		
6.08.00	All the numerical relays shall have communications on three ports, one local front port communication to laptop and two rear port on IEC 61850 to communicate with the DDCMIS through LAN.		
6.09.00	All Numerical relays shall have features for electrical measurements including voltage, current, power (active & reactive), frequency, power-factor and energy parameters.		
6.10.00	Relays used in incomers, ties and bus couplers shall have provision of two sets of voltage inputs (3Nos for bus voltage & 1No. for line voltage) for the purpose of synchronization.		
6.11.00	All CT terminals on the relays shall be of fixed type suitable for connection of ring-type lugs to avoid any hazard due to loose connection leading to CT open-circuit. In no circumstances Plug In type connectors shall be used for CT / VT connections.		
6.12.00	All numerical relays shall have key pad / keys to allow relay setting from relay front. Pre-programmed or programmable key for Master trip (86) reset shall be provided on the relay front.		
6.13.00	Relays shall have suitable output contact for circuit breaker failure protection (CBFP).		
6.14.00	Relays shall have self-diagnostic feature with continuous self-check for power failure, program routines, memory and main CPU failures and a separate output contact for indication of any failure.		
6.15.00	Relays shall have at least two sets or groups of two different sets of adaptable settings. Relays shall have multiple IEC / ANSI / user-programmable characteristics.		
6.16.00	Design of the relay must be immune to any kind of electromagnetic interference.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
6.17.00	All cards/ hardware of numerical relays shall be suitable for operation in Harsh environmental conditions with respect to high temperature, humidity & dust.			
6.18.00	Relays of each type/model shall be supplied with same Firmware/Software version for the complete package.			
7.00.00	Power Cable Termination			
7.01.00	Cable termination compartment and arrangement for power cables shall be suitable for heavy duty, 1.1 kV grade, stranded Aluminium conductor, PVC/ XLPE insulated, armored / unarmoured and PVC sheathed cables. All necessary cable terminating accessories such as supporting clamps and brackets, hardware etc. for cables shall be provided by the contractor to suit the final cable sizes.			
8.00.00	BUS TRUNKING SYSTEM (SANDWICH TYPE BUSDUCT)			
8.01.00	Three phase Bus trunking system conforming to IEC 61439-6 / IS 8623 (Parts 1 & 2) shall be provided for connecting the Main and Standby DG sets to Unit Emergency Switchgears.			
8.02.00	Enclosures shall be provided with flanged ends with drilling dimensions to suit the flanges at the switchgear and DG terminals. Any adapter boxes required for this purpose are in the contractor's scope of supply. The flanges shall be provided with gaskets, nuts, bolts, etc.			
8.03.00	The entire bus duct shall be designed for dust, vermin and weather proof construction. A suitable aluminium sheet flange-protection hood shall be provided to cover all outdoor bus duct enclosure joints to facilitate additional protection against rain water ingress. All horizontal runs of bus ducts shall have a suitable sloped enclosure top to prevent retention of water for both indoor and out door portion of busducts.			
9.00.00	TEMPERATURE –RISE			
	The temperature rise of the horizontal and vertical busbars and main bus links including all power draw-out contacts when carrying 90% of the rated current along the full run shall in no case exceed 55° C with silver plated joints and 40°C with all other types of joints over an outside ambient temperature of 50°C. The temperature rise of the accessible parts/external enclosures expected to be touched in normal operation shall not exceed 20°C. The temperature rise of manual operating means shall not exceed 10°C for metallic & 15°C for insulating material. Temperature rise for the busbars shall be carried out at 90% of the rated current. The above temperature rise limits are applicable for busducts also without any current derating.			
10.00.00	DERATING OF EQUIPMENTS			
	The Contractor shall ensure that the equipment offered will carry the required load current at site ambient conditions specified and perform the operating duties without exceeding the permissible temperature as per Indian Standards / Specification. Continuous current rating at 50°C ambient in no case shall be less than 90% of the normal rating specified.			
	The Contractor shall indicate clearly the derating factors if any employed for each component and furnish the basis for arriving at these derating factors duly considering the specified current ratings and ambient temperature of 50°C.			
11.00.00	PROTECTION CO-ORDINATION			
	It shall be the responsibility of the Contractor to fully coordinate the overload and short circuit tripping of the circuit breakers with the upstream and downstream circuit breakers / MCCBs /			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL specification section – vi, part-B BID DOC NO: CS-6401-001-2	SUB SECTION B-06 LT SWITCHGEARS & LT BUSDUCTS	PAGE 15 OF 18

All MCCBs shall be tested using primary injection kit in each switchgear during initial commissioning by the bidder. Such testing procedures shall be furnished during detailed engineering. Complete discrimination between incomer and outgoing breaker/MCCB feeders, Upstream and Downstream breakers/MCCB must be established by bidder at time of commissioning.

12.00.00

12.01.00

The following type test certificates of LT Switchgear and MCC panels shall be submitted.


1)	Circuit breaker of each rating	
	a)	Test sequence 1
	b)	Combined test sequence (With Circuit breakers mounted inside the Switchgear panel)
2)	Complete design verification of Switchgear/MCC Panels as per IEC 61439 Part-1, Annexure-D	
3)	Internal arc test for Personnel and Assembly Protection as per IEC/TR 61641. Test shall be conducted for breaker compartment, busbar chamber, incoming side of smallest sized module, outgoing terminals of module in cable alley.	
4)	MCC modules of any three ratings, as selected by the Employer, for class - II protection Co-ordination as per IS 13947-4-1 / IEC 60947-4-1.	


For the following equipment the contractor shall submit the reports of all the type tests

- NUMERICAL RELAYS
- LOCAL PUSH BUTTON STATION
- LOCAL MOTOR STARTER
- MCCB

Type test reports for the following tests on the model of the Numerical relays, Ethernet switches shall be submitted for Employer's review.

S. No.	TEST ITEMS	Standard
1	Dimensions of structure and visual inspection	IEC 60297-3-101
2	Functional requirements:	Relevant IEC 60255-100 series
	– Steady-state simulation	
	– Dynamic simulation	
3	Product safety requirements	IEC 60255-27
	(including the dielectric tests and thermal short time rating)	
4	EMC requirements:	IEC 60255-26
	– Emission	
	– Immunity	
5	Energizing quantities:	

CLAUSE NO.	TECHNICAL REQUIREMENTS																																					
	<table><tr><td></td><td>– Burden</td><td>N/A</td></tr><tr><td></td><td>– Change of auxiliary energizing quantity</td><td>IEC 60255-11</td></tr><tr><td>6</td><td>Contact performance</td><td>N/A</td></tr><tr><td>7</td><td>Communication requirements</td><td>Relevant IEC protocol standards</td></tr><tr><td rowspan="5">8</td><td>Climatic environmental requirements:</td><td>IEC 60068-2-14,</td></tr><tr><td>– Cold</td><td>IEC 60068-2-1,</td></tr><tr><td>– Dry heat</td><td>IEC 60068-2-2,</td></tr><tr><td>– Change of temperature</td><td>IEC 60068-2-78,</td></tr><tr><td>– Damp heat</td><td>IEC 60068-2-30, IEC 60255-27</td></tr><tr><td rowspan="4">9</td><td>Mechanical requirements: – Shock</td><td>IEC 60255-21-1,</td></tr><tr><td>– Vibration</td><td>IEC 60255-21-2,</td></tr><tr><td>– Bump</td><td>IEC 60255-21-3</td></tr><tr><td>– Seismic</td><td></td></tr><tr><td>10</td><td>Enclosure protection</td><td>IEC 60529, IEC 60255-27</td></tr></table>		– Burden	N/A		– Change of auxiliary energizing quantity	IEC 60255-11	6	Contact performance	N/A	7	Communication requirements	Relevant IEC protocol standards	8	Climatic environmental requirements:	IEC 60068-2-14,	– Cold	IEC 60068-2-1,	– Dry heat	IEC 60068-2-2,	– Change of temperature	IEC 60068-2-78,	– Damp heat	IEC 60068-2-30, IEC 60255-27	9	Mechanical requirements: – Shock	IEC 60255-21-1,	– Vibration	IEC 60255-21-2,	– Bump	IEC 60255-21-3	– Seismic		10	Enclosure protection	IEC 60529, IEC 60255-27		
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12.03.00	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.																																					
12.04.00	The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.																																					
12.05.00	Routine checking to observe compliance to degree of protection, first numeral, on switchboard enclosures and busbar chambers shall be as under :																																					
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13.00.00	ERECTION / INSTALLATION OF SWITCHBOARDS AND OTHER EQUIPMENTS																																					
14.00.00	COMMISSIONING OF LT SWITCHGEARS																																					
	Commissioning of LT switchgears at site shall only be carried out either by the switchgear manufacturer himself or under the supervision of the switchgear manufacturer.																																					
15.00.00	RESPONSIBILITY OF THE ASSOCIATE/COLLABORATOR (APPLICABLE IF LT SWITHCHGEAR IS SUPPLIED THROUGH PROVENNESS CRITERIA: ROUTE-2):																																					
	The Associate/Collaborator (as applicable) for sourcing of LT Air Circuit Breaker shall be fully responsible and accountable for the item supplied and its compliance to the specification requirements.																																					
	The Associate/Collaborator (with respect to his manufactured and supplied LT Air Circuit Breaker) shall:																																					
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<div><div>i) Participate in the Inspection of the LT Switchgears at Switchgear Supplier's Works, if required by Employer.</div><div>(ii) Participate in Technical Co-ordination Meetings (TCMs) from time to time during detailed engineering, if required.</div><div>(iii) Participate in Site Testing and Commissioning of LT Switchgears, if required.</div><div>(iv) Participate/address/resolve the issues raised during Contract Execution Period.</div></div>			
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SUB-SECTION-B – 07


NOT USED


SUB-SECTION-B – 08


HT LT & CONTROL CABLES


CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	<u>HT, LT Power Cables & Control Cables</u>			
	This chapter has to be read in conjunction with sub-section B-0 "General electrical specification" of Technical specification Section- VI, Part-B and Sub-Section-IIB Electrical system/Equipment of Technical Specifications Section-VI, Part-A".			
	CODES AND STANDARDS			
	All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes :			
	IS:7098 (Part -II)	Specification for Cross linked polyethylene insulated PVC sheathed cables. Part-II: For working voltages from 3.3 KV upto and including 33 KV.		
	IS : 3975	Low Carbon Galvanized steel wires, formed wires and tapes for armouring of cables.		
	IS:4905	Methods for random sampling.		
	IS : 5831	PVC insulation and sheath of electrical cables.		
	IS : 8130	Conductors for insulated electrical cables and flexible cords.		
	IS : 10418	Specification for drums for electric cables.		
	IS : 10810	Methods of tests for cables.		
	ASTM-D 2843	-	Standard test method for density of smoke from the burning or decomposition of plastics.	
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.			
IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.			
IS : 3961 IEC- 332	Recommended current ratings for cables Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).			
IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS																								
2.00.00	TECHNICAL REQUIREMENTS																								
2.01.00	All cables (HT Power, LT power and control cables) shall be Armoured type irrespective of anything contrary mentioned elsewhere in the specification.																								
2.02.00	All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.																								
2.03.00	Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be multi stranded.																								
2.04.00	XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.																								
2.05.00	The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmored cables, shall have distinct extruded PVC inner sheath of black color as per IS: 5831.																								
2.06.00	For single core Armoured cables, armoring shall be of aluminum wires. Fire resistant tape between armour and outer sheath shall be provided.																								
	For multicore Armoured cables armoring shall be of galvanized steel as follows : -																								
	<table><tr><th colspan="2">Calculated nominal diameter of cable under armour</th><th>Size and Type of armour</th></tr><tr><td>i)</td><td>Upto 13 mm</td><td>1.4mm dia GS wire</td></tr><tr><td>ii)</td><td>Above 13 & upto 25mm</td><td>0.8 mm thick GS formed wire / 1.6 mm dia GS wire</td></tr><tr><td>iii)</td><td>Above 25 & upto 40 mm</td><td>0.8mm thick GS formed wire / 2.0mm dia GS wire</td></tr><tr><td>iv)</td><td>Above 40 & upto 55mm</td><td>1.4 mm thick GS formed wire/2.5mm dia GS wire</td></tr><tr><td>v)</td><td>Above 55 & upto 70mm</td><td>1.4 mm thick GS formed wire/3.15mm dia GS wire</td></tr><tr><td>vi)</td><td>Above 70mm</td><td>1.4 mm thick GS formed wire / 4.0 mm dia GS wire</td></tr></table>				Calculated nominal diameter of cable under armour		Size and Type of armour	i)	Upto 13 mm	1.4mm dia GS wire	ii)	Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire	iii)	Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire	iv)	Above 40 & upto 55mm	1.4 mm thick GS formed wire/2.5mm dia GS wire	v)	Above 55 & upto 70mm	1.4 mm thick GS formed wire/3.15mm dia GS wire	vi)	Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire
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v)	Above 55 & upto 70mm	1.4 mm thick GS formed wire/3.15mm dia GS wire																							
vi)	Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire																							
2.06.01	The aluminum used for armoring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm-sq.mm/mtr at 20 deg.C. The types and sizes of aluminum armoring shall be same as mentioned for galvanized steel at 2.05.00 above.																								
2.06.02	The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armoring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S. wire/ formed wire.																								
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB-SECTION-B-08 HT, LT AND CONTROL CABLES	PAGE 2 OF 8																					

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.06.03	Distinct extruded PVC inner sheath of black color as per IS:5831 shall be provided for the cables as follows: a) For all multicore cables. b) For single core Armoured cables, where armouring is not being used as metallic screen.			
2.07.00	Outer sheath shall be of PVC black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties. a) Oxygen index of min. 29 (Test method as per IS 10810 Part-58) b) Acid gas emission of max. 20% as per IEC-754 (Part-I) c) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTM-D-2843.			
2.07.01	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3.			
2.08.00	Allowable tolerances on the overall diameter of the cables shall be +\ -2 mm maximum over the declared value in the technical data sheets.			
2.09.00	Cable lengths shall be considered in such a way that straight through cable joints is avoided.			
2.010.00	Multicore cable are allowed upto 300sq mm only. All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated. However, for cable sizes upto 120 sq.mm. XLPE / PVC insulated LT power cables are acceptable. For LT cables, Same cable sizes to be used for same type & rating of motor i.e if there are three drives for one application, all three-drive motor should be provided with same cables sizes. However as per the design of cable sizing & layout requirements more no of runs of same size cable may be used.			
2.011.00	Cores of the cables shall be identified by coloring of insulation. Following color scheme shall be adopted: i. 1 core - Red, Black, Yellow or Blue ii. 2 core - Red & Black iii. 3 core - Red, Yellow & Blue iv. 4 core - Red, Yellow, Blue and Black v. 5 core - Red, Yellow, Blue, Black and Grey			
2.012.00	For reduced neutral conductors, the core shall be black.			
2.013.00	In plant repairs to the cables shall not be accepted. Pimples, fisheye, blow holes etc. are not acceptable.			
2.014.00	The cross-sectional area of the metallic screen strip/tape/wires shall be considered in sizing calculations.			
2.015.00	The eccentricity of the core shall not exceed 10% and ovality not to exceed 2%.			
2.016.00	Multicore cable having same insulation color shall be provided with legible core identification.			
2.017.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath. (a) Cable size and voltage grade - To be embossed			
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CLAUSE NO.	TECHNICAL REQUIREMENTS 
<p>3.00.00</p> <p>3.00.01</p> <p>3.00.02</p> <p>4.00.00</p> <p>4.00.01</p> <p>4.00.02</p>	<p>(b) Word 'FRLS' at every 5 metre - To be embossed</p> <p>(c) Sequential marking of length of the cable in metres at every one metre - To be embossed / printed</p> <p>(d) ISI Marking/BIS/CML number – To be embossed / printed</p> <p>The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.</p> <p>CABLE SELECTION & SIZING</p> <p>Cables shall be sized based on the following considerations:</p> <p>a) Rated current of the equipment</p> <p>b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage</p> <p>c) Short circuit withstand capability</p> <p>Derating Factors</p> <p>Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:</p> <p>a) Variation in ambient temperature for cables laid in air</p> <p>b) Grouping of cables</p> <p>c) Variation in ground temperature and soil resistivity for buried cables.</p> <p>The bidder shall furnish detailed cable selection/sizing criteria for Employer's approval.</p> <p>CONSTRUCTIONAL FEATURES</p> <p>19/33, 11/11 KV Grade Power Cables:</p> <p>Cables shall conform to IS 7098 Part-II. These cables shall be multi-stranded, compacted circular aluminum conductor, XLPE-insulated, metallic screened PVC outer sheathed. The conductor screen and insulation screen shall both be of extruded semiconducting compound and shall be applied along with the XLPE insulation in a single operation of triple extrusion process so as to obtain continuously smooth interfaces. Method of curing for 33/33 KV Cables shall be "dry curing / gas curing ". The metallic screen for each core shall be capable of carrying the system earth fault current and shall consist of copper wires or tape with minimum overlap of 20%. However, for single core Armoured cables, the armouring shall constitute the metallic part of the screening.</p> <p>3.3/3.3kV Grade Power Cables:</p> <p>Cables shall conform to IS: 7098 Part - II. These cables shall be multi- stranded, compacted circular aluminum conductor, XLPE insulated, metallic screened, PVC outer sheathed. The metallic screen of each core shall consist of copper wires or tape with minimum overlap of 20%. However, for single core Armoured cables, the armouring shall constitute the metallic part of the screening. The metallic screen of each core shall be capable of carrying the system earth fault current. Method of curing for cables shall be "dry curing / gas curing / steam curing".</p>
<p>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</p> <p>SUB-SECTION-B-08 HT, LT AND CONTROL CABLES</p> <p>PAGE 4 OF 8</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.00.03	<p>Trailing Cables:</p> <p>Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968</p>			
4.00.04	<p>1.1 KV Grade Power Cables</p> <p>(a) 1.1 KV grade XLPE power cables shall have compacted aluminum conductor, XLPE insulated, PVC inner-sheathed (as applicable), Armoured-PVC outer-sheathed conforming to IS: 7098. (Part-I).</p> <p>(b) 1.1KV grade PVC power cables shall have aluminum conductor (compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) Armoured, PVC outer-sheathed conforming to IS:1554 (Part-I).</p> <p>(c) 1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I). Conductor size shall be 1.5 sq mm, 2.5 sq mm or higher.</p> <p>(d) 1.1 KV grade Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968.</p> <p>(e) Fire survival cable shall be as per relevant indian standard/IS 17505 with 1100 volt grade, 90 Deg.C rating, Power cables with stranded Copper conductor, heat resistance elastomeric insulation generally conforming to Type IE-2 of IS:6380, extruded Halogen free or very low Halogen elastomeric inner sheath, generally conforming to Type SE-3 of IS-6380, round wire/strip armour and extruded outer sheath of elastomeric material generally conforming to Type SE-3 of IS:6380. The cables shall be generally manufactured in conformity to IS-9968 Part-1/1988. The cables shall be rated for 3 hours fire rating.</p> <p>For Fire survival power cable, the armouring is:</p> <p>i) Single core cables to be used in A.C. system, the armouring over inner sheath shall consist of single layer of round copper wire.</p> <p>ii) multi-core cables to be used in A.C. system and single/two core cables in D.C. System, the armouring over inner sheath shall consist of single layer of round galvanized steel wire.</p>			
4.00.05	<p>CABLE DRUMS</p> <p>a) Cables shall be supplied in steel drums of heavy construction. The drum shall be designed on the basis of weight, diameter, bending radius and length of cable. The surface of the drum and the outer most cable layer shall be covered with waterproof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection.</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS																																					
5.00.00 5.01.00	<p>b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.</p> <p>c) The standard drum length for HT power cables with a maximum tolerance of +/- 5%, may be decided by the bidder subject to condition that there shall not be any joint in cable, where application length of cable is up to & including 1000 meter for single core cable, and 750 meter for multicore cable.</p> <p>d) The standard drum length of LT power cable with a maximum tolerance of +/- 5% may be decided by the bidder subject to condition that there shall not be any joint in cable, where application length of cable is up to & including 1000 meter for single core cable excluding 630 sq.m size, and 750 meter for multicore cable & single core 630 sq.m.</p> <p>e) The standard drum length for Control cables with a maximum tolerance of +/- 5% may be decided by the bidder subject to condition that there shall not be any joint in cable, where application length of cable is up to & including 1000 meter.</p> <p>f) One drum length of each cable size can be of non-standard length (not less than 250 meter) so as to match the ordered quantity subject to condition that there shall not be any joint in cable.</p>																																					
	TYPE, ROUTINE AND ACCEPTANCE TESTS																																					
	Type Tests																																					
	The reports for the following type tests shall be submitted for one size each of LT XLPE, LT PVC Power, LT fire survival (IEC 331 Part-1) and control cables. The following type tests shall be carried out on one size each of 19/33 KV & 11/11 KV, 3.3/3.3 KV HT Cables. Size shall be decided by the employer during detailed engineering																																					
	<table><tr><th>S. No</th><th>Type Test</th><th>Remarks</th></tr><tr><td colspan="3">Conductor</td></tr><tr><td>1.</td><td>Resistance test</td><td></td></tr><tr><td colspan="3">For Armour Wires / Formed Wires</td></tr><tr><td>2.</td><td>Measurement of Dimensions</td><td></td></tr><tr><td>3.</td><td>Tensile Test</td><td></td></tr><tr><td>4.</td><td>Elongation test</td><td></td></tr><tr><td>5.</td><td>Torsion test</td><td>For round wires only</td></tr><tr><td>6.</td><td>Wrapping test</td><td></td></tr><tr><td>7.</td><td>Resistance test</td><td></td></tr><tr><td>8(a)</td><td>Mass & uniformity of Zinc Coating tests</td><td>For GS wires/formed wires only.</td></tr><tr><td>8(b)</td><td>Adhesion test</td><td>For GS wires/formed wires only</td></tr></table>	S. No	Type Test	Remarks	Conductor			1.	Resistance test		For Armour Wires / Formed Wires			2.	Measurement of Dimensions		3.	Tensile Test		4.	Elongation test		5.	Torsion test	For round wires only	6.	Wrapping test		7.	Resistance test		8(a)	Mass & uniformity of Zinc Coating tests	For GS wires/formed wires only.	8(b)	Adhesion test	For GS wires/formed wires only	
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S. No	Type Test	Remarks
	For XLPE insulation & PVC Sheath	
9.	Test for thickness	
10.	Tensile strength and elongation test before ageing and after ageing	
11.	Ageing in air oven	
12.	Loss of mass test	For PVC outer sheath only.
13.	Hot deformation test	For PVC outer sheath only.
14.	Heat shock test	For PVC outer sheath only
15.	Shrinkage test	
16.	Thermal stability test	For PVC outer sheath only
17.	Hot set test	For XLPE insulation only
18.	Water absorption test	For XLPE insulation only
19.	Oxygen index test	For PVC outer sheath only
20.	Smoke density test	For PVC outer sheath only
21.	Acid gas generation test	For PVC outer sheath only
22.	Flammability test as per IEC-332 Part-3 (Category -B)	For completed cable only

5.02.00

The following type tests reports for HT Cables shall be submitted for each type (voltage grade) & size of the cable:


S. No.	Type Test For all cables
1.	Insulation resistance test (Volume Resistivity method)
2.	High voltage test
For cables of 19/33kV, 11/11KV, 3.3/3.3KV Grade only.	
3.	Partial discharge test
4.	Bending test
5.	Dielectric power factor test
	a) As a function of voltage
	b) As a function of temperature
6.	Heating cycle test
7.	Impulse withstand test

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>Additional Type test for fire survival cable:</p> <p>i) 3 Hour Fire Survival test IEC-331 --</p> <p>ii) Swedish Chimney Test SS-424-14-75 75 9 (Class F3)</p> <p>iii) Vertical tray flame propagation test IEEE383/74</p> <p>iv) Single Vertical cable fire Resistance Test IEC-332-1</p> <p>Indicative list of tests/ checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of Cables.</p>			
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SUB-SECTION-B – 09


DG SETS

CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>
	DIESEL GENERATORS		
1.00.00	CODES AND STANDARDS		
	DIESEL ENGINE	IS -10000, BS- 5514	
	INTERNAL COMBUSTION ENGINES (12 PARTS)	IS -10000	
	SPEED OF DIESEL GENERATOR	BS649 / 195B	
	ALTERNATOR	IS-4722/IEC-60034, IS12065, IS12075	
	PERMISSIBLE LIMITS OF NOISE LEVEL OF ROTATING MACHINES	IS 12065	
	MEASURE, EVALUATION AND LIMIT OF VIBRATION SEVERITY OF ROTATING ELECTRICAL MACHINES SHAFT 65 mm DIA OR HIGHER	IS 12075	
	DIESEL FUELS – SPECIFICATIONS	IS1460	
	RECOMMENDED PRACTICE FOR HOT-DIP GALVANIZING OF IRON AND STEEL	IS 2629	
	METHODS FOR TESTING UNIFORMITY OF COATING OF ZINC COATED ARTICLES	IS 2633	
	CODE OF PRACTICE FOR FIRE – SAFETY	IS 3034	
	RECIPROCATING INTERNAL COMBUSTION ENGINES	ISO 3046, ISO 15550	
	OSID STANDARD ON LIGHTENING PROTECTION	OISD-GDN-180	
1.01.00	The installation work shall conform to Indian Electricity Act and Indian Electricity Rules as amended up to the date this specification is issued. Any approval required from statutory authorities shall be obtained by the Contractor. Nothing in this specification shall be construed to relieve the Contractor of this responsibility.		
1.02.00	Equipment complying with other internationally accepted standards such as ASA, IEC, BS, VDE etc. will also be considered if they ensure performance and constructional features equivalent to or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted and also furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments in force as on date of opening of bid. Bidder shall clearly bring out the salient features for comparison.		
2.00.00	TYPE		
	Diesel Engine	Stationary type, turbo charged and water cooled.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.00.00	TECHNICAL REQUIREMENTS		
	a)	Ambient temperature	50 degree. (to be considered for deration of alternator)
	b)	Relative Humidity	100%
	c)	Fuel	HSD Fuel as per IS 1460
	d)	Rated Speed	1500 rpm
	e)	Governor (Electronic Type)	A1 type as per BS:5514
	f)	Vibrations	Max. 250 microns peak to peak with anti-vibration pads
	g)	Starting	Electrical self starting
	h)	Fuel service tank	990 litres
	i)	Air intake system	Dry type air filter, 15 micron size or better with 90% efficiency or better
	j)	Cooling	Forced water cooled for Engine & Air cooled for Alternator.
	k)	Paint Shade	Grey RAL9002
4.00.00	GENERAL		
4.01.00	The sizing criteria for the emergency DG set is given in General electrical requirement in General Specification.		
4.02.00	The emergency DG set shall come in to operation in the event of total power failure in the station.		
4.03.00	DG set including stack height, acoustics, air emission and fuel oil installation shall meet the requirement given by gazette notifications of Ministry of Environment & Forest time to time , CPCB guidelines, all statutory requirement of Govt. of India and State Pollution Board Guidelines & as updated as on date of bid opening. Necessary lightening protection shall be provided by the bidder for the stack as per statutory and safety requirements. Bidder shall furnish the detailed break-up for arriving at the capacity of the DG set and also furnish overload capacity with a variation in ambient temperature.		
4.04.00	DG Set shall be located inside acoustic enclosure and suitable for outdoor duty. The bidder shall recommend his own layout and indicate the space requirement. If required, the necessary approval of the installation from statutory authorities shall be taken by bidder. The exhaust shall be discharged through a silencer & stack at a sufficient height. Necessary lightning protection as per OISD standard OISD-GDN-180 shall be provided by the bidder for the stack		
4.05.00	The generating set shall be suitable placed and enclosed so as to meet the technical, functional and statuary requirement like Noise level, IP protection etc.		
4.06.00	Critical speed of the machine shall not be lesser than 120% of the normal speed.		
4.07.00	All couplings shall be capable of withstanding the maximum generator sudden short circuit torque.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>	
4.08.00	Necessary ducting, piping, valves, drains, etc. shall also be provided.		
4.09.00	Maintenance and erection tools and tackles for all the equipment shall be provided by the bidder.		
4.10.00	The DG set shall be capable of starting largest size of emergency 415 V drive (motor) having starting KVA/rated KW ratio of 8 (higher if starting current is more than 8) and starting power factor of 0.2 with terminal voltage drop being restricted to 15%. Generator loading before starting of this motor shall be considered as 50% of generator rating. However, actual motor parameters may be used if available.		
4.12.00	The DG set shall also be able suitable for 12 hours continuous running of which one hour at 10% overload at rated speed.		
4.11.00	BHP rating of the engine shall be Limited-time running Power (LTP) as per ISO 8528-1 considering deration for 50 deg C ambient temperature		
4.13.00	The DG set shall be able to deliver specified net electrical out put while supplying power / driving all electrical and mechanical auxiliaries connected to alternator terminals and engine shaft.		
5.00.00	DUCTING, PIPING VALVES AND FITTINGS		
5.01.00	The engine shall be supplied with all necessary silencer, exhaust, piping, valves and fittings for the fuel oil, lubricating oil, engine starting, air inlet and engine exhaust system, along with expansion joints, drain plugs, flanges and their support structure etc.		
5.02.00	Necessary starters for ventilation fans/ exhaust fans / acoustic enclosure and priming pump motors etc. shall be in the scope along with necessary AC distribution board, cables and cabling. Distribution board shall be metal enclosed, compartmentalized, wall/structure mounted and shall be fabricated out of cold rolled sheet steel of thickness 1.6mm with degree of protection of IP-54. The same shall be provided inside the acoustic enclosure. The alternator outgoing supply of DG Set shall be fed into bidder's breaker panel.		
6.00.00	OPERATIONAL REQUIREMENTS		
6.01.00	Starting and Control.		
6.01.01	All DG Sets shall be controlled independently through separate control panel. It shall also have auto initiation through a 'No volt relay 'and' Auto position of auto/manual selector switch. Subsequent loading of the set shall also be automatic up to a preset value. It shall also have auto initiation through command from remote panel/ central control room. The DG set shall have suitable control arrangement so as to meet functional/control requirement mentioned elsewhere in the specification. Necessary relays, contactor etc for the purpose shall be included. Also three (3) attempt starting facility shall be provided.		
6.01.02	The starting time required from the initiating signal until the operating speed and voltage is attained and the engine and generator are ready to take load, shall not be greater than 30 seconds. Three attempt starting facility shall be provided either by using two impulse timer and a summation timer or by using microprocessor based controller along with auxiliary panel if any. The DG set shall lockout automatically in case of failure of above. The DG shall be capable of being stopped manually from remote as well as local. Interlock shall be provided in DG		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>control panel to prevent shutting down operation (when in auto mode) as long as the circuit at generator output is closed.</p>			
6.01.03	<p>For electrical self starting system the source of energy shall be batteries backed up by battery chargers which shall be supplied</p>			
6.01.04	<p>The starter motor shall conform to IS: 4722.</p>			
6.01.05	<p>The fuel oil system and the lubricating oil shall also start operating simultaneously and automatically as soon as a starting impulse is received to obviate any chance of seizure of the piston and bearing as well as air locking in fuel supply system.</p>			
6.02.00	Battery and Battery Charger			
6.02.01	<p>The battery for starting the engine shall be capable of performing six (6) normal start without recharging The charger shall be protected by a suitable current limiting device. The battery shall be sized for site minimum temperature. Battery and battery charger shall also feed the control supply of DG control panel. The minimum voltage at the end of load cycle shall not be less than 1.75 volts per cell.</p>			
6.02.02	<p>A suitable battery charger shall be housed inside the panel to recharge the battery within ten hours. The battery charger shall be SMPS based automatic and shall be complete with the following</p> <div><div>a.</div><div>DC voltmeter</div><div>b.</div><div>DC Ammeter</div><div>c.</div><div>Float / Boost selector switch Auto / Manual selector switch for Boost to float change over.</div><div>d.</div><div>The charger shall have necessary filters to reduce the ripple factor less than three (3) and suitable dropping characteristics by means of choke and/ or suitable input transformer impedance to automatically reduce the charging current as the battery gradually charges up</div></div>			
6.02.03	<p>The battery shall be of at least 24V 360 AH or 2 sets of 2 numbers of 12 V, 180 AH battery connected in parallel and shall conform to the requirements of IS : 7372 /IEC:60095. The battery with Polypropylene containers meeting the other technical requirements of IS: 7372 may be acceptable</p>			
7.00.00	DIESEL GENERATOR CONTROL PANEL			
7.01.01	<p>The local control panel shall be of robust construction, floor mounting, free standing type made of 2.0 mm thick CRCA sheet steel including doors and Partition. Neoprene gaskets shall be provided between all openings and joints. It shall be provided with hinged door with locking arrangement. The control panels shall have IP-54 degree of protection as per IS: 13947 Part-I.</p> <p>Control panel with provision for local starting shall be provided. This shall incorporate all controls required for starting, monitoring, regulating and stopping DG set. It shall be equipped with all necessary instrumentation to provide adequate surveillance of DG set under all operating conditions including ‘Standby’.</p> <p>All cables shall be bottom entry. Enough space shall be provided in the control panel for easy access during maintenance and repairs.</p> <p>A tinned copper/ aluminum bus-bar of adequate dimension shall be provided for earth connection complete with nuts and bolts as required for external connection to earth grid.</p> <p>CT shorting links, test terminal blocks etc. shall be provided. All the equipment mounted inside the control panel shall be identified by lamicoid labels/ stenciling by paint. Panel shall be provided with panel illumination lamp operated by the door</p>			
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7.02.00	<p>switch and thermostat-controlled space heater. Control panel shall be furnished complete with all accessories and wiring for safe and trouble free operation of the system.</p> <p>The Control panel shall be complete with the following</p> <p>(i) Microprocessor base control unit</p> <p>Microprocessor base control unit with following.</p> <ul style="list-style-type: none">(a.) Voltage sensing mains supply failure monitor(b.) Auto engine start / stop & failure to start lock out.(c.) Generator voltage & frequency sensing(d.) Selector switch and push button to facilitate remote starting/stopping, speed & voltage control(e.) Manual / Auto / Test selector switches(f.) DG start /stop push button(g.) DG Incomer Breaker close / trip push button(h.) Mains breaker close / trip push button(i.) Auto manual Speed adjustment(j.) Auto manual Voltage adjustment(k.) Auto manual selector switch for priming pump motor (if required) <p>(ii) LED indication lamps</p> <p>LED indication lamp shall be provided for the following</p> <ul style="list-style-type: none">(a.) 'DG ON' indication lamp'(b.) DG Breaker ON' indication lamp(c.) 'Mains ON' indication lamp(d.) 'Mains Breaker ON' indication lamp.(e.) Charger ON indication lamp. <p>(iii) Annunciation</p> <p>Annunciation for the following shall be provided with fault indication, alarm & trip contact, accept, reset and test facility. Any one or more of the following defects shall cause the alarm or running diesel generator to be tripped. In case of tripping, re-start shall be prevented until the fault(s) are removed and manual resetting is done. Separate indicators shall be provided for each of the following in control panel:</p> <ul style="list-style-type: none">(a.) Engine fails to start(Alarm)(b.) Low lube – oil pressure.(Trip)(c.) High cooling water temperature.(Trip)(d.) D.G. overload.(Alarm)(e.) DC failure(f.) DG over speed(Trip)			
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	<div><div><div>(g.) Fuel level low in day tank(Alarm)</div><div>(h.) Fuel level very low in day tank(Trip).</div><div>(i.) Generator stator temperature high.(Alarm)</div><div>(j.) Electrical protection operated.(Trip)</div><div>(k.) Incomer to emergency switchgear from DG closed.</div><div>(l.) Earth fault (alarm) input from switchgear.</div><div>(m.) Lube Oil Priming Pump 'Fault' indication (if applicable)</div></div><div><div>(iv) Metering</div><div>Following meters shall be provided in the panel:</div><div><div>(a.) AC voltmeter</div><div>(b.) AC Ammeter</div><div>(c.) Frequency meter</div><div>(d.) Electronic Kwh meter with counter display.</div><div>(e.) KW meter</div><div>(f.) PF Meter</div></div></div></div>			
7.03.00	Suitable 4-20mA transducers with dual output shall be provided in the control panel for voltmeter & frequency meter readings at remote use.			
7.04.00	<div>In addition, coupling relays (with diodes) having 24V DC or suitable energizing coil in the control panel shall be provided for remote application for the followings</div> <div><div>(a.) DG Start</div><div>(b.) DG Stop</div><div>(c.) DG Voltage raise</div><div>(d.) DG voltage lower</div><div>(e.) DG speed raise</div><div>(f.) DG speed lower</div><div>(g.) DG auto start</div></div>			
7.05.00	<div>For issuing simultaneous start command to standby DG set, there shall be set of three (3) aforesaid coupling relays in case of standby DG set. Provision for following status/ signal shall also be provided in the DG control panel:</div> <div><div>(a.) DG fail to start.</div><div>(b.) DG start command actuated/ reset.</div><div>(c.) DG working/ stop signal.</div><div>(d.) DG trouble/ normal signal.</div><div>(e.) DG control supply failure/ normal signal.</div></div>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>			
7.06.00	The requirement of CT, VTs, relays, timers, auxiliary contacts shall be as per the system requirement.				
7.07.00	The bidder shall supply any other controls and indications for diesel generator set though not specifically mentioned here but which the supplier may recommend and are required to make system complete for satisfactory operation of DG sets.				
7.08.00	Necessary pressure switches, level switches, thermostats, flow switches, auxiliary relays, etc. required for the above alarm and annunciation system shall be furnished under the scope of this specification.				
7.09.00	Panel shall be provided with panel illumination lamp operated by the door switch and thermostat-controlled space heater. Control panel shall be furnished complete with all accessories and wiring for safe and trouble free operation of the system				
7.10.00	All fuses shall be of HRC cartridge link type. Screw type fuses are not acceptable				
7.11.00	Relays				
7.11.01	A voltage relay for sensing the supply to control Panel shall be provided. The relay shall operate at about 90% of voltage and shall be English Electric type VAG 11 or equivalent				
7.12.00	Indicating lamps shall be of the panel mounting LED type with series resistor and of low power consumption. Lamps shall be provided with series resistor built-up lamp assembly				
8.00.00	DIESEL ENGINE				
8.01.00	Construction Features				
	(a) Diesel engine shall be mounted on visco damper type vibration dampening system or equivalent anti-vibration mounting system (as recommended by Engine manufacturer) and shall be complete with integral air intake through dry type air filters and exhaust systems, metering facility, speed regulation system, fuel injection system, lube oil system, primary cooling water system along with necessary filters, silencers, ducts, exhaust, piping and fittings, valves, instruments, etc. as required.				
	(b) The generating unit shall be complete with all auxiliaries and its performance, torsional vibration, materials and workmanship, etc. shall be in accordance with the standard practices of diesel engine manufacturer's association in USA. IS-10000, BS-5514. The engine shall be properly balanced so as to transmit only small unbalanced forces to the foundation.				
8.02.00	DIESEL OIL SYSTEM				
	(a) The diesel oil system as provided shall be complete with simplex type filters, hoses, piping, fittings, relief valves, supports, control and instrumentation and all other accessories to make it complete.				
	(b) The fuel consumption of the engine at full and three quarters of its rated power output shall be indicated.				
	(c) A day oil tank of 990 litres fuel capacity shall be provided, mounted on fabricated steel platform outside the acoustic enclosure. The tank shall be complete with level indicator marked in Litres, two nos. of level switches, filling inlet with removable screen, an				
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. All pipe joints shall be brazed/ welded.			
8.03.00	Lubricating oil System (a.) Automatic pressure lubrication shall be provided by a shaft driven gear type pump through an oil cooler and fin mesh filters to the end bearing, camshaft bearings, camshaft chain and gear drives, governor, air starting, distribution, auxiliary drive gears etc. (b.) Hand driven and/ or A.C. motor driven lube oil priming pump (if applicable) along with starter is to be provided as recommended by the engine manufacturer. (c.) All necessary accessories like pressure gauges, temperature and oil level indicators, pressure relief valves, bypass valves, pressure switches for alarm and control shall be furnished together with all inter connecting piping, fittings, supports, valves, etc. (d.) A lubricating oil filter shall be provided for operation under normal conditions for period of a more than 250 hours without the necessity of its replacement or cleaning.			
8.04.00	Cooling System In case, Jacket water cooling system is offered, same be in closed cycle and shall have radiator located in front of the engine with a fan driven mechanically from the engine shaft. Forced water circulation by means of pump driven by the engine shaft shall be employed. The radiator tubes shall be of copper with sufficient heat transfer area.			
8.05.00	Governing System (a) The governor shall be electronic type with class A1 type as per BS-5514. (b) The governor shall have necessary characteristics to maintain the speed substantially constant even with sudden variation in load. However a tripping shall be provided even if speed exceeds the maximum permissible limit.			
8.06.00	Ancillary Equipment The following equipment as per system requirements shall be included: (a.) Flywheel (b.) Fuel piping (c.) RPM indicator (d.) Lubricating oil cooler (e.) Exhaust silencer and piping (f.) Fuel and lubricating oil filters, air filters. (g.) Temperature indicator for water. (h.) Pressure indicator for lubricating oil (i.) Hand barring gear. (j.) Necessary foundation bolts and base channels for the engine, alternator, fuel service tank and for all other equipment included in this package. (k.) Base frames (l.) Starting equipment (m.) Protective equipment preferably in the form of fuel cut-off solenoid and suitable relays to protect the engine against low lubrication pressure.			
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9.00.00	(n.) Lifting attachment for lifting the complete set or the engine alternator separately.			
	(o.) Radiator.			
	(p) Any other ancillary equipment not specifically mentioned in the specification but are necessary for proper operation and maintenance of the set and safety of operating personnel.			
	GENERATOR			
	i) The generator shall be of totally enclosed or screen protected drip proof and self air cooled type. The generator shall be driven by the Diesel engine in this specification and shall match the same in all respects. The generator shall conform to IEC-60034.			
	ii) AC generator shall be supplied along with it's excitation system, AVR and include all necessary auxiliaries.			
	iii) Rating			
	The Generator shall be star connected 3-phase, 50 Hz synchronous generator and shall have a continuous rating. The operating condition for each electric generator shall be as follows:			
	a) Voltage : 415V			
	b) Frequency : 50 C/S (+3 to-5%)			
c) Power factor : 0.80				
iv) Insulation and Temperature Rise of Windings and Core				
All insulated winding conductors of alternator shall be of copper. The generator stator and rotor windings core insulation and all connections including main and neutral leads shall have insulation conforming to IEC-60034-Pt1. The winding shall be given power house treatment (i.e. two coats of varnish and backing followed by final coat of resin). The total insulation shall be non hygroscopic. The temperature rise of the stator core and mechanical parts in contact with or adjacent to winding shall not exceed the specified limits of IEC-60034-Pt1.				
v) Space heaters				
Suitably rated 240 V, single phase, 50 Hz, space heaters located in lower part of alternator shall be provided to maintain the internal temperature above the dew point to prevent moisture condensation on the insulation when the set is not running.				
vi) Separate terminal boxes shall be provided for phase and neutral side of leads. The terminal boxes shall be dust tight, weather proof phase segregated double walled (metallic as well as insulated barriers) having degree of protection of IP-54 as per IS: 13947..				
vii) Elastimold terminals with protective covers shall also be acceptable. As far as possible connection between exciter and alternator shall be contained within the machine frame and connections carrying AC and DC current shall be segregated from each other. The necessary CT's for differential protection shall be provided on neutral side.				
viii) Alternator vibration level shall not exceed the values as defined in IS:12075. Alternators in case driven by Diesel engine shall be able to withstand vibration level of 9mm/sec. as per BS 5000 Part III. Vibration level shall not exceed the permissible				
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CLAUSE NO.	TECHNICAL REQUIREMENTS																								
		levels for Generator however the same shall in any case not exceed 250 micron peak to peak.																							
	ix)	Resistance element temperature detector shall be installed at the following locations: Six numbers of Duplex type or 12 nos. Simplex type Resistance element Temperature Detectors (RTDs) shall be suitably distributed at locations where highest temperatures may be expected in stator windings and one (1) element in each bearing. The RTD's shall comply with the latest edition of IS:2828.																							
	x)	The generator shall be complete with voltage transformers necessary for AVR/ Synchronization.																							
	xi)	The Main Phase side terminal box shall be suitable for terminating Sandwiched type LT bus ducts/cables. The sizing of the same shall be as per system requirements.																							
	xi)	As far as possible connection between exciter and alternator shall be contained within the machine frame and connections carrying AC and DC current shall be segregated from each other. The necessary CT's for differential protection shall be provided on neutral side. The neutral point shall be brought to DG control panel and shall be connected to 300/110V VT, to be supplied and mounted inside the DG control panel by the bidder for earth fault detection.																							
9.01.00	Excitation System The generator shall be provided with complete excitation system capable of supplying the excitation current of the generator under all conditions of output from no load to full load and capable of maintaining voltage of the generator constant within +/- 1% of set value. The setting range available on voltage regulator shall be at any value with +/- 10% of the rated voltage. It shall be possible to set the same from remote also.																								
9.02.00	TECHNICAL PARAMETERS OF CURRENT AND POTENTIAL TRANSFORMERS TO BE SUPPLIED BY THE BIDDER.																								
9.02.01	Neutral side current transformers for differential protection: <table><tr><td>(a.)</td><td>Type</td><td>Cast resin, bar primary</td></tr><tr><td>(b.)</td><td>Voltage</td><td>660V, 50Hz</td></tr><tr><td>(c.)</td><td>Ratio</td><td>2500/1A</td></tr><tr><td>(d.)</td><td>KPV</td><td>>= 125V</td></tr><tr><td>(e.)</td><td>RCT</td><td>=< 3 ohm</td></tr><tr><td>(f.)</td><td>Class</td><td>PS</td></tr><tr><td>(g.)</td><td>One minute power frequency withstand voltage</td><td>2.5KV</td></tr></table>				(a.)	Type	Cast resin, bar primary	(b.)	Voltage	660V, 50Hz	(c.)	Ratio	2500/1A	(d.)	KPV	>= 125V	(e.)	RCT	=< 3 ohm	(f.)	Class	PS	(g.)	One minute power frequency withstand voltage	2.5KV
(a.)	Type	Cast resin, bar primary																							
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(g.)	One minute power frequency withstand voltage	2.5KV																							
9.02.02	Single phase voltage Transformers (Neutral) <table><tr><td>(a.)</td><td>Type</td><td>Cast resin</td></tr><tr><td>(b.)</td><td>Voltage Ratio</td><td>300/110</td></tr><tr><td>(c.)</td><td>Accuracy</td><td>1.0 class</td></tr><tr><td>(d.)</td><td>Rated Voltage factor</td><td>1.2 continuous</td></tr><tr><td>(e.)</td><td>VA Burden</td><td>20VA</td></tr></table>				(a.)	Type	Cast resin	(b.)	Voltage Ratio	300/110	(c.)	Accuracy	1.0 class	(d.)	Rated Voltage factor	1.2 continuous	(e.)	VA Burden	20VA						
(a.)	Type	Cast resin																							
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CLAUSE NO.	<div style="text-align: center;"> TECHNICAL REQUIREMENTS  </div>		
9.02.03	<div style="display: flex; justify-content: space-between;"> (f.) One minute power frequency withstand Voltage 2.5kV rms </div> <p>Voltage Transformers for Metering</p> <div style="display: flex; justify-content: space-between;"> (a.) Type Cast resin </div> <div style="display: flex; justify-content: space-between;"> (b.) Voltage Ratio 440/110 </div> <div style="display: flex; justify-content: space-between;"> (c.) Accuracy class 1.0 </div> <div style="display: flex; justify-content: space-between;"> (d.) Rated Voltage factor 1.2 continuous </div> <div style="display: flex; justify-content: space-between;"> (e.) Burden 100VA </div> <div style="display: flex; justify-content: space-between;"> (f.) One minute power frequency withstand Voltage 2.5kV rms </div>		
10.00.00	SOUND PROOFING SYSTEM		
10.01.00	Bidder shall furnish design calculation for sound proofing/ ventilation system. The detailed frequency response for noise absorbing characteristic of acoustic material shall be furnished.		
10.02.00	The sound absorptive layer shall comprise of bonded type mineral wool/glass wool of adequate thickness and density to comply the design requirements.		
10.03.00	<p>DG shall be placed in acoustic enclosure. The requirements of acoustic enclosure are as following:</p> <ol style="list-style-type: none"> a. The acoustic enclosure shall be fabricated from 2.0 mm thick CRCA sheet with steel section & frame of suitable size. The construction shall be modular type to facilitate dismantling as required for maintenance. The frame shall be of sufficient stiffness and rigidity. The enclosure shall be suitable for outdoor duty. The sheet and all sections shall be powder coated shade of grey RAL9002. A minimum clear space of 800mm shall be kept inside the enclosure. b. The exposed surface of lining shall be retained in place by minimum 1.0mm thick CRCA/ aluminium perforated sheet. Absorptive lining shall be provided between the perforated sheet and absorbing material. Necessary acoustic sealing shall be done in the panels/ modular unit joints. c. Enclosure shall be provided with adequate lighting. Enclosure shall be provided with adequate number of door and viewing glass. d. All hardware of mild steel shall be electro-galvanized. 		
10.04.00	The door design shall be generally compatible to the enclosure design. The bonded mineral wool slab of adequate thickness shall be used. The door shall be provided with heavy duty hinges and handles. The sealing shall be done with neoprene/ silicon rubber gasket to avoid leakage of noise. The size of the door shall be as per the functional requirements.		
10.05.00	Suitable louvers with acoustic treatment shall be provided as required.		
10.06.00	Ventilation system of adequate capacity shall be provided. The system shall comprise of tubular axial flow fans for air intake and air exhaust with splitter silencer. The ventilation shall be design to ensure required air flow rate as per manufacturer recommendations, after providing necessary acoustic treatment/ silencers in air flow path. The ventilation system shall be design to prevent leakage of sound and temperature shall not increase by more than 5 degree centigrade when DG is running continuously at specified rating.		
10.07.00	The construction of ventilation duct shall be from 1.6 mm thick CRCA perforated sheet. Other constructional details shall be similar to that of the acoustic enclosure.		
10.08.00	The exhaust air from radiator shall be discharge through modular duct of adequate size.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
10.09.00	The acoustic enclosure shall have suitable opening for routing out of Sandwiched type LT bus ducts/cables from alternator terminal box. Further suitable acoustic treatment of the opening shall be done to achieve the desired acoustic level.			
10.10.00	Any other facility required to achieve the desired acoustic level shall be in the bidder's scope.			
11.00.00	TYPE TESTS			
11.02.00	Type test reports for the following type tests shall be submitted:			
11.02.01	Type test reports on Engine This shall be as per ISO 3046/15550			
11.02.02	Type test reports on Alternator (a.) Measurement of resistance (b.) Phase sequence test (c.) Regulation test (d.) Measurement of open circuit and short circuit characteristics (e.) Efficiency test (f.) Temperature Rise Test (g.) Momentary overload test (h.) Over speed test (i.) High Voltage test (j.) Insulation resistance test (both before and after High Voltage Test) (k.) Noise level as per IS:12065 (l.) Vibration as per IS: 12075. (m.) Determination of Deviation of voltage waveform from sinusoidal. (n.) Degree of protection test on control panel for IP-52			
12.00.00	COMMISSIONING CHECKS			
12.01.00	In addition to the checks and test recommended by the manufacturers, the contractor shall supervise the following commissioning test to be carried out on each set at site.			
12.01.01	The battery or compressed air system for starting the engine shall be capable of performing six (6) normal start without recharging.			
12.01.02	Load Test The engine shall be given test run for a period of at least 6 hours. The set shall be subjected to the maximum achievable load as decided by Project Manager without exceeding the specified DG set rating. During the load test half hourly records of the following be taken: (a.) Ambient temperature. (b.) Exhaust temp. if exhaust thermometer is fitted.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<div><div>(c.) Cooling water temp. at a convenient point adjacent to the water output from the engine jacket.</div><div>(d.) Lubricating oil pressure.</div><div>(e.) Speed.</div><div>(f.) Voltage, wattage and current output.</div><div>(g.) Oil tank level.</div></div>			
12.01.03	Insulation Resistance Test for Alternator			
	Insulation resistance in mega-ohms between the coils and the frame of the alternator when tested with a 500 V megger shall not be less than $IR= 2x$ (rated voltage in KV) + 1.			
12.01.04	Check of fuel consumption			
	A check of the fuel consumption shall be made throughout the load run test. The fuel consumption should not exceed the design values.			
12.01.05	Insulation Resistance of Wiring			
	Insulation resistance of control panel wiring shall be checked with 500V megger. The IR shall not be less than one mega ohm.			
13.00.00	FUNCTIONAL TESTS			
	Following functional tests are to be carried out at site:			
13.01.00	Functional tests on control panel.			
13.02.00	Functional tests on starting provision on the engine.			
13.03.00	Functional tests on all field devices.			
13.04.00	Functional tests on DG Set complete with AVR and speed governor.			
14.00.00	MEASUREMENT OF VIBRATION			
	The vibration shall be measured at no load and at load as close to maximum achievable load and shall not exceed 250 microns. Any modification/rectification required to bring down the vibration level with in allowable limits specified by the manufacturer shall be done by the bidder. Vibration test is to be carried out at site.			
15.00.00	Noise Level (Sound Pressure Level) Check			
	Noise level measurement shall be done generally following the guidelines given in IS: 12065. The measurement shall be carried out with a calibrated integrating sound level meter as per IS: 9779. This test is to be carried out at site.			
16.00.00	INSTALLATION OF DG SETS			
	The installation, testing and commissioning of Diesel-Generator sets including all the accessories/equipment as required shall be carried out strictly in accordance with the applicable Codes of practice, statutory requirements the manufacturer's instructions, drawings etc., The Contractor shall provide all tools, equipment's, instruments, fuel and any other facility required for installations, testing and commissioning.			
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SUB-SECTION-B – 10


CABLING EARTHING AND LIGHTNING PROTECTION


CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>																																																		
1.00.00	CODES AND STANDARDS																																																					
1.01.00	<p>All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.</p> <table><tr><td>IS:513</td><td>Cold rolled low carbon steel sheets and strips.</td></tr><tr><td>IS:802</td><td>Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.</td></tr><tr><td>IS:1079</td><td>Hot Rolled carbon steel sheet & strips</td></tr><tr><td>IS:1239</td><td>Mild steel tubes, tubulars and other wrought steel flittings</td></tr><tr><td>IS:1255</td><td>Code of practice for installation and maintenance of power cables upto and including 33 KV rating</td></tr><tr><td>IS:1367 Part-13</td><td>Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).</td></tr><tr><td>IS:2147</td><td>Degree of protection provided by enclosures for low voltage switchgear and control gear</td></tr><tr><td>IS:2309</td><td>Code of Practice for the protection of building and allied structures against lightning.</td></tr><tr><td>IS:2629</td><td>Recommended practice for hot dip galvanising of iron & steel</td></tr><tr><td>IS:2633</td><td>Method for testing uniformity of coating on zinc coated articles</td></tr><tr><td>IS:3043</td><td>Code of practice for Earthing</td></tr><tr><td>IS:6745</td><td>Methods for determination of mass of zinc coating on zinc coated iron & steel articles.</td></tr><tr><td>IS:8308</td><td>Compression type tubular in- line connectors for aluminium conductors of insulated cables</td></tr><tr><td>IS:8309</td><td>Compression type tubular terminal ends for aluminium conductors of insulated cables.</td></tr><tr><td>IS:9537</td><td>Conduits for electrical installation.</td></tr><tr><td>IS:9595</td><td>Metal - arc welding of carbon and carbon manganese steels – recommendations.</td></tr><tr><td>IS:13573</td><td>Joints and terminations for polymeric cables.</td></tr><tr><td>BS:476</td><td>Fire tests on building materials and structures</td></tr><tr><td>IEEE:80</td><td>IEEE guide for safety in AC substation grounding</td></tr><tr><td>IEEE:142</td><td>Grounding of Industrial & commercial power systems</td></tr><tr><td>DIN 46267 (Part-II)</td><td>Non tension proof compression joints for Aluminium conductors.</td></tr><tr><td>DIN 46329</td><td>Cable lugs for compression connections, ring type ,for Aluminium conductors</td></tr><tr><td>BS:6121</td><td>Specification for mechanical Cable glands for elastomers and plastic insulated cables.</td></tr><tr><td></td><td>Indian Electricity Act.</td></tr><tr><td></td><td>Indian Electricity Rules.</td></tr></table>				IS:513	Cold rolled low carbon steel sheets and strips.	IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.	IS:1079	Hot Rolled carbon steel sheet & strips	IS:1239	Mild steel tubes, tubulars and other wrought steel flittings	IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating	IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).	IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear	IS:2309	Code of Practice for the protection of building and allied structures against lightning.	IS:2629	Recommended practice for hot dip galvanising of iron & steel	IS:2633	Method for testing uniformity of coating on zinc coated articles	IS:3043	Code of practice for Earthing	IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.	IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables	IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.	IS:9537	Conduits for electrical installation.	IS:9595	Metal - arc welding of carbon and carbon manganese steels – recommendations.	IS:13573	Joints and terminations for polymeric cables.	BS:476	Fire tests on building materials and structures	IEEE:80	IEEE guide for safety in AC substation grounding	IEEE:142	Grounding of Industrial & commercial power systems	DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.	DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors	BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.		Indian Electricity Act.		Indian Electricity Rules.
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1.02.00	<p>Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE, NEMA etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.</p>																																																					
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB-SECTION B-10 CABLING, EARTHING AND LIGHTNING PROTECTION	PAGE 1 OF 20																																																		


CLAUSE NO.	<p style="text-align: center;">TECHNICAL REQUIREMENTS</p>	
2.00.00	DESIGN AND CONSTRUCTIONAL FEATURE	
2.01.00	Inter Plant Cabling	
2.01.01	<p>Interplant cabling for main routes shall be laid along overhead trestles/duct banks. Cables from main plant to switchyard control room shall be laid in overhead trestles or duct bank. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering. Directly buried cables, if essential, shall not have concentration of more than 4 cables in one route. Cables crossing Railway line (if applicable) shall be laid underground through nearest culvert/through hume pipes/ overhead trestle. Necessary statutory clearance if required shall be taken by Bidder. All HT, LT and control cable shall be armoured.</p>	
2.01.02	<p>Transformer yard In transformer yard cables shall be laid in overhead trestle. The main cable routes coming out from Main plant building and crossing the Transformer yard shall be laid in overhead trestles. In transformer yard, trestle height for rail/road crossing shall be suitable for movement of Generator Transformer with bushing.</p>	
2.01.03	<p>Trenches PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.</p>	
2.01.04	<p>No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant.</p>	
2.01.05	<p>Cable Vault The cable vault/ / cable spreader room space below the HT / LT switchgear room, Control Rooms, unit control equipment room, Programmer room, UPS, Charger & Battery Rooms, shall have 800 mm wide and 2.1 m high movement passage all around the cable trays in the cable vault/ cable spreader room for easy laying/maintenance of cables. However, at Junction location where multiple trays cross each other at such crossing portions, clear height of min 1.8mt shall be maintained.</p> <p>Cable vaults shall be provided with adequate drainage facilities for drainage of fire water. Each cable vault should have at least two fire proof doors preferably diagonally opposite.. Exit signs shall be provided near doors for personnel escape in case of emergency</p>	
2.01.06	<p>Not used</p>	
2.01.07	<p>Two separate cable routes shall be provided for cable routing of working and standby drives or different set/group (say 50% capacity) of auxiliaries.</p>	
2.01.08	<p>For feeder in bidder's scope for areas, overhead cable tray arrangement shall be followed. However cable trenches/slit may also be acceptable, for some areas, if found to be required during detailed engineering.</p>	
2.01.09	<p>Cable trenches provided shall be separated from fuel oil area to avoid oil accumulation. The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling.</p>	
2.01.10	<p>Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum conductor size shall be 6 sq.mm. for aluminium conductor and 2.5 sq.mm. for copper conductor cable.</p>	
2.01.11	<p>Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to:</p> <ul style="list-style-type: none"> Meet all safety requirements 	
<p style="text-align: center;">GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</p>	<p style="text-align: center;">SUB-SECTION B-10 CABLING, EARTHING AND LIGHTNING PROTECTION</p> <p style="text-align: right;">PAGE 2 OF 20</p>

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	<ul style="list-style-type: none">Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc.			
3.00.00	EQUIPMENT DESCRIPTION			
3.01.00	Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.			
3.01.02	Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant clause of this chapter.			
3.01.03	Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm.			
3.01.04	Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanized as per relevant clause of this chapter. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm.			
3.01.05	The tolerance for cable tray and accessories shall be as per IS 2102 (Part-1). Tolerance Class: - Coarse			
3.02.00	Support System for Cable Trays			
3.02.01	Cable tray support system shall be pre-fabricated out of single sheet as per enclosed tender drawings.			
3.02.02	<p>Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder:</p> <ul style="list-style-type: none">a) Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.b) The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fittings and accessories shall be prefabricated factory galvanized.c) The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvansied surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.d) All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation.			
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	<p>e) The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below: The main support channel and cantilever arms shall be fabricated out of 2.5 thick rolled steel sheet conforming to IS 1079.</p> <p>f) Cantilever arms of 170mm 320 mm, 620mm and 750 mm in length are required, and shall be as shown in the enclosed drawing. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.</p> <p>g) Support system shall be able to withstand</p> <ul style="list-style-type: none"> • weight of the cable trays • weight of the cables (75 Kg/Metre run of each cable tray) • Concentrated load of 75 Kg between every support span • Factor of safety of minimum 1.5 shall be considered 	
3.02.03	<p>The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Bidder without any additional cost to the Employer. The bidder shall submit the detailed drawings of the system offered by him along with the bid.</p>	
3.02.04	<p>Four legged structure shall be provided wherever there is change in elevation and change in direction</p>	
3.02.05	<p>Not Used.</p>	
3.03.00	<p>Pipes, Fittings & Accessories</p>	
3.03.01	<p>Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria.</p>	
3.03.02	<p>GI Pipes shall be of medium duty as per IS: 1239</p>	
3.03.03	<p>Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.</p>	
3.03.04	<p>Hume pipes shall be NP3 type as per IS 458.</p>	
3.03.05	<p>Flexible conduit shall be water proof, rust proof, made of heat resistant steel with temperature rating of 150 deg C. Conduit diameter shall be uniform throughout its length. Internal surface of the conduit shall be free from burrs and sharp edges. Conduits shall be complete with necessary accessories for proper termination of the conduit with junction boxes and lighting fixtures.</p>	
3.03.06	<p>HDPE pipes and conduits shall be PE-80, PN-10 type as per IS 4984/IS 8008 part-I.</p>	
3.04.00	<p>Junction Boxes</p>	
3.04.01	<p>Junction box shall be made of Fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. The box shall be provided with the terminal blocks, mounting bracket and screws etc. The cable entry shall be through galvanized steel conduits of suitable diameter. The JB shall have suitable for installing glands of suitable size on the bottom of the box. The JB shall be suitable for surface mounting on ceiling/structures. The JB shall be of grey color RAL 7035. All the metal parts shall be corrosion protected. Junction box surface</p>	
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	<p>should be such that it is free from crazings, blisterings, wrinkling, colour blots/striations. There should not be any mending or repair of surface. JB's will be provided with captive screws so that screws don't fall off when cover is opened. JB's mounting brackets should be of powder coated MS. Type test reports for the following tests shall be furnished:</p> <p>a) Impact resistance for impact energy of 2 Joules (IK07)as per BS EN50102</p> <p>b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb</p> <p>c) Class of protection shall be IP 55</p> <p>d) HV test</p>			
3.04.02	<p>Terminal blocks shall be 1100V grade, of suitable current rating, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side the required cables/wire size. All internal wiring shall be of cu. Conductor PVC wire.</p>			
3.05.00	<p>Terminations & Straight Through Joints</p>			
3.05.01	<p>Termination and jointing kits for 33kV, 11 kV, 6.6 KV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be Pre-moulded type or heat shrinkable type. Further Cold shrinkable type termination and jointing kits are also acceptable. The Cold shrinkable type kits shall be type tested as per relevant standards. Calculation to withstand the required fault level shall also be furnished in case of cold shrinkable type kits. 33 kV, 11 kV, 6.6 KV and 3.3kV grade joints and terminations shall be type tested and Type test reports as per IS:13573 Part-II and IEC60502 shall be furnished. Also, heat shrink material shall comply with requirements of ESI 09-13 (external tests). Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Cable joints and terminations should be with FRLS properties as per IEC 60754-1&2. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the tinned copper solderless crimping type cable lugs & ferrule or mechanical connectors (wherein bolts are tightened that shear off at an appropriate torque) as per DIN standard suitable for aluminium compacted conductor cables.</p>			
3.05.02	<p>Straight through joint and termination shall be capable of withstanding the fault level of 21 KA for 0.12 Sec. with dynamic peak of 52 KA for 33 KV system & of 40 kA for 0.12 sec with a dynamic peak of 100 kA for 11 kV, 6.6 KV & 3.3 KV system. Straight through joints shall have provisions for shield connection and earthing wherever required and complete with all accessories and consumables suitable for storage without deterioration at a temperature of 50 deg. C with shelf life of more than five years. 1.1 kV grade straight through joints shall also be of proven design</p>			
3.05.03	<p>1.1 KV grade Straight Through Joint shall be of proven design</p>			
3.06.00	<p>Cable glands</p> <p>Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better</p>			
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<p>3.07.00</p> <p>3.07.01</p>	<p>synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.</p> <p>Cable lugs/ferrules</p> <p>Cable lugs/ferrules shall be solderless crimping type suitable for power and control cables as per the DIN 46239. Aluminium solderless crimping lugs/ ferrules shall be used for Aluminium cables and Copper lugs/ferrules shall be used for Copper cables. Bimetallic washers or bimetallic type lugs shall be used for bimetallic connections.</p> <p>Crimping tool for crimping (from 1.5sqmm cable to 630sqmm cables) above mentioned lugs shall be of Hexagonal Type crimp profile, with suitable die of crimp match code.</p> <p>Characteristics of crimping tool:</p> <ol style="list-style-type: none"> 1) Tool should generate enough pressure to pass pull out test as per IEC 61238-1. Relevant type test to be produced for the sizes specified in the tender. 2) Tool die shall be replaceable for assorted sizes and crimp code to be mentioned on both part the die 3) Tool should be compliant of testing according to IEC, UL and GS standards <p>Tool shall have features such as</p> <ul style="list-style-type: none"> • Auto retraction system • Manual retraction stop • Feedback signals for improper pressure • Better battery capacity and with status display • Flexible and rotating head for easy crimping <p>3.08.00</p> <p>3.08.01</p> <p>Trefoil clamps</p> <p>Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength, when installed at 1 mtr intervals, to withstand the forces generated by the peak value of maximum system short circuit current</p> <p>3.09.00</p> <p>3.09.01</p> <p>Cable Clamps & Ties</p> <p>The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.</p> <p>3.10.00</p> <p>3.10.01</p> <p>Receptacles</p> <p>Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in/loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break, AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polyimide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with RCCB/RCD of 30mA sensitivity having facility for manual</p>			
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	testing/checking of operation of RCCB/RCD. Location and Minimum no of RC type receptacle TG and SG area shall be provided as per Annex-I attached.			
3.11.00	Cable Drum Lifting Jack The jack for cable drum lifting shall be of screw type with 10 ton capacity. The cable drum jacks shall be manufactured from fabricated steel. The spindles supplied with the cable drum jack shall be manufactured using BSEN-24 grade steel bar with locking collars. Jack nests shall be of SG cast steel. Cable drum jack supplied shall have undergone load testing and reports for the same shall be submitted. At least Two Nos. of jacks shall be supplied for NTPC use. Contractor has to make arrangements for his own jacks for cable reeling/unreeling under his scope of installation.			
3.12.00	Galvanising			
3.12.01	Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 & IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.			
3.12.02	The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified.			
3.13.00	Welding			
3.13.01	The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595.			
4.00.00	INSTALLATION			
4.01.00	Cable tray and Support System Installation			
4.01.01	Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.			
4.01.02	Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with tray loadings/drawings.			
4.01.03	The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated			
4.01.04	The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval and the same shall be finalized at pre-award stage.			
4.01.05	All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.			
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4.01.06	In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.												
4.01.07	In fire prone areas and any other strategic location etc, fire retardant paint to be applied after installation cables. The fire-retardant paint to be applied on cables in all indoor areas of oil Unloading pump house, oil storage/handling area like Main oil tank area, Lube oil tank etc.												
4.02.00	Conduits/Pipes/Ducts Installation												
4.02.01	The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.												
4.02.02	GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.												
4.02.03	Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material												
4.02.04	<div>Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise</div> <table><tr><th>Conduit /pipe size (dia).</th><th>Spacing</th></tr><tr><td>Upto 40 mm</td><td>1 M</td></tr><tr><td>50 mm</td><td>2.0 M</td></tr><tr><td>65-85 mm</td><td>2.5 M</td></tr><tr><td>100 mm and above</td><td>3.0 M</td></tr></table>			Conduit /pipe size (dia).	Spacing	Upto 40 mm	1 M	50 mm	2.0 M	65-85 mm	2.5 M	100 mm and above	3.0 M
Conduit /pipe size (dia).	Spacing												
Upto 40 mm	1 M												
50 mm	2.0 M												
65-85 mm	2.5 M												
100 mm and above	3.0 M												
4.02.05	For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.												
4.03.00	Junction Boxes Installation												
4.03.01	Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.												
4.04.00	Cable Installation												
4.04.01	Cable installation shall be carried out as per IS:1255 and other applicable standards.												
4.04.02	<div>For Cable unloading, pulling etc following guidelines shall be followed in general:</div> <div>a. Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum</div>												
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	<p>shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.</p> <p>b. While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager.</p>			
4.04.03	Cables shall be laid on cable trays strictly in line with cable schedule			
4.04.04	Power and control cables shall be laid on separate tiers inline with the approved guidelines/drawings. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on top most tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every one metre. All multicore cables shall be laid in touching formation. Control and instrumentation cable can be laid in 3 layers subject to maximum cable tray filling upto 80% tray depth only. Power and control cables shall be secured fixed to trays/support with cable clamps/ties with self locking arrangement. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter interval. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by cable clamps/ties with self locking arrangement at every five meter interval and at every bend. Fibre Optical cable shall be laid in trenches/trays or as decided by Employer			
4.04.05	Bending radii for cables shall be as per manufacturer's recommendations and IS:1255.			
4.04.06	Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ HDPE pipe/overhead trestle.			
4.04.07	No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted. Vendor shall identify and accordingly procure the cable drum length.			
4.04.08	In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.			
4.04.09	Wherever few cables are branching out from main trunk route, troughs/ Local Buried Pipe / Slit / branch Trays shall be used.			
4.04.10	Wind loading shall be considered for designing support as well Cable trays wherever required			
4.04.11	Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures			
4.04.12	The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day.			
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	Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time											
4.04.13	Separation At least 300mm clearance shall be provided between: <ul style="list-style-type: none">- HT power & LT power cables,- LT power & LT control/instrumentation cables											
4.04.14	Segregation <ul style="list-style-type: none">1) Segregation means physical isolation to prevent fire jumping2) All cables associated with the unit shall be segregated from cables of other units3) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set4) In switchyard, control cables of each bay shall be laid on separate racks/trays											
4.04.15	Minimum number of spare cores required to be left for interconnection in control cables shall be as follows: <table><tr><td>No. of cores in cable</td><td>No. of spare cores</td></tr><tr><td>2C,3C, 5C</td><td>1</td></tr><tr><td>6C-10C</td><td>2</td></tr><tr><td>14C and above</td><td>3</td></tr></table>				No. of cores in cable	No. of spare cores	2C,3C, 5C	1	6C-10C	2	14C and above	3
No. of cores in cable	No. of spare cores											
2C,3C, 5C	1											
6C-10C	2											
14C and above	3											
4.04.16	Directly Buried Cables <ul style="list-style-type: none">a) Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS:1255 and the enclosed drawings showing cabling details.b) RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.											
4.04.17	Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags. The cable tag requirements mentioned above shall prevail over Tag requirements mentioned elsewhere in this document for HT power, LT power & control cables.											
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4.04.18	While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.		
4.05.00	Cable Terminations & Connections		
4.05.01	The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site		
4.05.02	Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.		
4.05.03	The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.		
4.05.04	Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.		
4.05.05	All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, ---etc along with cable numbers and coiled up after end sealing.		
4.05.06	All cable terminations shall be appropriately tightened to ensure secure and reliable connections.		
5.00.00	EARTHING SYSTEM		
5.01.00	Earthing system shall be in strict accordance with IS:3043 and Indian Electricity Rules/Acts. The earthing system shall be designed for a life expectancy of at least forty (40) years, for a system fault current of as specified in relevant chapter of the specification. The minimum rate of corrosion of steel for selection of earthing conductor shall be 0.12mm per year. Earthing system network/earthmat shall be interconnected mesh of mild steel rods buried in ground in the plant. All areas under contractor scope of supply shall be interconnected together by minimum two parallel conductors. The Contractor shall furnish the detailed design and calculations for Employer's approval. Contractor shall obtain all necessary statutory approvals for the system. All the columns shall be earthed by nearby risers and earthmat grid spacing shall be maximum 15 mts Separate dedicated riser shall be provided for C&I earthing purpose and also for Lightning down conductor connection purpose. Sufficient nos of risers near the equipment shall be provided as per the system requirement. Ring type earthing around the offsite building shall be provided with interconnection of with main grid at minimum two points.		
5.02.00	The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects.		
5.03.00	The material of the earthing conductors shall be as follows:		
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5.04.00	1. Conductors above ground level and in built up trenches. - Galvanized steel			
	2. Conductors buried in earth - Mild steel			
	3. Earth electrodes - Mild steel rod			
	The sizes of earthing conductors for various electrical equipments shall be as below:			
	Equipment	Earth conductor buried in earth	Earth conductor above ground level & in built-up trenches	
	i. Main earth grid	Min 40 mm dia. MS rod or as per actual calculation whichever is more	65 x 8mm GS flat	
	ii. 33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear	---	65 x 8mm GS flat	
	iii. 415 V MCC/ Distribution boards / Transformers	---	50 x 6mm GS flat	
	iv. LT Motors above 125 KW	---	50 x 6mm GS flat	
	25 KW to 125 KW	---	25 x 6mm GS flat	
5.05.00	1KW to 25 KW	---	25 x 3mm GS flat	
	Fractional House power motor	---	8 SWG GS wire	
	v. Control panel & control desk	---	25 x 3 mm GS flat	
	vi. Push button station / Junction	---	8 SWG GI wire	
	vii. Columns, structures, cable trays and bus ducts enclosures	---	50 x 6mm GS flat	
	viii. Crane, rails, rail tracks & other non-current carrying metal parts		25 x 6mm GS flat	
	ix. Along cable Tray & supporting structure	---	50 x 6mm GS flat	
	x. Along cable Trough & supporting structure	---	25 x 6mm GS flat	
	Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, Crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise approved. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable.			
5.06.00	A continuous 50x6 mm (minimum size) GS Flat earthing conductor shall run along the cable tray and supporting structure of all cable routes. A continuous 25x3 mm (minimum size) GS Flat earthing conductor shall run along the cable troughs and supporting structure of all branch cable routes.			
5.06.02	Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 meter. Wherever earth mat is not available, necessary connections shall be done by driving an earth electrode in the ground.			
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5.07.00	Transformer neutral shall be connected to earth mat through 2 No, treated earthing pit and shall meet the statutory requirements. Neutral points of HT transformer shall be earthed through NG resistors. The Contractor shall connect the NGR earthing point to 2No treated earth pit by suitable earth conductors.		
5.08.00	Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.		
5.09.00	Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti corrosive paint/compound.		
5.10.00	Suitable earth risers as approved shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.		
5.11.00	Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding.		
5.12.00	Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.		
5.13.00	Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawing. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm.		
5.14.00	Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.		
5.15.00	A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductors crossings the road can be installed in pipes. Wherever earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same.		
5.16.00	Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.		
5.17.00	Earth pit shall be of treated type & shall be constructed as per IS:3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with salt and charcoal as per IS:3043. Test links shall be provided with bolted arrangement along with each earth pit, in order to facilitate measurement of earth resistance as & when required.		
5.18.00	On completion of installation continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured and recorded. All equipment required for testing shall be furnished by contractor.		
5.19.00	Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.20.00	Other Requirements of Earthing System: Standard/Code Earthing System Life expectancy System Fault Level Soil resistivity Min. Steel corrosion Depth of burial of main earth conductor Conductor joints Surface resistivity	IEEE 80, IS 3043 40 Years As per System Fault Level Actual as per site conditions 0.12mm/year 600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them. By electric arc welding, with resistance of joint not more than that of the conductor. Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection - Gravel 3000 ohm-meter - Concrete 500 ohm-meter	
6.00.00	LIGHTNING PROTECTION SYSTEM		
6.01.01	Lightning protection system shall be in strict accordance with IEC : 62305 and latest IS standards.		
6.01.02	Lightning conductor shall be of 25x6mm GS strip when used above ground level and shall be connected through test link with earth electrode/earthing system.		
6.01.03	Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc. as per approved drawings.		
6.02.00	Down Conductors 1. Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode. 2. Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be in accessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point. 3. All joints in the down conductors shall be welded type. 4. Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval. 5. Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1500 mm. 6. All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system. 7. Lightning conductors shall not pass through or run inside GI Conduits. 8. Testing link shall be made of galvanized steel of size 25x 6mm. 9. Pulser system for lightning shall not be accepted. 10. Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths.		
7.00.00	TESTS		
7.01.00	Type Test reports shall be furnished for the following		
7.01.01	Type tests on Cable Trays support system		
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	<div>a) Test 1A: On main support channel type-C2 for cantilever arms fixed on one side only. A 3.5 meter length of main support channel shall be fixed vertically at each end to a rigid structure as per the fixing arrangement as shown in the enclosed drawing. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the points shown in the enclosed drawings and at the following load intervals:<div><div>i. Working load</div><div>ii. Working load + point load</div><div>iii. Off load</div><div>iv. Proof load + point load</div><div>v. Off load</div></div> The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied</div> <div>b) Test 1B Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2</div> <div>Test 2: On Main support channel type -C2 for cantilever arms fixed on both sides</div> <div>a) Test 2A: A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per the fixing arrangement as shown in the enclosed drawing. Six (6), 750 mm cantilever arms shall be attached to each side and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals.<div><div>i. Working load</div><div>ii. Working load + point load</div><div>iii. Off load</div><div>iv. Proof load + point load</div><div>v. Off load</div></div> The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied</div> <div>b) Test 2 B: The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side</div> <div>Test 3: Tests on Channel Fixed on Beam/Floor A length of main support channel section shall be fixed to steel structure/floor and have loads applied as shown in the drawing enclosed and as detailed below:</div> <div>a) Test 3A: A length of steel structure shall be rigidly supported. It should be fitted on a meter length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall</div>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB-SECTION B-10 CABLING, EARTHING AND LIGHTNING PROTECTION	PAGE 15 OF 20	

CLAUSE NO.	<div style="text-align: center;">TECHNICAL REQUIREMENTS</div> <div style="text-align: right;"></div>			
7.02.02	<p>be applied to the centre point via two brackets. No distortion or pulling of the components shall take place</p> <p>b) Test 3B: With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place</p> <p>c) Test 3C: With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line</p> <p>The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded</p> <p>Test 4 : Channel Insert Test</p> <p>A 2.5 m length of C1 channel fixed to the concrete wall/ steel structure as per actual site installation conditions. 6 nos. of 750 mm cantilever arms shall be attached to C1 channel as shown in enclosed drawing. Each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall then be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals.</p> <ol style="list-style-type: none"> i. Working load ii. Working load + point load iii. Off load iv. Proof load + point load v. Off load <p>The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.</p> <p>Test 5 : Channel nut slip characteristics (whatever applicable)</p> <p>Tests 5A1,5A2,5A3 : A length of channel C1 section 200mm long shall have fitted bracket with the two bolt fixing as shown in drawing enclosed.</p> <p>With loads applied at the position shown in drawing enclosed nut slip shall be determined with bolt torque of 30NM, 50 NM and 65 NM No fewer than three measurements shall be made for each torque setting.</p> <p>A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM</p> <p>Tests 5B1,5B2,5B3: The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing as shown in drawing enclosed. With loads applied at the position shown in drawing, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting</p> <p>A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 65 NM</p> <p>Test 6 Weld Integrity Test</p> <p>After deflection test as per test 1A, 1B, 2, 3 & 4 weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any.</p> <p>Cable termination kit and straight through joints should have been tested as per IS:13573 for 3.3kV grade & above.</p>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB-SECTION B-10 CABLING, EARTHING AND LIGHTNING PROTECTION	PAGE 16 OF 20

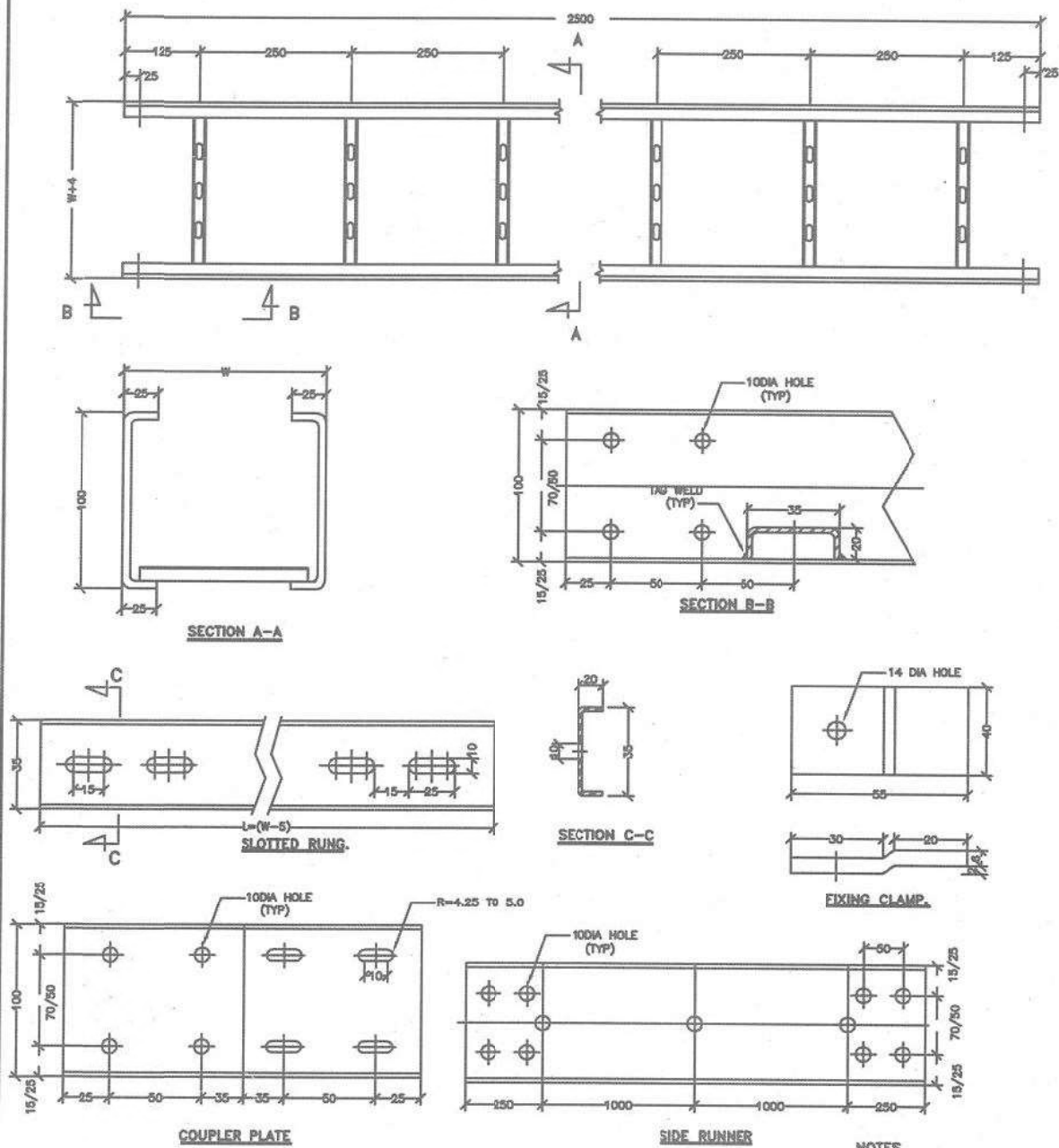
CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>		
7.03.00	Routine/ Acceptance Tests			
7.03.01	<p>Routine Tests</p> <p>a) Routine tests as per specification and applicable standards shall be carried out on all requirements/items covered in the specification</p> <p>b) Physical & dimensional check on all equipments as per approved drawings/standards</p> <p>c) HV/IR as applicable</p> <p>d) Check/measurement of thickness of paint/zinc coating/nickel-chrome plating as per specification & applicable standard</p>			
7.03.02	<p>Acceptance Test</p> <p>a) Galvanising Tests as per applicable standards</p> <p>b) Welding checks</p> <p>c) Deflection tests on cable trays</p> <p>One piece each of 2.5m length of cable tray of 300mm & above shall be taken as sample from each offered lot. It shall be supported at both end & loaded with uniform load of 76 kg/meter along the length of cable tray. The maximum deflection at the mid-span of each size shall not exceed 7mm</p> <p>d) Proof load tests on cable tray support system</p> <p>i. Tests on Main Support Channel shall be done if only C1 Channel are in scope of supply and cantilever arms shall be fitted on one side. This test shall be same as test 4 of type test.</p> <p>ii. Test on Main Support Channel shall be done with C2 channel and cantilever arms fitted on both sides, if C2 channels are in scope of supply. This test shall be same as test 2A of type test. Then test (i) above shall not be done.</p> <p>iii. Nut slip characteristic test (it shall support minimum load of 350kg before nut slips with a bolt torque of 65 NM). This test shall be same as test 5B3 of type test</p> <p>The procedure for carrying out tests at “d” above shall be as per details given in Type Tests in specification thereafter Die-Penetration test shall be carried out to check weld integrity</p> <p>e) The above acceptance tests shall be done only on one sample from each offered lot.</p>			
8.00.00	COMMISSIONING			
8.01.01	<p>The Contractor shall carry out the following commissioning tests and checks after installation at site. In addition the Contractor shall carry out all other checks and tests as recommended by the Manufacturers or else required for satisfactory performance</p>			
8.01.02	<p>Cables</p> <p>i. Check for physical damage</p> <p>ii. Check for insulation resistance before and after termination/jointing</p> <p>iii. HT cables shall be pressure tested (test voltage as per IS:7098) before commissioning</p> <p>iv. Check of continuity of all cores of the cables</p> <p>v. Check for correctness of all connections as per relevant wiring diagrams. Any minor modification to the panel wiring like removing/inserting, shorting, change in terminal connections, etc., shall be carried out by the Contractor.</p> <p>vi. Check for correct polarity and phasing of cable connections</p>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB-SECTION B-10 CABLING, EARTHING AND LIGHTNING PROTECTION	PAGE 17 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>									
8.02.00	vii. Check for proper earth connections for cable glands, cable boxes, cable armour, screens, etc.												
	viii. Check for provision of correct cable tags, core ferrules, tightness of connections												
	Cable trays / supports and accessories												
8.03.00	1. Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories.												
	2. Check for continuity of cable trays over the entire route.												
	3. Check that all sharp corners, burrs, and waste materials have been removed from the trays supports.												
9.00.00	4. Check for earth continuity and earth connection of cable trays.												
	Earthing and Lightning protection system												
	1. Earth continuity checks.												
9.00.00	2. Earth resistance of the complete system as well as sub-system.												
	ELECTRICAL LAYOUT PHILOSOPHY:												
	While developing the layout the bidder must give due consideration to the following requirements:												
9.00.00	a) Adequate distance shall be maintained between the transformers. As basic guidelines following norms will be adhered to:												
	1. Transformers shall be separated from the adjacent building/structures and from each other by a minimum distance as defined below or by a fire wall of two hours of fire resisting of height at least 600 mm above bushing / pressure relief vent whichever is higher.												
	<table><tr><td>Oil capacity of individual transformer (in liters)</td><td>Clear separating distance (in meters)</td></tr><tr><td>5,000 to 10,000</td><td>8.0</td></tr><tr><td>10,001 to 20,000</td><td>10.0</td></tr><tr><td>20,001 to 30,000</td><td>12.5</td></tr><tr><td>Over 30,001</td><td>15.0</td></tr></table>				Oil capacity of individual transformer (in liters)	Clear separating distance (in meters)	5,000 to 10,000	8.0	10,001 to 20,000	10.0	20,001 to 30,000	12.5	Over 30,001
Oil capacity of individual transformer (in liters)	Clear separating distance (in meters)												
5,000 to 10,000	8.0												
10,001 to 20,000	10.0												
20,001 to 30,000	12.5												
Over 30,001	15.0												
9.00.00	2. In case of auxiliary transformers having an aggregate oil capacity in excess of 2300 liters but individual oil capacity of less than 5000 liters, the maximum separating distance between transformers and surrounding building shall be at least 6M unless they are separated by fire separating walls or are protected by high velocity spray system												
	3. Rail track shall be provided in Transformer yard for movement of each transformer. The rail track in Transformer yard shall be connected with other area rail track The Foundation top of transformer & rail top shall be at EL +/- 0.0M. Bus duct support or Transformer body shall be at least 8.0M from building to clear the movement of transformers on rail line. Jacking pads shall be provided where the rail track changes the direction. Mooring post shall be provided on rail track for handling the transformers												
	4. For each transformer a pit shall be provided all around at a distance of 1.5 m (minimum) from transformer outer edge. A sump pit shall be provided for each pit. A common oil retention pit per unit shall be provided to hold oil quantity of the largest transformer (by volume) & 10 minutes of water quantity of HVW spray system for the largest transformer. Sump pit of individual transformer shall be connected to common oil retention pit of that unit.												
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2		SUB-SECTION B-10 CABLING, EARTHING AND LIGHTNING PROTECTION	PAGE 18 OF 20								

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<div><div><div>5. Rail track shall be provided for all outdoor transformers up to road for movement of each transformer of size more than or equal to 7.5MVA Transformer. Jacking pads shall be provided where the rail track changes the direction. Jacking pad shall also be provided at the location of installation of transformer and mooring post shall be provided on rail track for handling the transformers.</div><div>6. The Transformer fencing shall be at 1.0 M (minimum) distance from the pit wall. The Height of fencing shall be 2.5 M (minimum) and fencing shall have personal entry gate and removable type fencing/gate for transformer withdrawal.</div><div>7. The transformer firewall, pit sizing and clearances from adjacent building/structures etc. shall be as per IS 1646/CBIP manual on Transformer</div><div>8. However, for all outdoor transformers of oil capacity less than 2000 litre, a trench of suitable size shall be provided all around at a distance of 1.0 m (minimum) from transformer outer edge. A sump pit shall be provided for each trench.</div></div><div>b) Layout requirements for Electrical MCC/switchgear rooms</div><div><div>1. Not Used</div><div>2. The following clearances shall be maintained for HT Switchboard</div><div><div><div>i) For one Row of Swgr.</div><div>-</div><div>2.0 M (Min)</div></div><div><div>ii) For two Rows of Swgr.</div><div>-</div><div>2.5 M (Min)</div></div><div><div>b.) Back Clearance</div><div>-</div><div>1.5 M (Min.)</div></div><div>c.) Side Clearance</div><div>Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore end clearance shall be 800+width of panel (including spare panels/dummy panels etc.)</div><div>3. The following clearances shall be maintained for LT Switchboard.</div><div><div>a.) Front Clearance</div><div><div><div>i) For one Row of Swgr</div><div>-</div><div>1.5M (Min)</div></div><div><div>ii) For two Rows of Swgr</div><div>-</div><div>1.5/1.75M depending upon the depth of panels etc</div></div><div>b.) Back Clearance</div><div><div><div>i) For single front</div><div>-</div><div>1.0M (Min)</div></div><div><div>ii) For double front</div><div>-</div><div>1.5M (Min)</div></div><div>c.) Side Clearance:Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore end clearance shall be 800 mm + width of panel.</div></div><div>For offsite areas, HT Switchboard clearances shall be followed wherever both LT & HT switch boards are in the same MCC room</div><div>4. Height of HT/LT Switchgear Room and Boiler MCC room</div><div><div><div>i.</div><div>With Bus Duct</div><div>-</div><div>4.5 m (min)</div></div><div><div>ii.</div><div>Without Bus Duct</div><div>-</div><div>4.0 m (min)</div></div></div></div></div></div></div></div>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB-SECTION B-10 CABLING, EARTHING AND LIGHTNING PROTECTION	PAGE 19 OF 20

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	<p>Further no vertical bracings shall be envisaged in HT/LT switchgear room and associated cable vault area.</p> <p>5. Cable trench/Cable vault For LT switchgear/MCC room at EL 0.0M_r, the Maximum depth of cable trench shall be provided is 1400mm to route the cables. Horizontal cable trays shall be routed in cable trenches. Bidder to choose the cable vault if required for higher sizes requirement of cable trenches</p> <p>c) Minimum clear working space 1200mm around the equipment</p> <p>d) In buildings having MCC, minimum 2 fire door along with one rolling shutter of adequate size/capacity shall be provided</p> <p>e) The cable entry and exit from switchgear room shall be from 1.5 mtr (minimum) above FGL</p> <p>f) Wash basin with mirror shall be provided in battery room.</p> <p>g) Separate room shall be provided for each 220 V DC Battery Bank.</p>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB-SECTION B-10 CABLING, EARTHING AND LIGHTNING PROTECTION	PAGE 20 OF 20

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NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL:-2mm THICK. MS SHEET.
3. FINISH :-HOT DIP GALVANISED
4. THICKNESS:-3mm COUPLER PLATE
2mm TRAY.
5. TOLERANCE:-AS PER RELEVANT I.S.

RD	FOR TENDER PURPOSE	13	13	REL	-	N	-	-	-	05.07.18	
RC	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	05.07.18	
RB	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	07.04.2018	
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	17.01.2018	
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

LADDER TYPE CABLE TRAY.

SIZE
A4

SCALE
NTS

DRG. NO.

0000-211-PDE-A-001

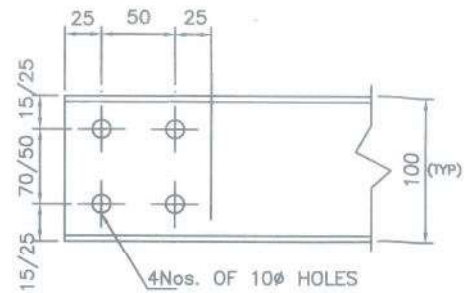
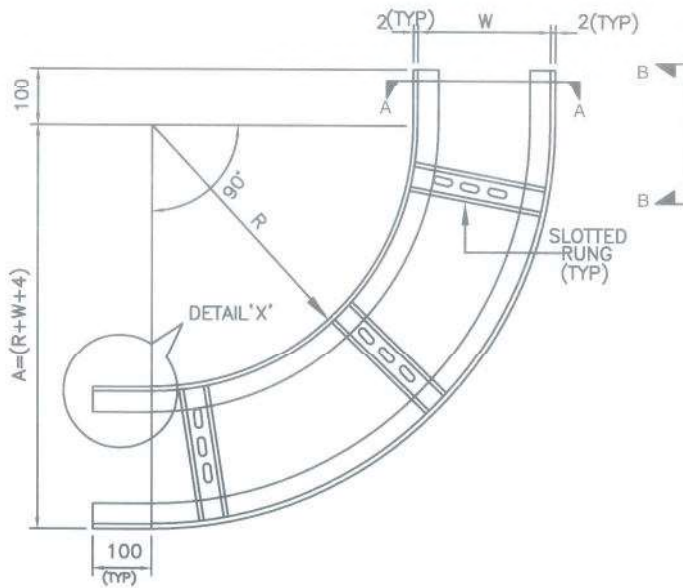
REV. NO.
RD

Technical drawing of a bridge deck cross-section showing a wide-flange beam with a curved bottom flange. The drawing includes dimensions: top flange width 100, total width $A = (2R + W + 4)$, top flange thickness 2 (TYP.), web thickness 2 (TYP.), bottom flange radius R , bottom flange thickness 2 (TYP.), and bottom flange width W . A detail 'X' is shown as a circular inset of the bottom flange corner.

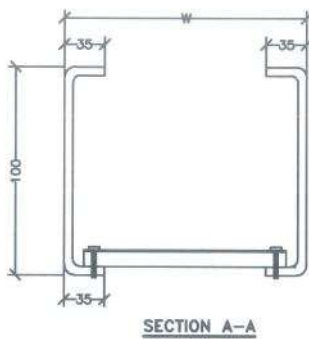
DETAIL - 'X'

RD	FOR TENDER PURPOSE	VC	VC	RKP		WV				DT	15.07.2006
RC	FOR TENDER PURPOSE	AB	AB	RKP	-	VV	-	-	-	DT	15.07.2006
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	15.07.2006
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	15.07.2006
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						

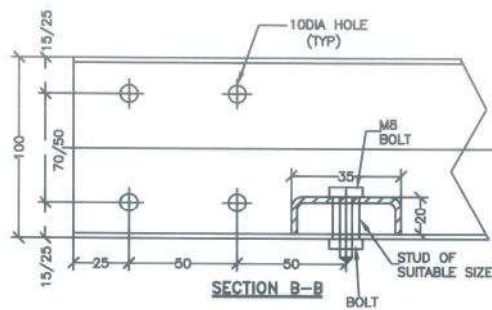
REV. NO.



DETAIL-X



SECTION A-A



SECTION B-B

HORIZONTAL BEND 90° (BOTH LEFT & RIGHT)

INSIDE WIDTH OF TRAY(W)	DEPTH OF TRAY (H)	BENDING RADIUS(R)	A		
			150	300	600
150, 300 & 600	100	1200	1354	1504	1804

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :- 150, 300 & 600mm.
3. MATERIAL :- 2mm. THICK MS SHEET.
4. TOLERANCE :- AS PER RELEVANT I.S.
5. FINISH :- HOT DIP GALVANISED
6. ALL HARDWARE SHALL BE GALVANISED AS PER STANDARD.

RD	FOR TENDER PURPOSE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
RC	FOR TENDER PURPOSE	AB	AB	RKP	✓	✓	✓	✓	✓	✓	✓
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	15.07.2000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE

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PROJECT

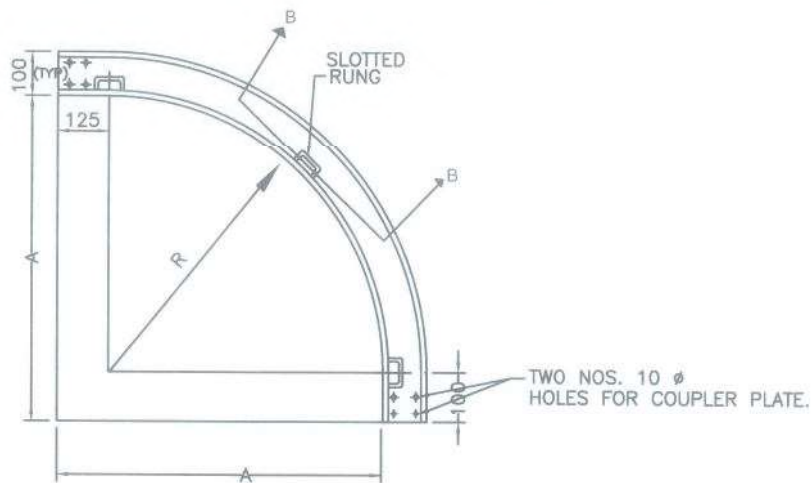
STANDARD

TITLE

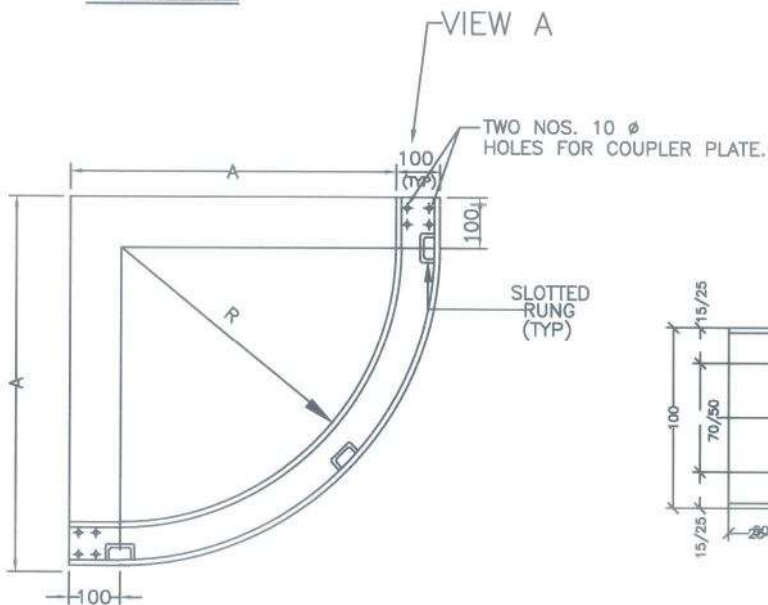
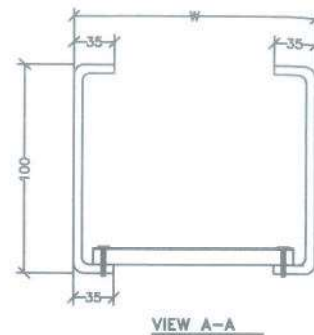
CABLE TRAY 90° BENDS (CTB 90°)

SIZE SCALE DRG. NO.

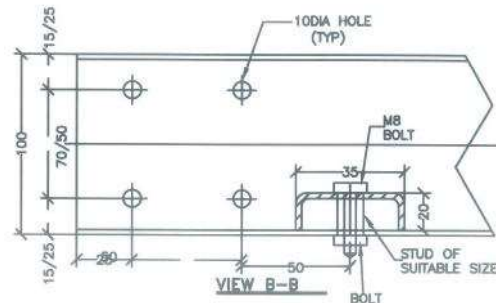
REV. NO.



ELEVATION
90° VERTICAL ELBOW
(UPSIDE)



90° VERTICAL BEND
(DOWNSIDE)



INSIDE WIDTH OF TRAY (W)	BENDING RADIUS (R)	A
150, 300 & 600	1050	1150

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :- 150, 300 & 600mm.
3. MATERIAL :- 2mm. THICK MS SHEET.
4. TOLERANCE :- AS PER RELEVANT I.S.
5. FINISH :- HOT DIP GALVANISED
6. ALL HARDWARE SHALL BE GALVANISED AS PER STANDARD.

RD	FOR TENDER PURPOSE	✓	✓	✓	W					15/12/20
RC	FOR TENDER PURPOSE	AB	AB	RKP	VV				DT	
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	AS	05.07.2000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	17.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	DATE
									APPD	

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PROJECT

STANDARD

TITLE

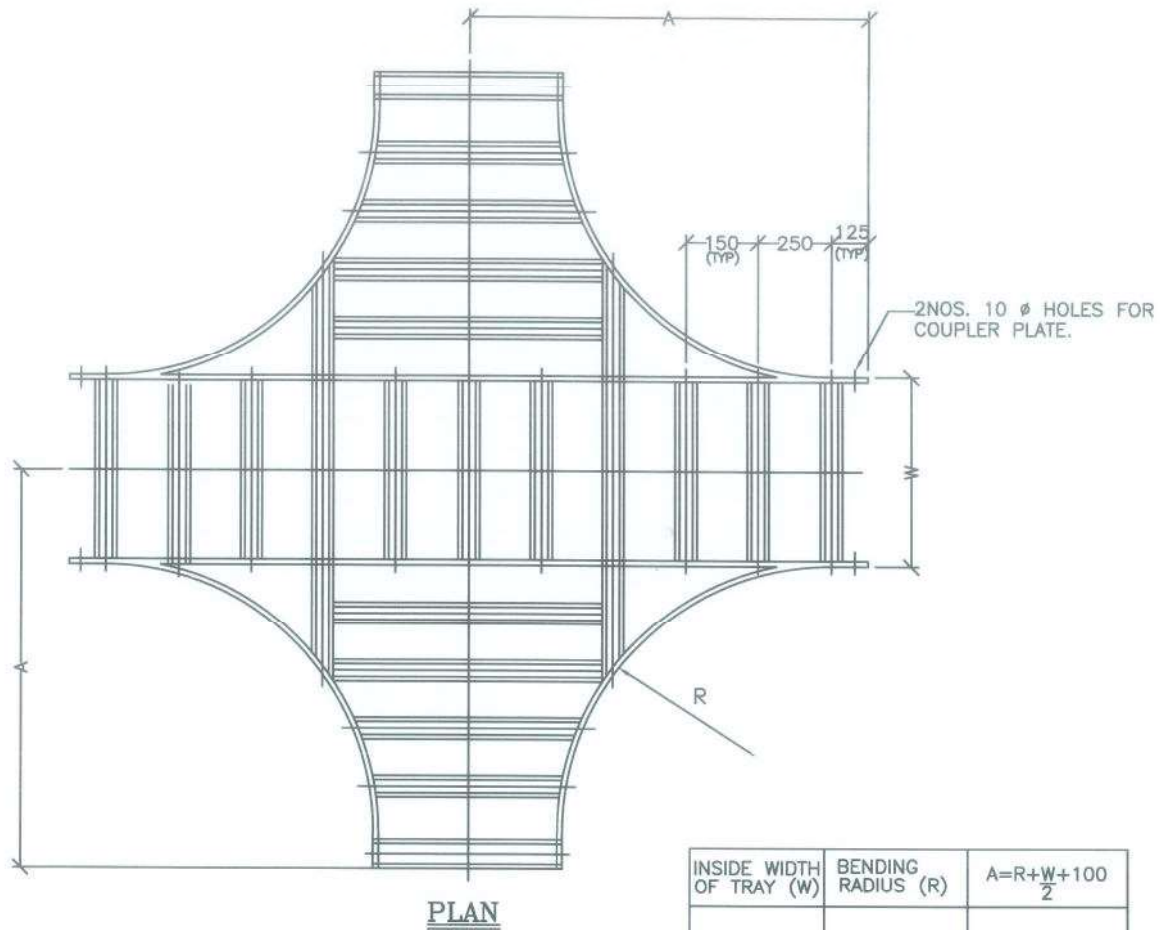
CABLE TRAY 90° VERTICAL ELBOW (OUTSIDE)
90° VERTICAL ELBOW (INSIDE)

SIZE

SCALE

DRG. NO.

REV. NO.



INSIDE WIDTH OF TRAY (W)	BENDING RADIUS (R)	$A = R + \frac{W}{2} + 100$
600	1050	1450
300	1050	1300

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. INNER WIDTH (W) :- 150, 300 & 600mm.
3. MATERIAL :- 2mm. THICK MS SHEET.
4. TOLERANCE :- AS PER RELEVANT I.S.
5. FINISH :- HOT DIP GALVANISED
6. ALL HARDWARE SHALL BE GALVANISED AS PER STANDARD.

RD	FOR TENDER PURPOSE	VC	VC	RKP	VV						
RC	FOR TENDER PURPOSE	AB	AB	RKP	VV					DT	
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	25.07.2006
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											



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PROJECT

STANDARD

TITLE

CABLE TRAY DETAILS CROSS

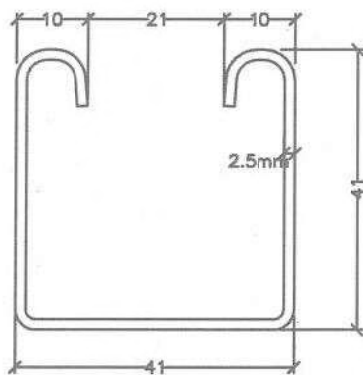
SIZE

SCALE

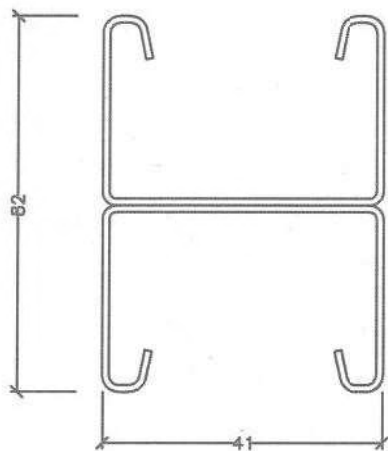
DRG. NO.

REV. NO.

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SINGLE CHANNEL-TYPE C1




DOUBLE CHANNEL-TYPE C2

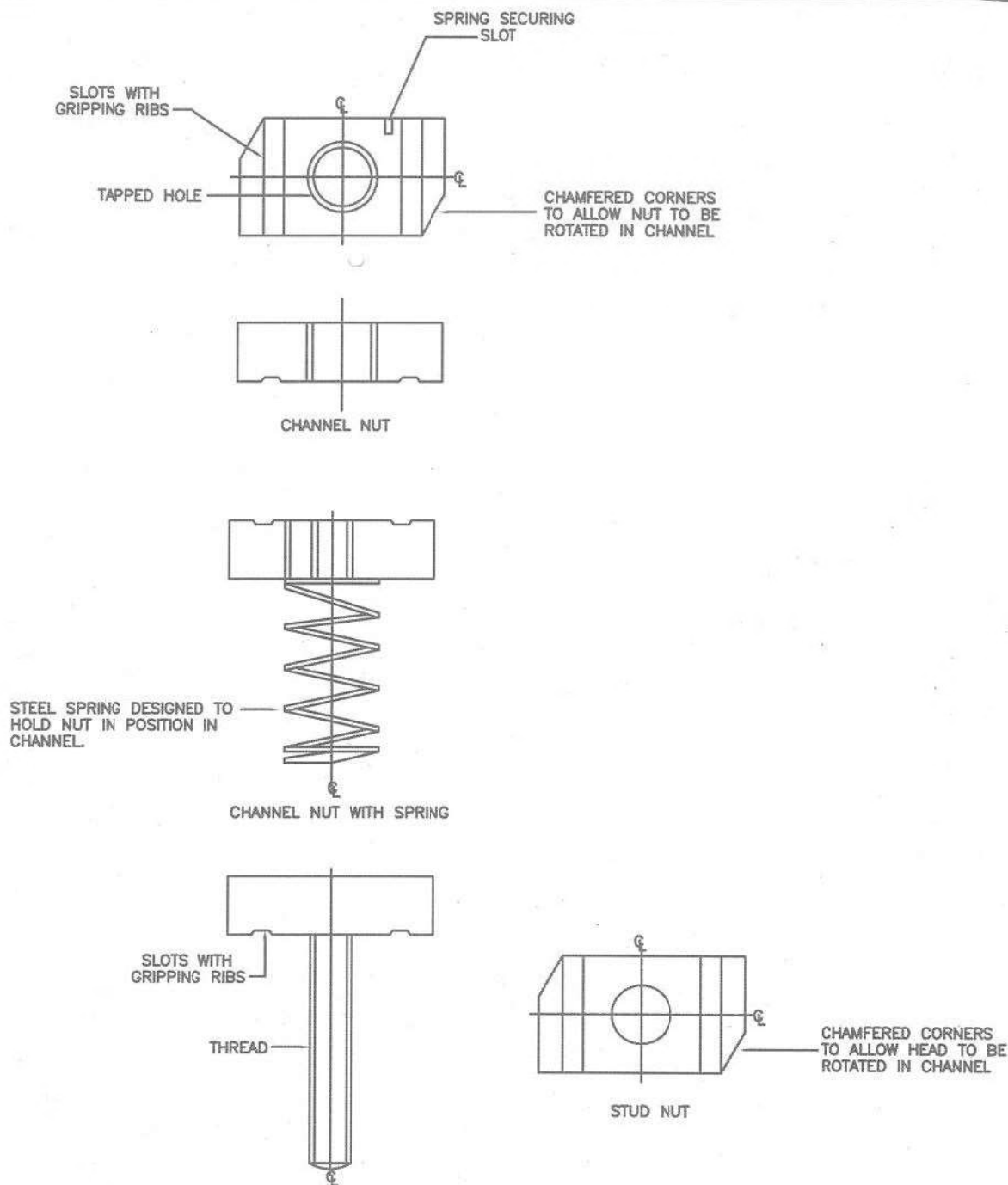
TWO LENGTHS OF C1 WELDED BACK TO BACK

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL :- 2.5mm. THICK MS SHEET.
3. TOLERANCE :- AS PER RELEVANT I.S.
4. FINISH :- HOT DIP GALVANISED

RC	FOR TENDER PURPOSE	M	M	DR	-	✓	-	-	-	AS	05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05.07.10
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07.08.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
		NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		C1 & C2 CHANNEL, CABLE TRAY SUPPORT SYSTEM									
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-013								REV. NO. RC	

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TYPICAL DETAILS OF FIXING ACCESSORIES

NOTES.


1. MATERIAL :- MILD STEEL
2. FINISH :- HOT DIP GALVANISED

RC	FOR TENDER PURPOSE	M3	M3	PKR	-	VV	-	-	-	AS	05/07/2000
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05/07/2000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07/08/2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
<div>एन टी पी सी NTPC</div> <div>NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION</div>											
PROJECT STANDARD											
TITLE TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-014								REV. NO. RC	

This diagram illustrates the assembly of a C2 channel section. The main component is a long, thin C-channel. A vertical plate is attached to its top flange using a bolt and nut. A spring is connected to the vertical plate. A small rectangular component is mounted on the side of the channel. A detailed view of the bolt and nut is shown separately.

1. FINISH :—HOT DIP GALVANISED

RC	FOR TENDER PURPOSE	B3	B3	PLP	-	VV	-	-	-	AS	05.11.2009
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05.11.2009
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	27.11.2009
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

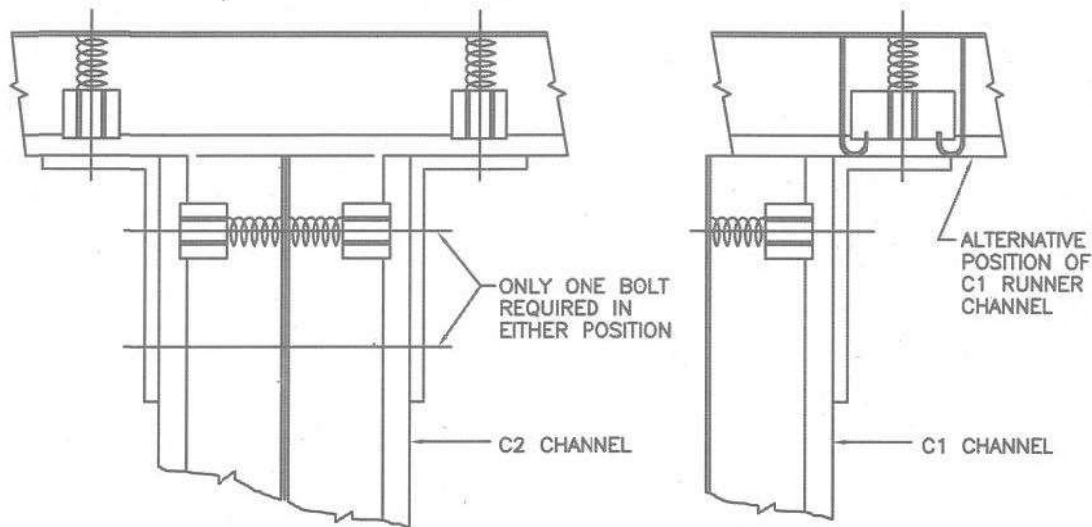


NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT		STANDARD	
TITLE			
TYPICAL DETAIL OF CABLE TRAY SUPPORT SYSTEM			
SIZE A4	SCALE NTS	DRG. NO. 0000-211-P0E-A-015	REV. NO. RC

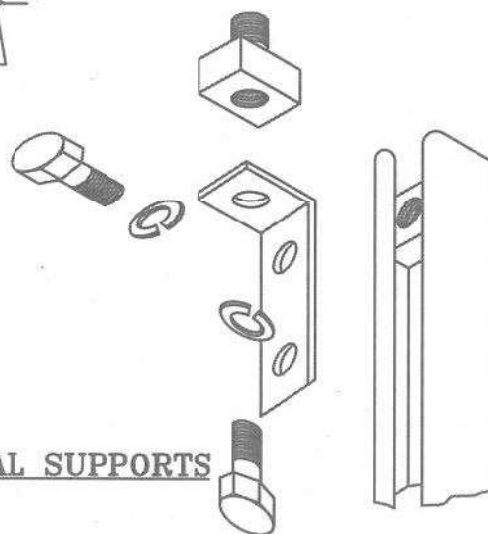
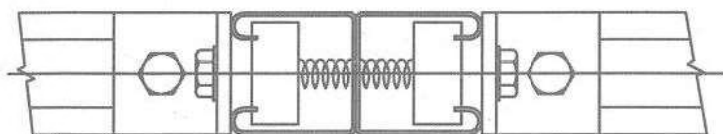
[illegible]

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ASSEMBLY-1

ASSEMBLY-2



ASSEMBLY-1
UPPER FIXING C2 CHANNEL

ASSEMBLY-2
UPPER FIXING C1 CHANNEL

UPPER FIXING FOR CHANNEL VERTICAL SUPPORTS

- NOTES.
1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	M3	M3	EX	-	✓	-	-	-	AS	05-02-18
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	03.07.0000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.0000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPO	DATE
CLEARED BY											

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ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM

SIZE

A4

SCALE

NTS

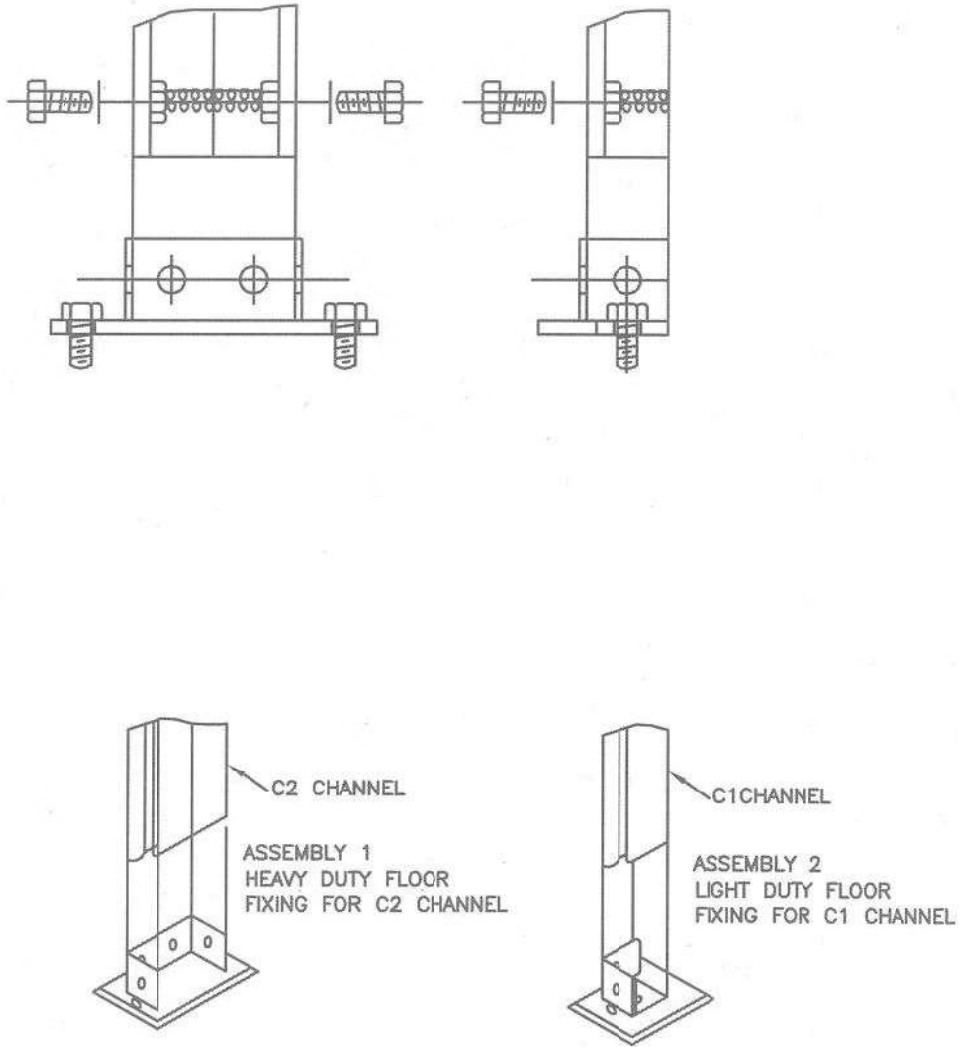
DRG. NO.

0000-211-POE-A-017

REV. NO.

RC

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FLOOR FIXING FOR CHANNEL VERTICAL SUPPORTS

NOTES.

1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	M3	M3	REV	-	✓	-	-	-	AS	05/07/20
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05/07/20
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07/08/20
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

TYPICAL DETAILS OF CABLE
TRAY SUPPORT SYSTEM

SIZE

SCALE

DRG. NO.

0000-211-POE-A-018

REV. NO.

RC

A4

NTS

Diagram illustrating the installation of a channel clamp on a wall using a rawl bolt and lock nut.

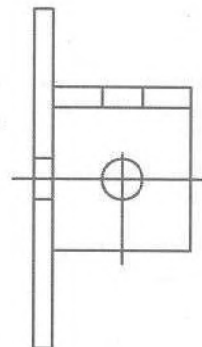
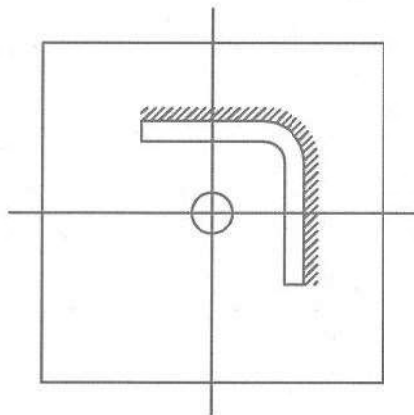
The diagram shows a vertical channel clamp being attached to a wall. The clamp is labeled "CHANNEL CLAMP". The wall is labeled "CHANNEL". The rawl bolt is labeled "RAWL BOLT". The lock nut is labeled "LOCK NUT".

The diagram shows the rawl bolt being inserted through the channel clamp and the wall. The lock nut is then threaded onto the rawl bolt to secure the clamp to the wall.

HOLES TO BE DRILLED IN WALL FOR FIXING RAWL BOLT

1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

[illegible]



1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	B3	B3	P28	-	✓	-	-	-	05-02-10	
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	10.07.2009	
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	17.01.2009	
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						

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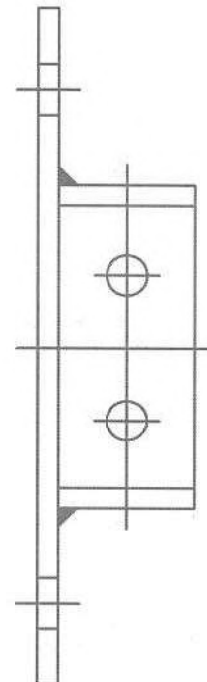
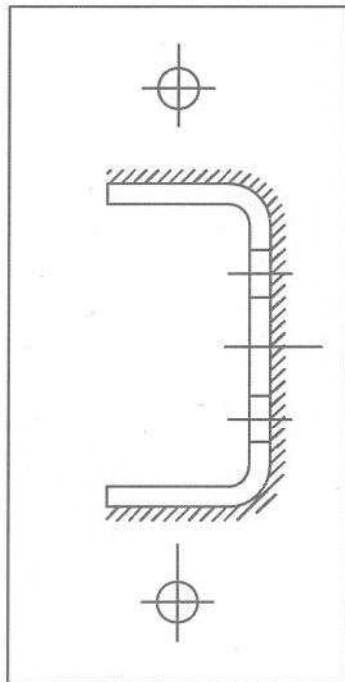
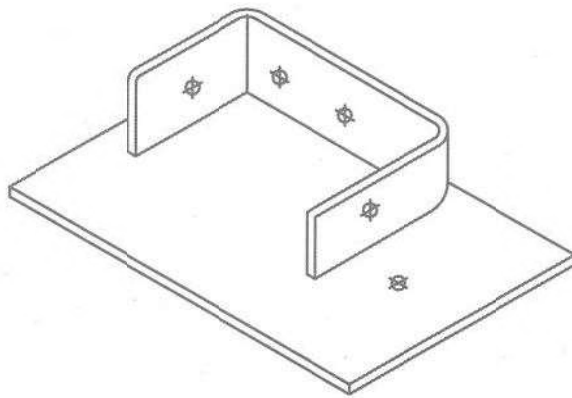
NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

STANDARD

BRACKET FLOOR PLATE LIGHT DUTY.

REV. NO.	RC
----------	----

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NOTES.

1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	1/3	1/3	1/4	-	1/4	-	-	-	AS	17.01.2000
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	17.01.2000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

BRACKET FLOOR PLATE HEAVY DUTY.

SIZE
A4

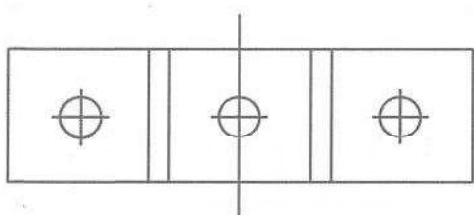
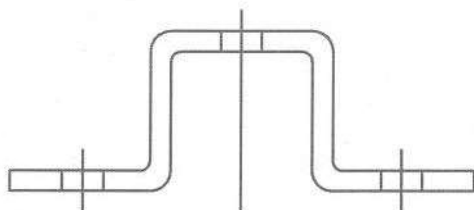
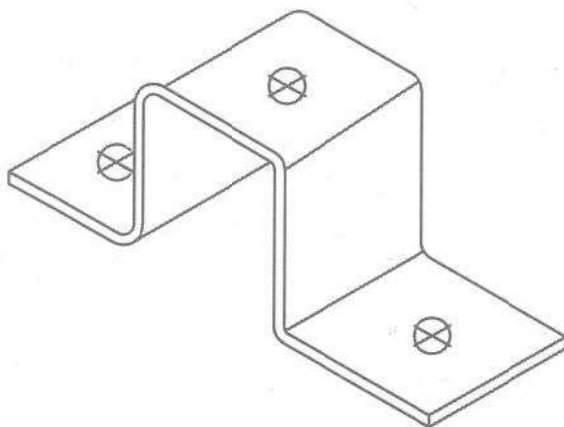
SCALE
NTS

DRG. NO.

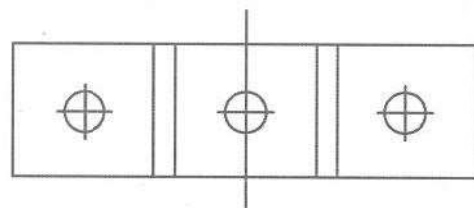
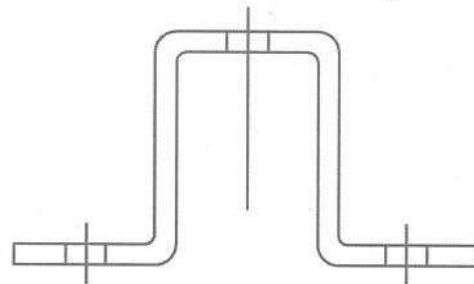
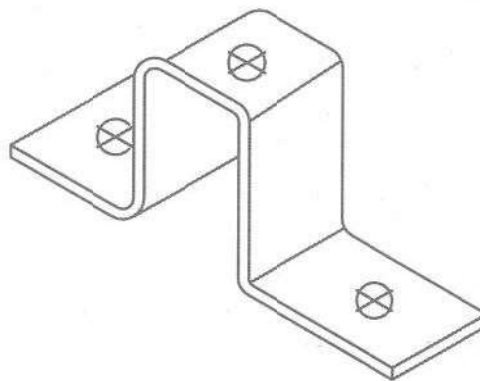
0000-211-PDE-A-021

REV. NO.
RC

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BRACKET-C1 CHANNEL CLAMP HEAVY DUTY.



BRACKET-C2 CHANNEL CLAMP.

NOTES.

1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	M3	M3	OK	-	✓	-	-	-	AS	05/07/2000
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05/07/2000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07/01/2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

BRACKET C1 CHANNEL CLAMP HEAVY DUTY.
AND BRACKET C2 CHANNEL.

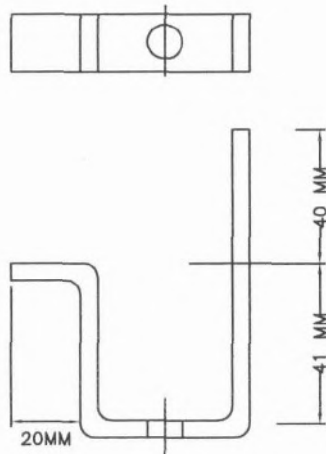
SIZE
A4

SCALE
NTS

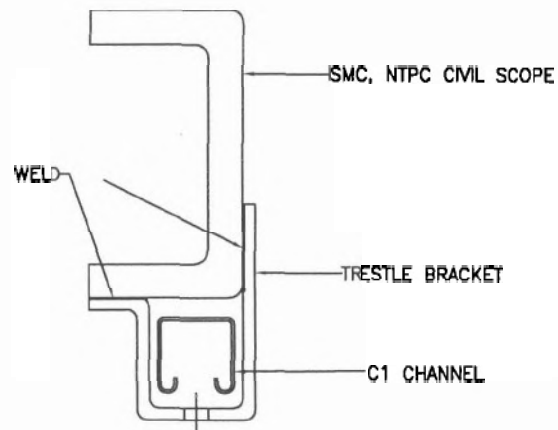
DRG. NO.

0000-211-PDE-A-022

REV. NO.
RC




TRESTLE BRACKET.



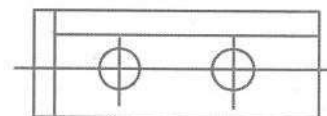
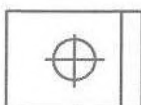
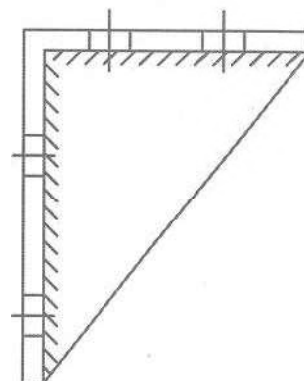
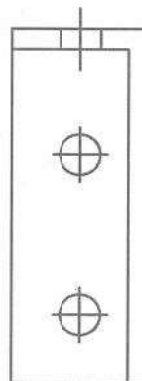
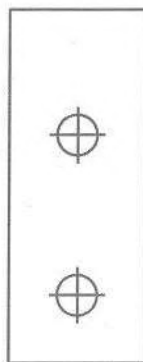
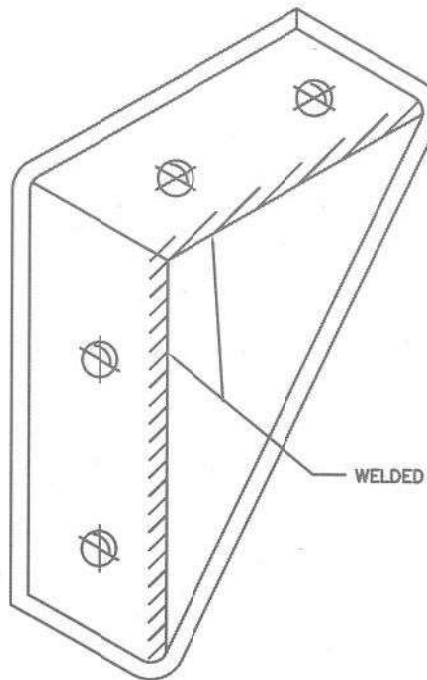
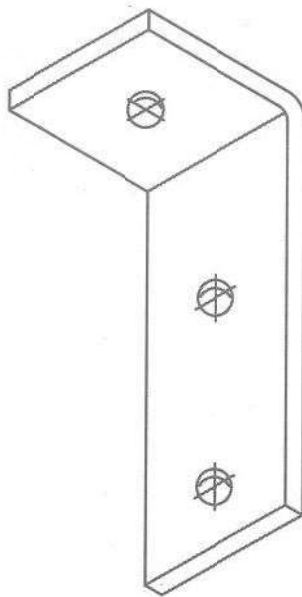
FIXING ARRANGEMENT OF TRESTLE BRACKET.

NOTES

- 1) MATERIAL : MILD STEEL.
- 2) FINISH : HOT DIP GALVANISED.

RA	FOR TENDER PURPOSE	MV	RKP	VKM	-	SS	-	-	-	DT	08.10.2008
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
		NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) (FORMERLY NATIONAL THERMAL POWER CORPORATION LTD.) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		FIXING OF CHANNEL FOR TRESTLE AND TRESTLE BRACKET.									
SIZE	SCALE	DRG. NO.							REV. NO.		
A4	NTS	0000-211-PDE-A-022A							RA		

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BRACKET RIGHT ANGLE.

BRACKET RIGHT ANGLE HEAVY DUTY.

NOTES.

1. MATERIAL : MS SHEET.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	M3	M3	R4	-	M	-	-	-	-	05/07/20
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05/07/20
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	05/07/20
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

BRACKET RIGHT ANGLE &
BRACKET RIGHT ANGLE HEAVY DUTY.

SIZE
A4

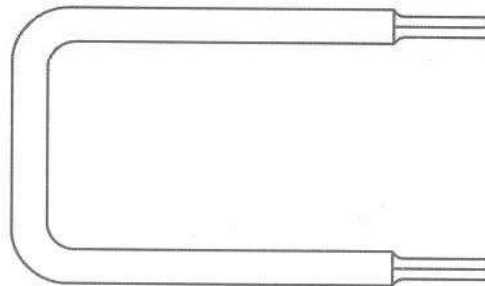
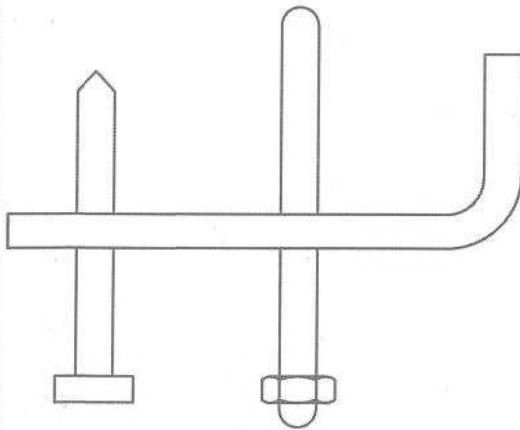
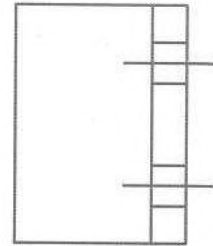
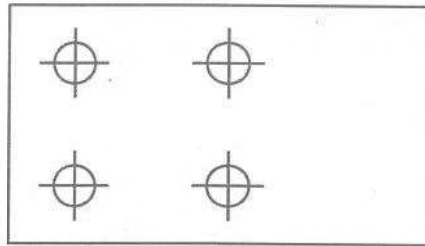
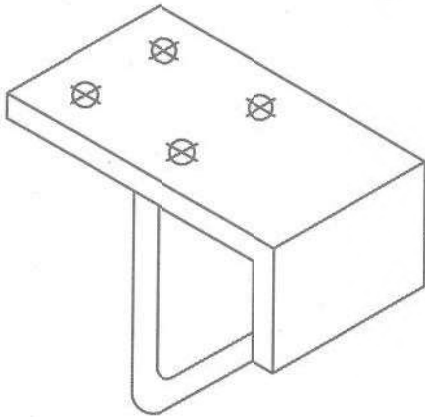
SCALE
NTS

DRG. NO.

0000-211-PDE-A-023

REV. NO.
RC

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NOTES.

1. MATERIAL : MILD STEEL.
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	13	13	13	-	W	-	-	-	AS	05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05.07.2000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

BEAM CLAMP.

SIZE
A4

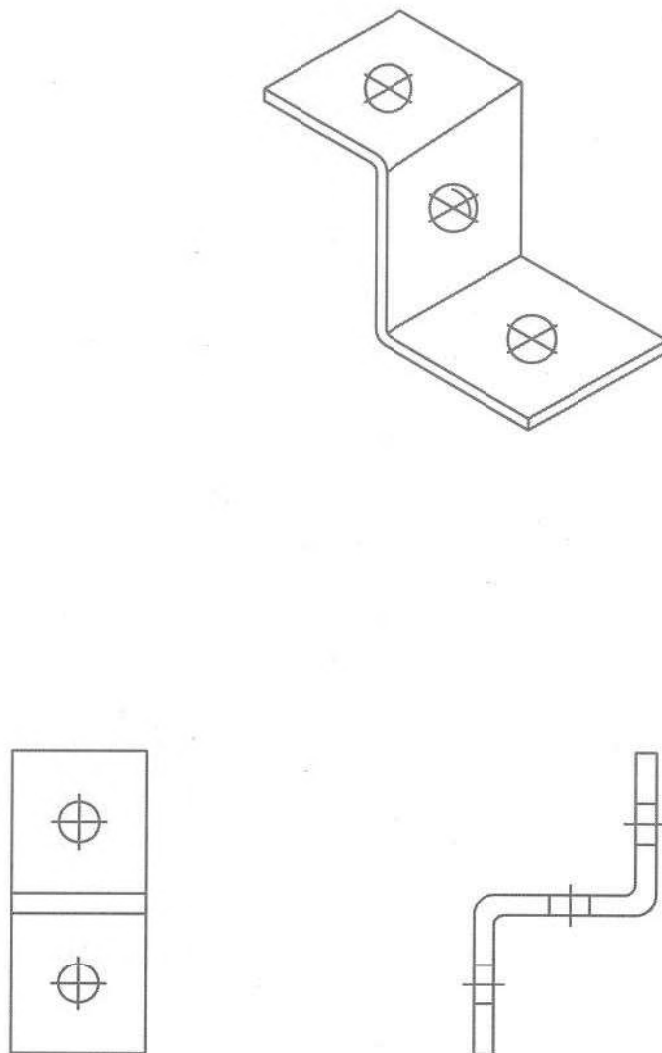
SCALE
NTS

DRG. NO.

0000-211-PDE-A-024

REV. NO.
RC

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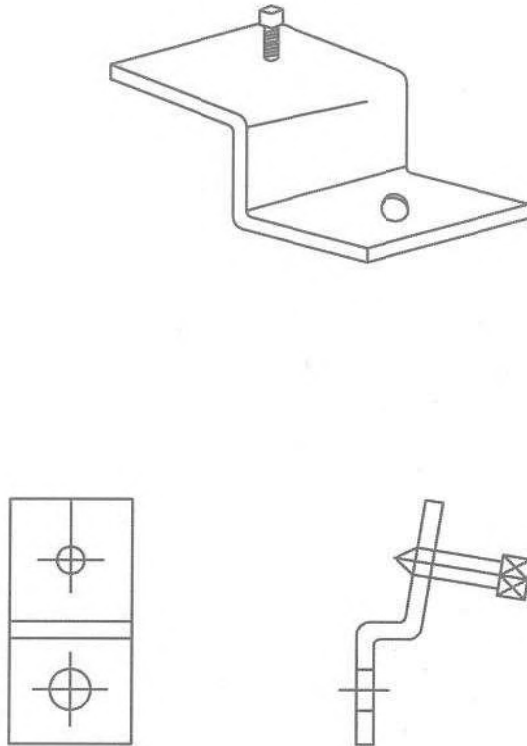
BRACKET-C1 CHANNEL CLAMP.

NOTES.

1. MATERIAL : MILD STEEL
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	M3	M3	PH	-	W	-	-	-	AS	05.07.10
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05.07.10
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07.06.0000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
<div>एन टी पी सी NTPC</div> <div>NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION</div>											
PROJECT STANDARD											
TITLE BRACKET C1 CHANNEL CLAMP.											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-025								REV. NO. RC	

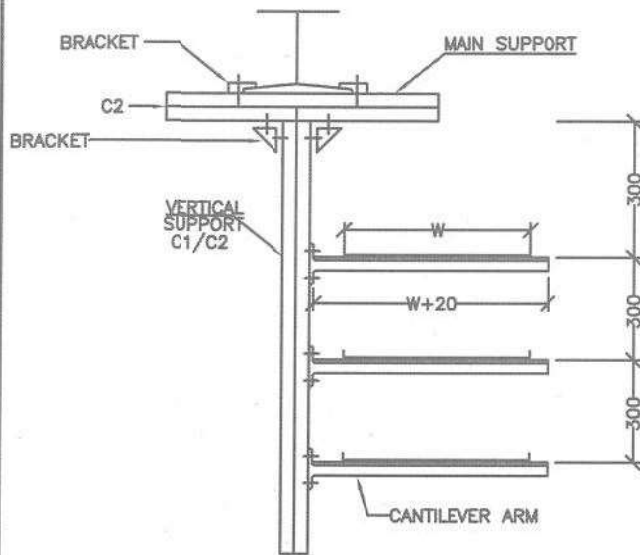
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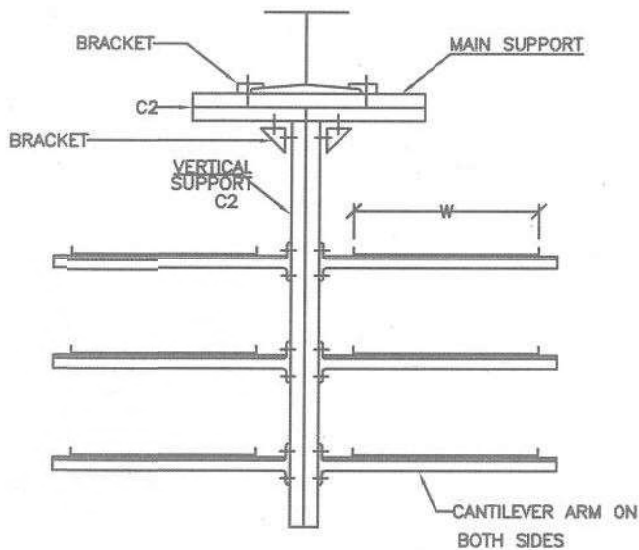
NOTES.

1. MATERIAL : MILD STEEL
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	1/3	1/3	1/3	-	✓	-	-	-	15.07.2000	
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS 15.07.2000	
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	17.06.2000	
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
<div>एन टी पी सी NTPC</div>		<div>NTPC LTD.</div> <div>(A GOVERNMENT OF INDIA ENTERPRISE)</div> <div>ENGINEERING DIVISION</div>									
PROJECT		STANDARD									
TITLE		BRACKET BEAM CLAMP									
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-026							REV. NO. RC		



ARRANGEMENT TYPE-B1



ARRANGEMENT TYPE-B2

VERTICAL SUPPORT

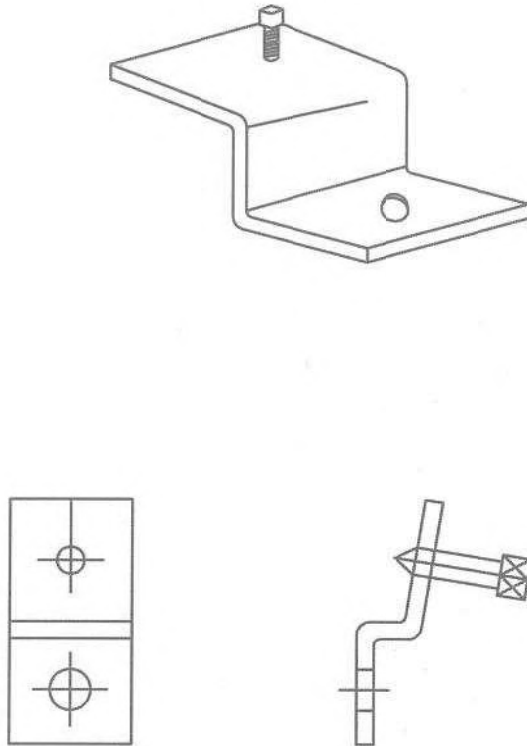
- 1) FOR 1 TO 6 TIER OF 600mm TRAY - C2 CHANNEL
- 2) FOR 1 TO 3 TIER OF 300mm TRAY - C1 CHANNEL
- 3) FOR 4 TO 6 TIER OF 300mm TRAY - C2 CHANNEL
- 4) FOR 1 TO 6 TIER OF 150mm TRAY - C1 CHANNEL

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. IN CASE OF HANGING SUPPORT C2 CHANNEL TO BE USED FOR MAIN SUPPORT

RC	FOR TENDER PURPOSE	M3	M3	REL	-	W	-	-	-	AS	05-07-16
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05-07-16
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07-08-2020
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
<div>एन टी पी सी NTPC</div> <div>NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION</div>											
PROJECT STANDARD											
TITLE STANDARD CABLE SUPPORT ASSEMBLY											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-030								REV. NO. RC	

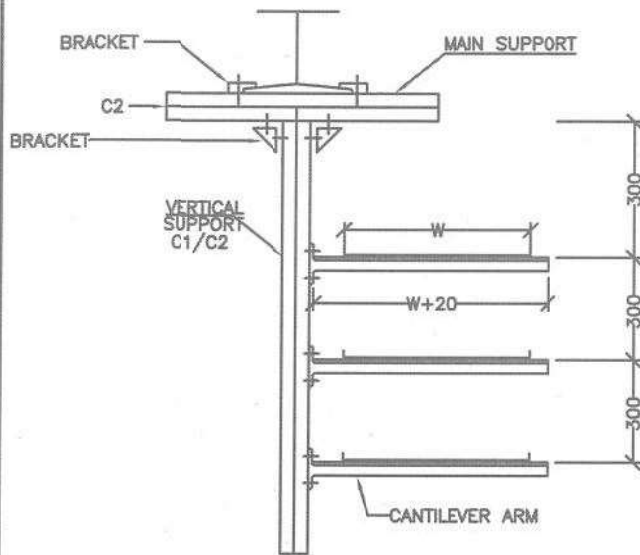
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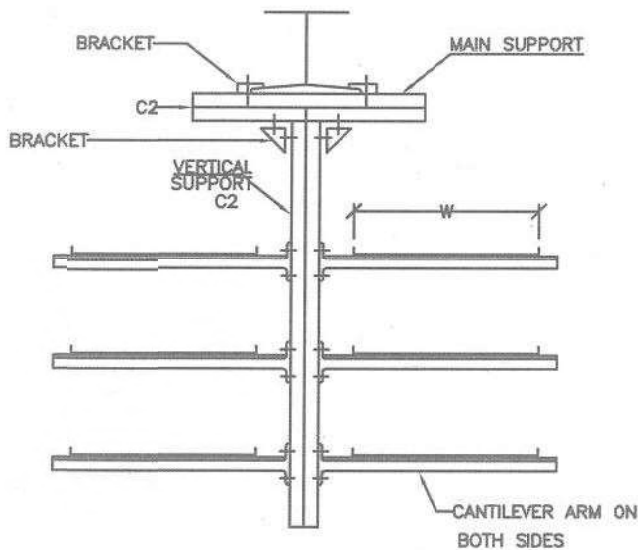
NOTES.

1. MATERIAL : MILD STEEL
2. FINISH : HOT DIP GALVANIZED

RC	FOR TENDER PURPOSE	M	M	REL	-	✓	-	-	-	AS	05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05.07.2000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
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PROJECT		STANDARD									
TITLE		BRACKET BEAM CLAMP									
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-026								REV. NO. RC	



ARRANGEMENT TYPE-B1



ARRANGEMENT TYPE-B2

VERTICAL SUPPORT

- 1) FOR 1 TO 6 TIER OF 600mm TRAY - C2 CHANNEL
- 2) FOR 1 TO 3 TIER OF 300mm TRAY - C1 CHANNEL
- 3) FOR 4 TO 6 TIER OF 300mm TRAY - C2 CHANNEL
- 4) FOR 1 TO 6 TIER OF 150mm TRAY - C1 CHANNEL

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. IN CASE OF HANGING SUPPORT C2 CHANNEL TO BE USED FOR MAIN SUPPORT

RC	FOR TENDER PURPOSE	M3	M3	REL	-	W	-	-	-	-	AS	05-07-16
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	-	AS	05-07-16
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	-	07-08-2020
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE	

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ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

STANDARD CABLE SUPPORT
ASSEMBLY

SIZE
A4

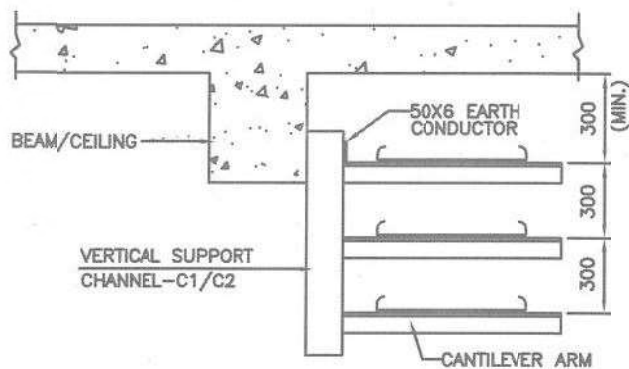
SCALE
NTS

DRG. NO.

0000-211-PDE-A-030

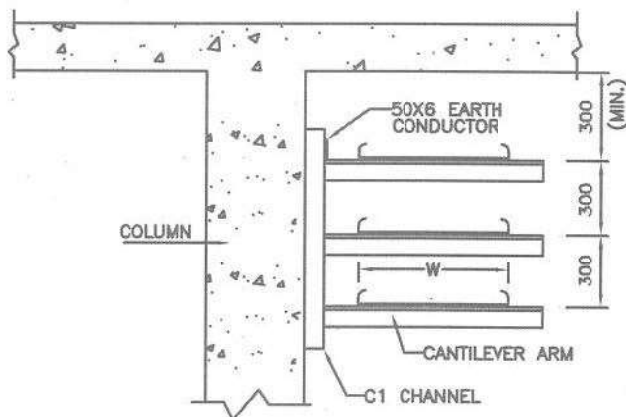
REV. NO.
RC

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VERTICAL SUPPORT

- 1) FOR 1 TO 6 TIER OF 600mm TRAY - C2 CHANNEL
- 2) FOR 1 TO 3 TIER OF 300mm TRAY - C1 CHANNEL
- 3) FOR 4 TO 6 TIER OF 300mm TRAY - C2 CHANNEL
- 4) FOR 1 TO 6 TIER OF 150mm TRAY - C1 CHANNEL



ARRANGEMENT TYPE-C1

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

RC	FOR TENDER PURPOSE	M3	M3	R/L	-	W	-	-	-	AS	05.07.2010
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05.07.2010
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.06.2008
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

STANDARD CABLE SUPPORT
ASSEMBLY

SIZE
A4

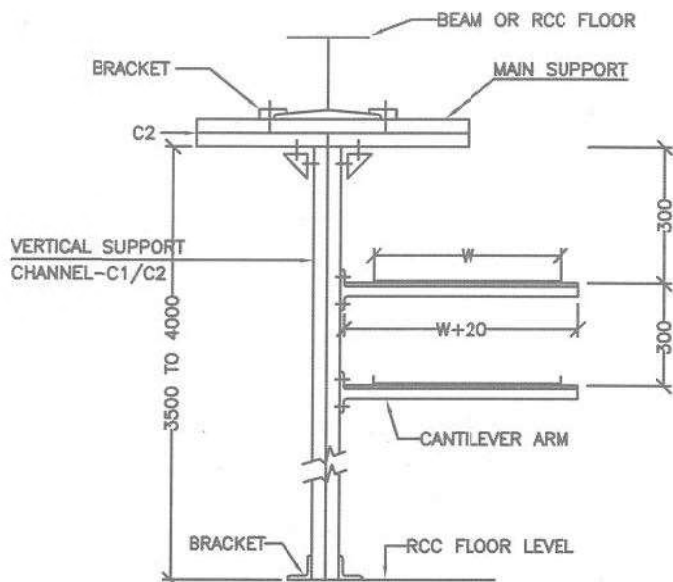
SCALE
NTS

DRG. NO.

0000-211-PDE-A-031

REV. NO.
RC

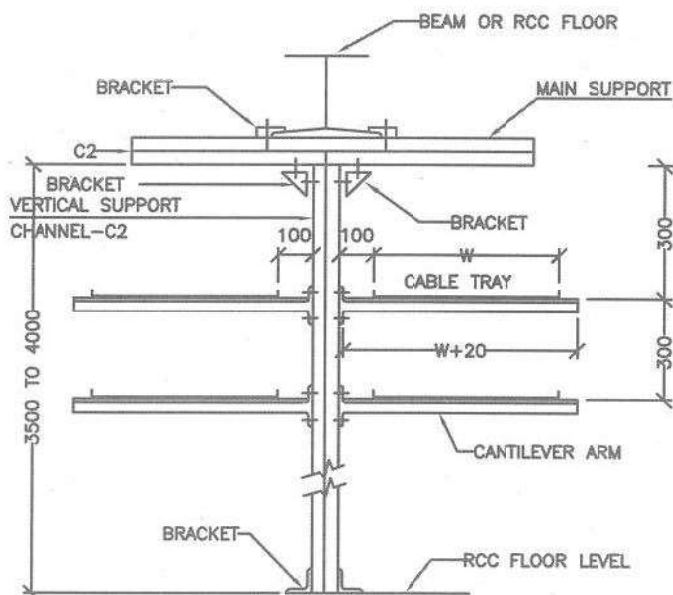
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VERTICAL SUPPORT

- 1) UPTO 3 TIER - C1 CHANNEL
- 2) ABOVE 3 TIER - C2 CHANNEL

ARRANGEMENT TYPE-D1



ARRANGEMENT TYPE-D2

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

RC	FOR TENDER PURPOSE	13	13	REF	-	W	-	-	-	05.02.10	
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	17.01.0000	
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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STANDARD

TITLE

STANDARD CABLE SUPPORT
ASSEMBLY

SIZE

A4

SCALE

NTS

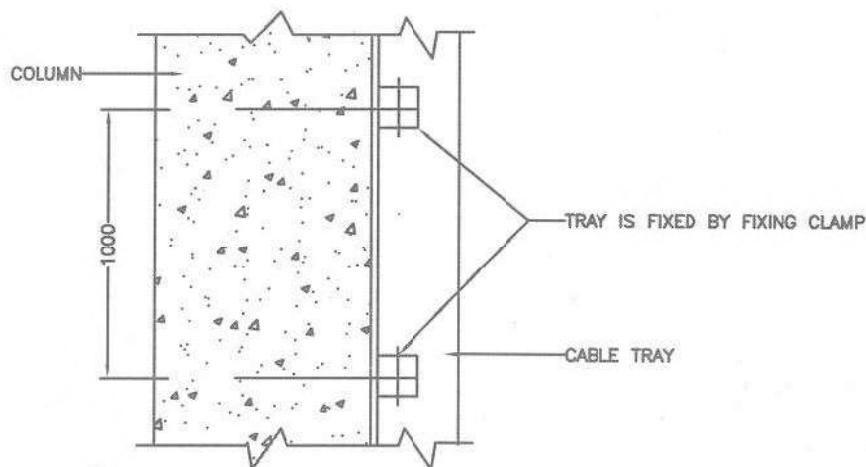
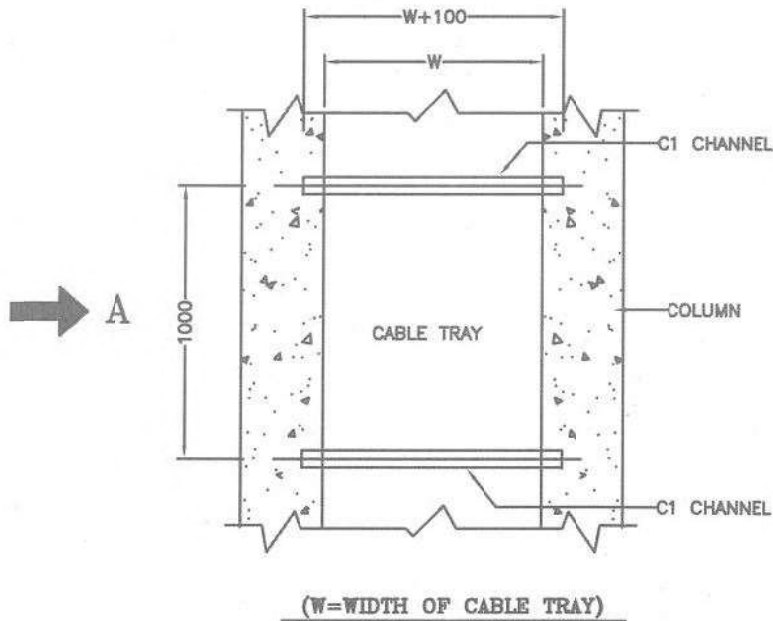
DRG. NO.

0000-211-PDE-A-032

REV. NO.

RC

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VIEW-A
ARRANGEMENT TYPE-S1

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

RC	FOR TENDER PURPOSE	M3	M3	EXP	-	VV	-	-	-	AS	05.02.10
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	10.07.2000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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PROJECT

STANDARD

TITLE

STANDARD CABLE SUPPORT
ASSEMBLY

SIZE
A4

SCALE
NTS

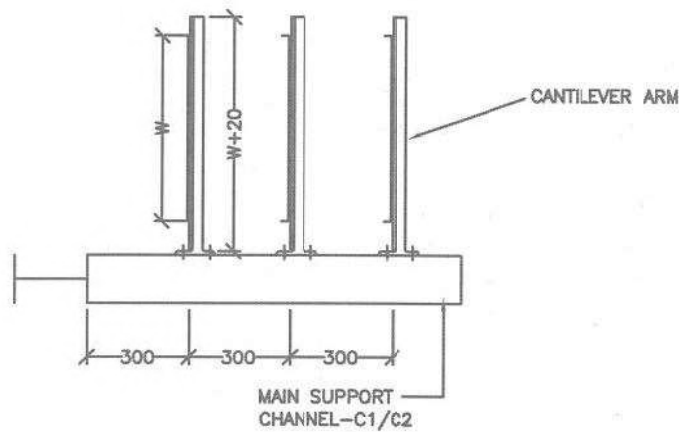
DRG. NO.

0000-211-PDE-A-033

REV. NO.
RC

MAIN SUPPORT

- 1) FOR 1 TO 5 TIER OF 600mm TRAY - C2 CHANNEL
- 2) FOR 1 TO 3 TIER OF 300mm TRAY - C1 CHANNEL
- 3) FOR 4 TO 5 TIER OF 300mm TRAY - C2 CHANNEL
- 4) FOR 1 TO 5 TIER OF 150mm TRAY - C1 CHANNEL



ARRANGEMENT TYPE-S2

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

RC	FOR TENDER PURPOSE	13	13	ext	-	vv	-	-	-	AS	05/07/10
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05/07/10
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07/01/2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

STANDARD CABLE SUPPORT
ASSEMBLY

SIZE
A4

SCALE
NTS

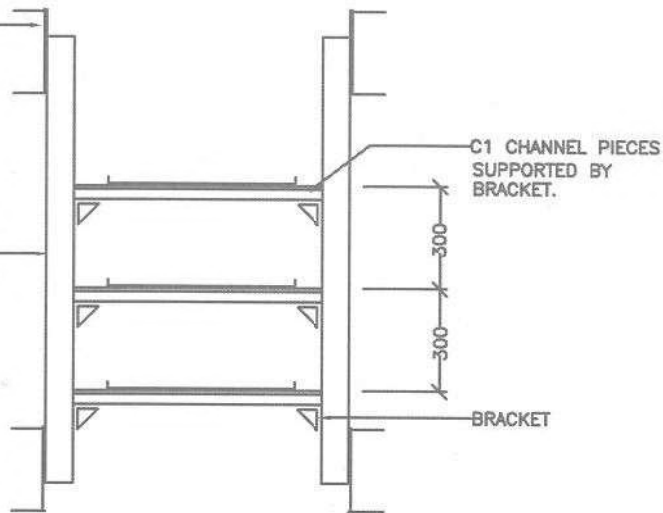
DRG. NO.

0000-211-PDE-A-034

REV. NO.
RC

CHANNELS SUPPORTED BY
FLOOR BEAM

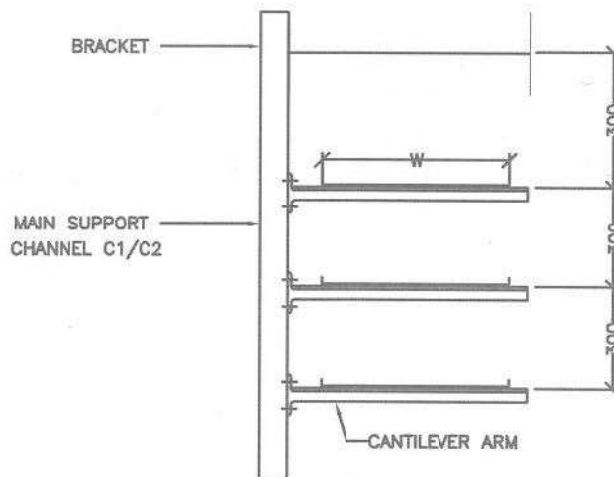
MAIN SUPPORT
CHANNEL IS
SUPPORTED BY
BRACKET



MAIN SUPPORT

- 1) UPTO 3 TIER - C1 CHANNEL
- 2) ABOVE 3 TIER - C2 CHANNEL

ARRANGEMENT TYPE-S3



ARRANGEMENT TYPE-S4

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. MATERIAL : MS SHEET.
3. FINISH : HOT DIP GALVANIZED
4. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

RC	FOR TENDER PURPOSE	M3	M3	R4	-	W	-	-	-	AS	05.07.2000
RB	FOR TENDER PURPOSE	DL	DL	SS	-	RA	-	-	-	AS	05.07.2000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07.06.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

STANDARD CABLE SUPPORT
ASSEMBLY

SIZE
A4

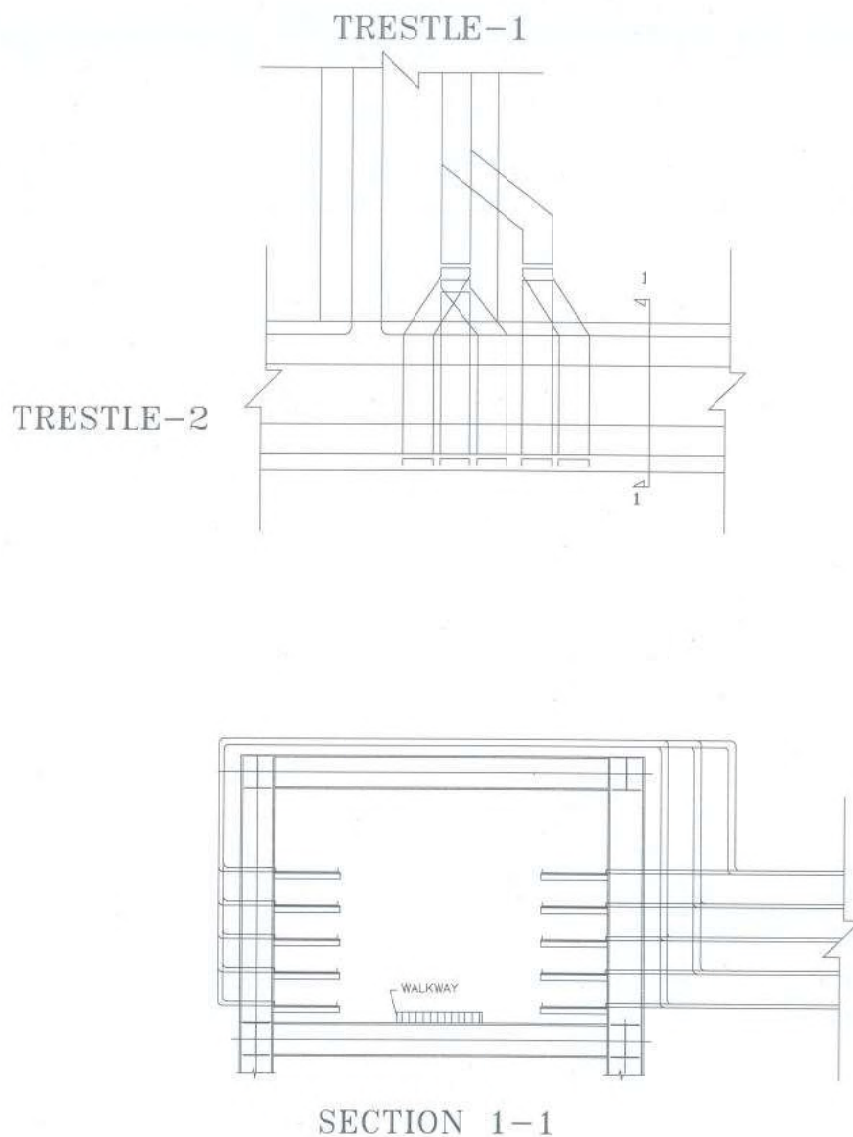
SCALE
NTS


DRG. NO.

0000-211-PDE-A-035

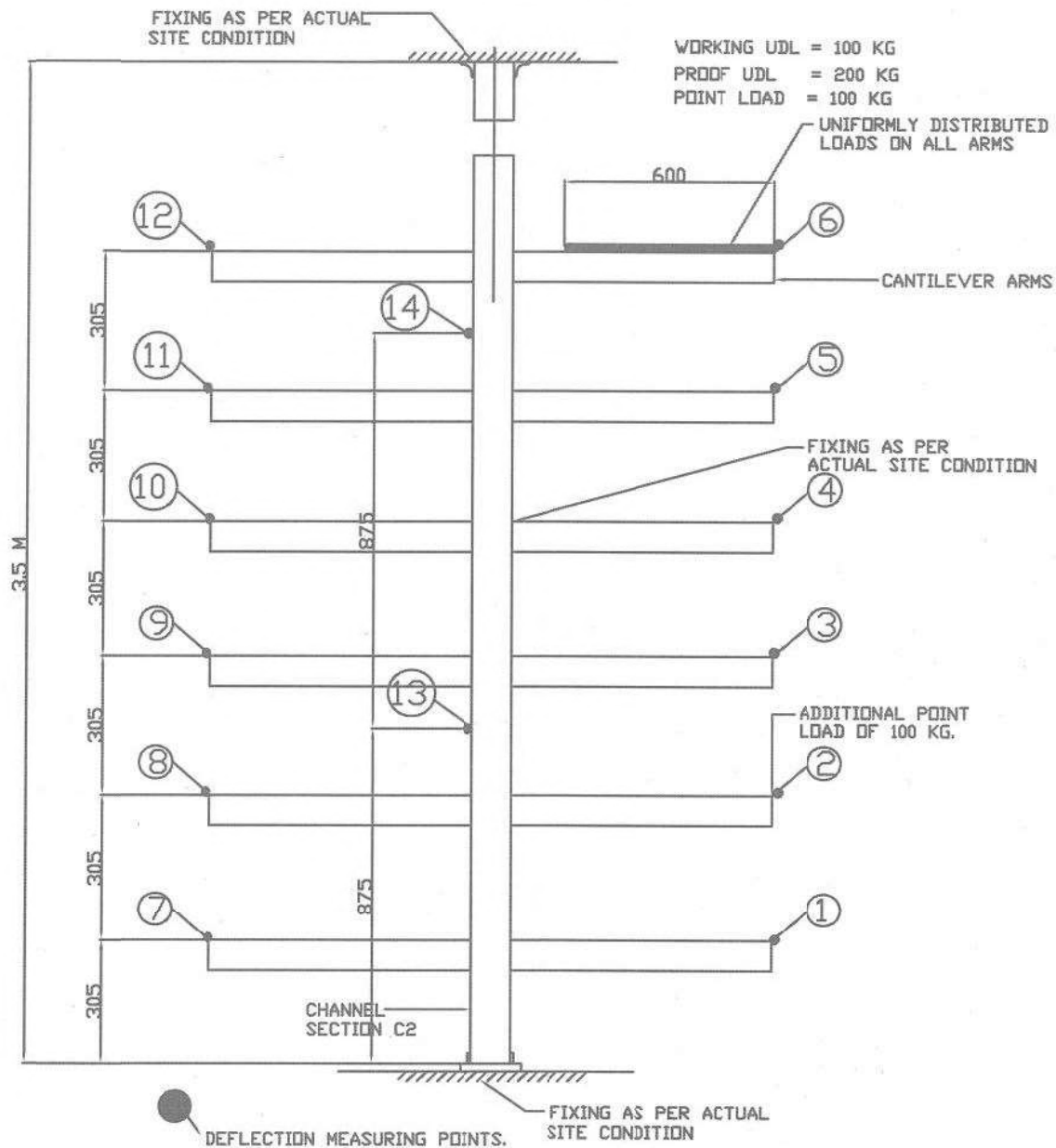
REV. NO.
RC

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RA.	FOR TENDER PURPOSE	B3	B3	24P	-	10	-	-	-	10/10	
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD.	DATE
Cleared by											
		NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		TYPICAL INTERCONNECTION DETAILS BETWEEN TWO PERPENDICULAR TRESTLES									
SIZE	SCALE	DRG. NO.								REV. NO.	
A4	NTS	0000-21'-PCF-A-035A								RA	

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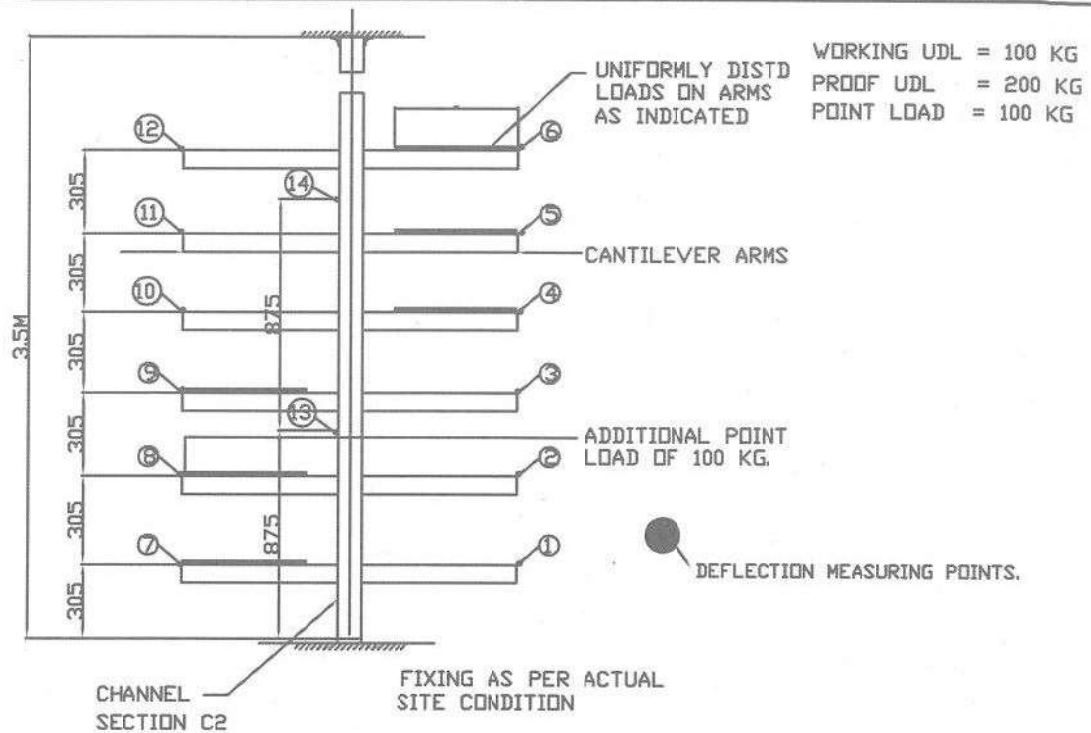
TEST 2A : MAIN SUPPORT CHANNEL (CANTILEVER ARMS ON BOTH SIDES)

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

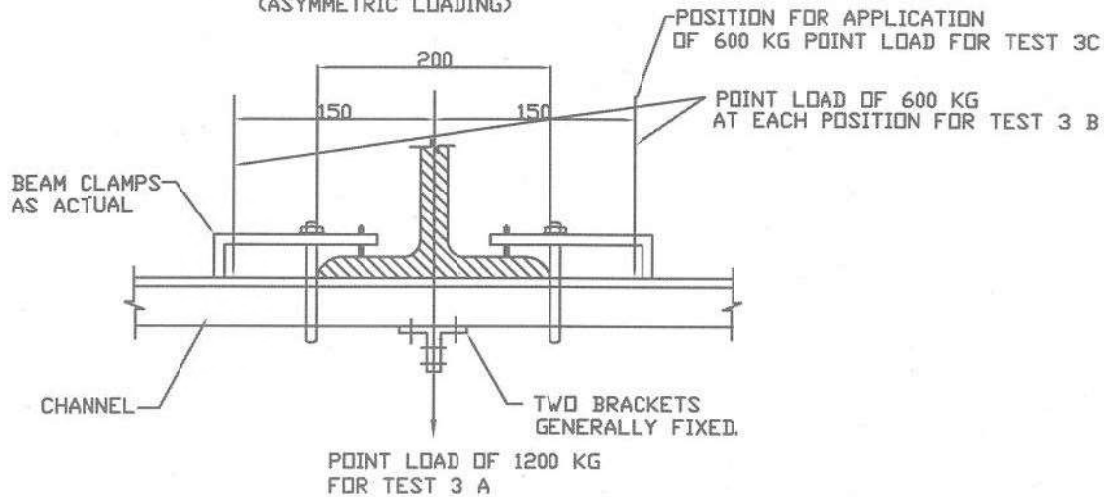
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TEST 2B MAIN SUPPORT CHANNEL

(ASYMMETRIC LOADING)



TEST 3A, 3B & 3C

NOTES.

1. ALL DIMENSIONS ARE IN mm.
2. BRACKETS USED FOR FIXING OF C1/C2 CHANNEL SHALL BE ANCHOR BOLTED/WELDED.

RC	FOR TENDER PURPOSE	B	B	RVP	-	N	-	-	-	-	05.07.20
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	-	10.11.2006
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.11.2006
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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PROJECT

STANDARD

TITLE

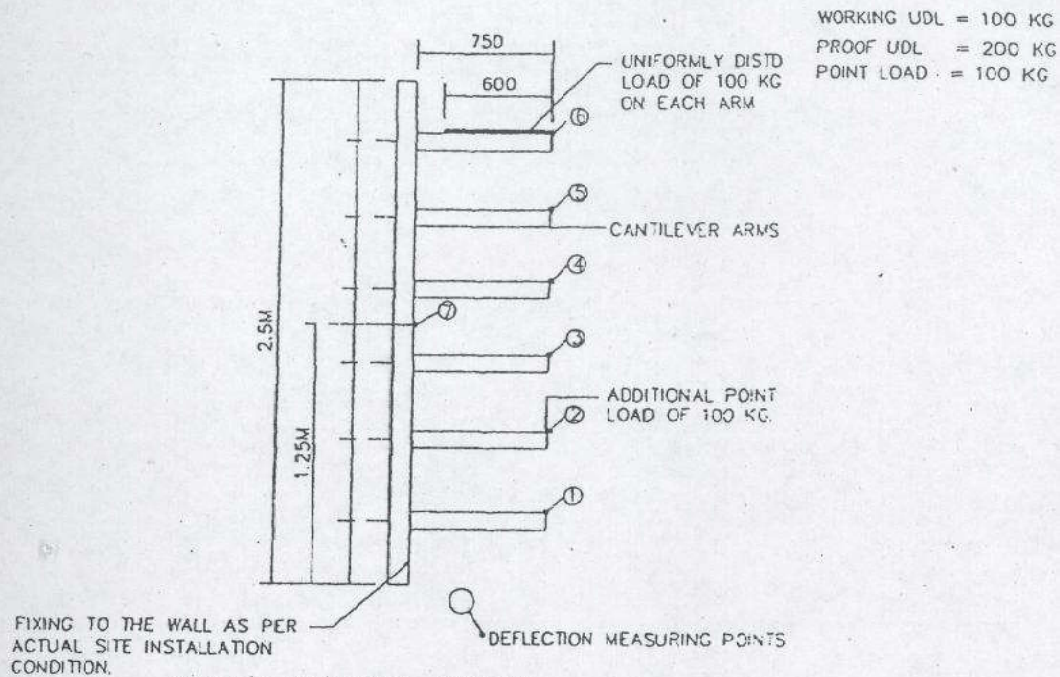
TYPICAL DETAILS STRUCTURE FOR TESTING

SIZE
A4

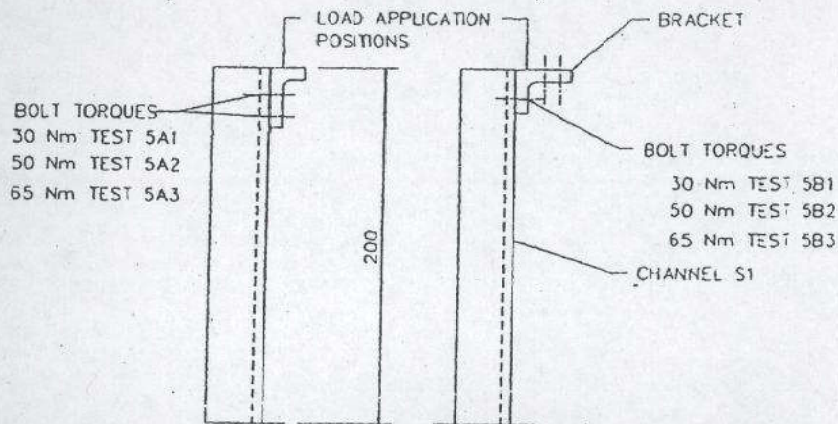
SCALE
NTS

DRG. NO. 0000-211-POE-A-038

REV. NO.
RC



TEST 4 CHANNEL INSERT



TESTS 5A TESTS 5B
 ASSEMBLE USING M12 x25 MM LONG
 HEX. HD. SCREWS LOCK WASHERS AND
 M12 CHANNEL NUT WITH SPRING

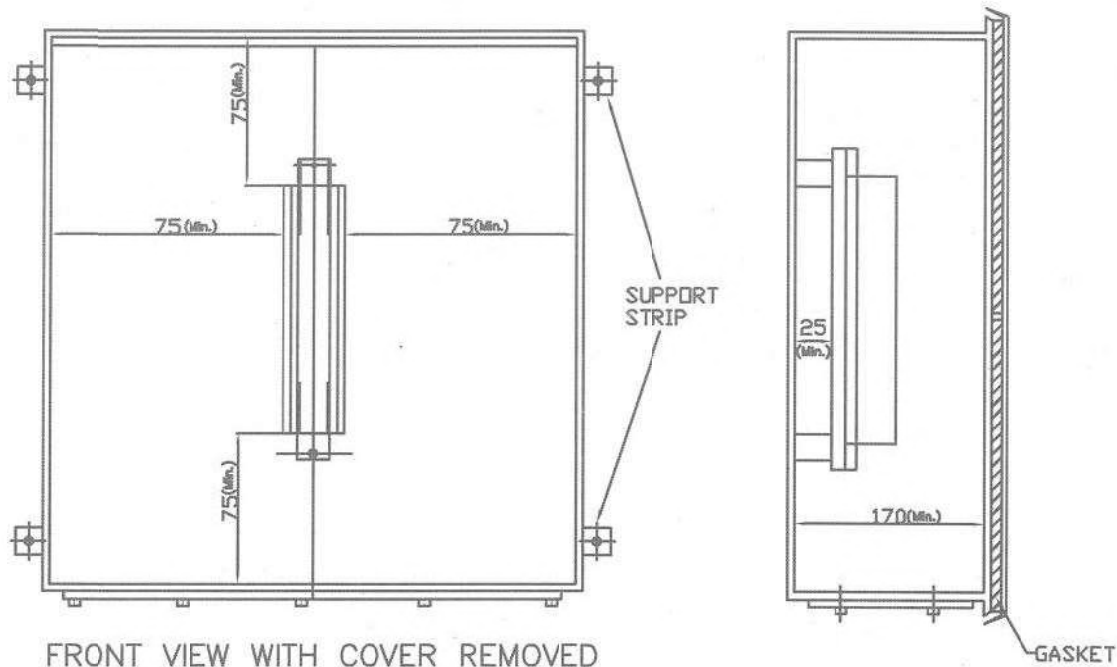
TESTS 5A 1,2,3 & 5B 1,2,3 CHANNEL NUT SLIP CHARACTERISTIC.

NOTES

ALL DIMENSIONS ARE IN MM
 (SCALE-NTS)

RB	FOR TENDER PURPOSE	REC	DES	CHK	APP	-	01	-	-	-	-
RA	FOR TENDER PURPOSE ONLY	R	DES	CHK	APP	-	02	-	-	-	12/01/10
REV. NO.	DESCRIPTION	DRW	DESIGN	CHKD	M	E	C	C&I	ARCH	APPO	DATE
Cleared By											
<div style="display: flex; justify-content: space-between;"> <div> <p>एनटीपीसी</p> <p>NTPC</p> </div> <div> <p>NTPC Limited</p> <p>(A GOVERNMENT OF INDIA ENTERPRISE)</p> <p>ENGINEERING DIVISION</p> </div> </div>											
PROJECT											
STANDARD											
TITLE											
TYPICAL DETAILS OF STRUCTURE FOR TESTING											
SIZE	SCALE	DRG. NO.								REV. NO.	
A4	NTS	0000-211-P0E-A-039								RB	

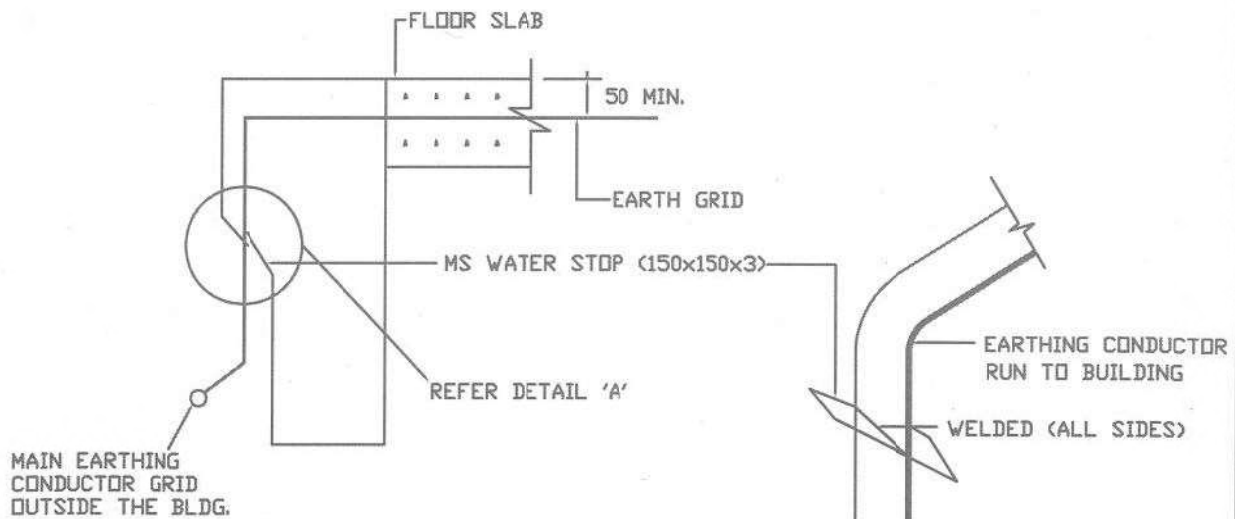
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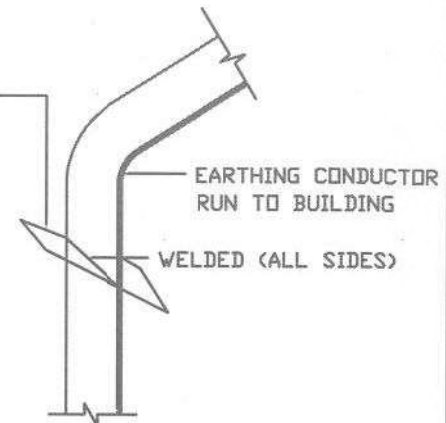
NOTE.
1. ALL DIMENSIONS ARE IN mm.

RC	FOR TENDER PURPOSE	M3	M3	RXP	-	VY	-	-	-	AS	05/07/10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	05/07/10
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	05/07/10
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
<div>एन टी पी सी NTPC</div> <div>NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION</div>											
PROJECT STANDARD											
TITLE TYPICAL DRAWING FOR JUNCTION BOX											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-040								REV. NO. RC	

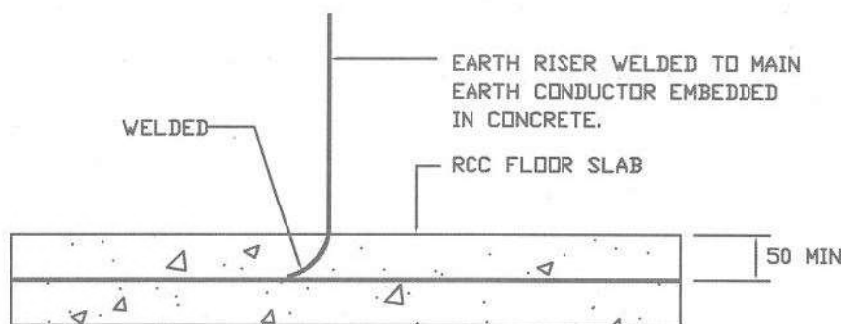
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INSERT IN RETAINING WALL



DETAIL 'A'



EARTH RISER

NOTE.
1. ALL DIMENSIONS ARE IN mm.

RC	FOR TENDER PURPOSE	M3	M3	R/L	-	W	-	-	-	AS	05.07.10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	05.07.10
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07.08.08
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

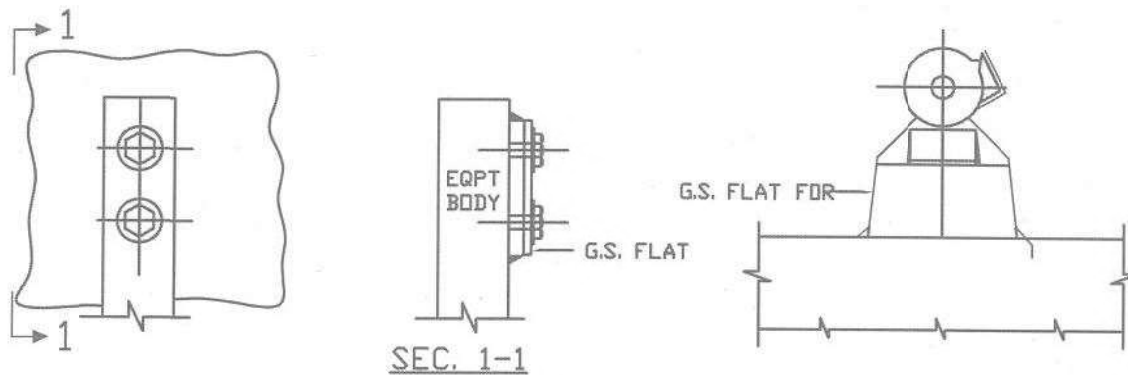
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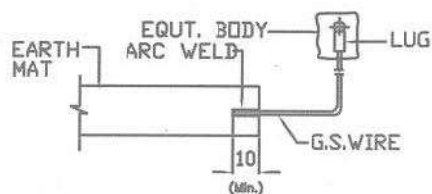
PROJECT
STANDARD

TITLE
EARTHING DETAILS

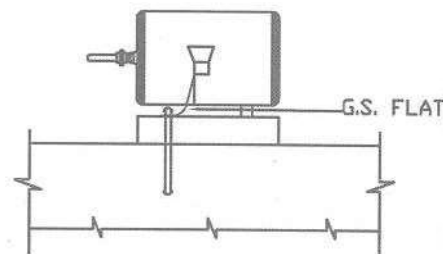
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-041	REV. NO. RC
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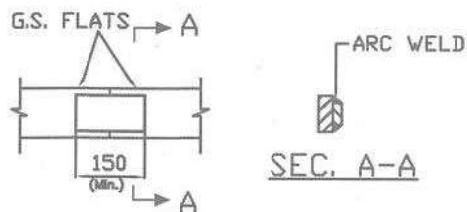
EQUIPMENT GROUNDING WITH G.S. FLAT



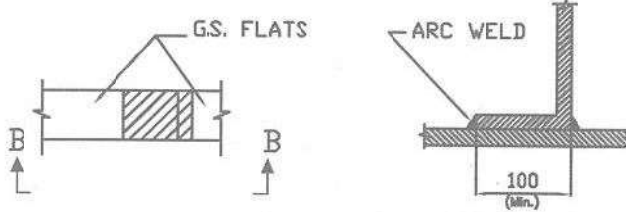
EQUIPMENT GROUNDING WITH G.S. WIRE



MOTOR TERMINAL BOX GROUNDING DETAIL



LAP JOINTS BETWEEN G.S. FLATS



ANGULAR JOINTS BETWEEN G.S. FLATS

NOTE.
1. ALL DIMENSIONS ARE IN mm.

RC	FOR TENDER PURPOSE	A3	A3	PVK	-	NV	-	-	-	AS	05-02-10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	04.11.2004
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.2005
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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PROJECT

STANDARD

TITLE

EARTHING DETAILS

SIZE
A4

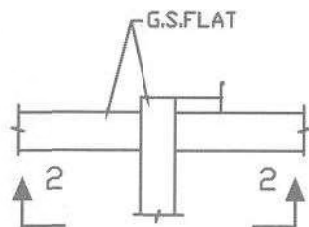
SCALE
NTS

DRG. NO.

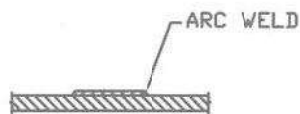
0000-211-POE-A-042

REV. NO.
RC

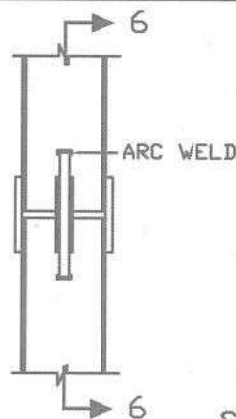
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CROSS JOINTS BETWEEN FLATS

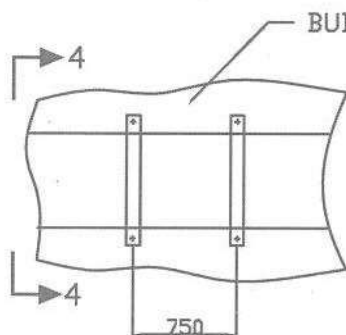
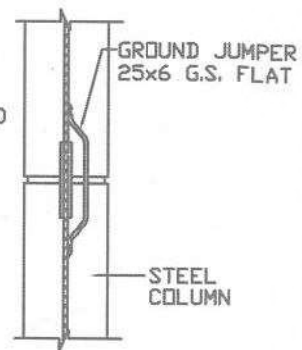


SEC. 2-2



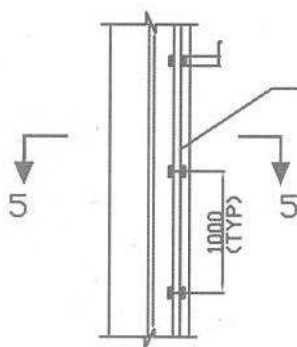
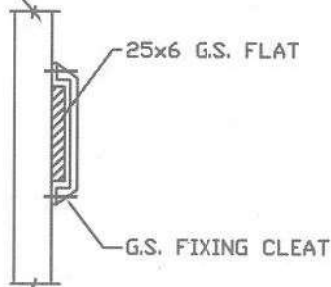
SEC. 6-6

BONDING OF STEEL COLUMN



SEC. 4-4

GROUND CONDUCTOR ALONG BUILDING WALL



GROUND CONDUCTOR ALONG STEEL COLUMN STRUCTURE

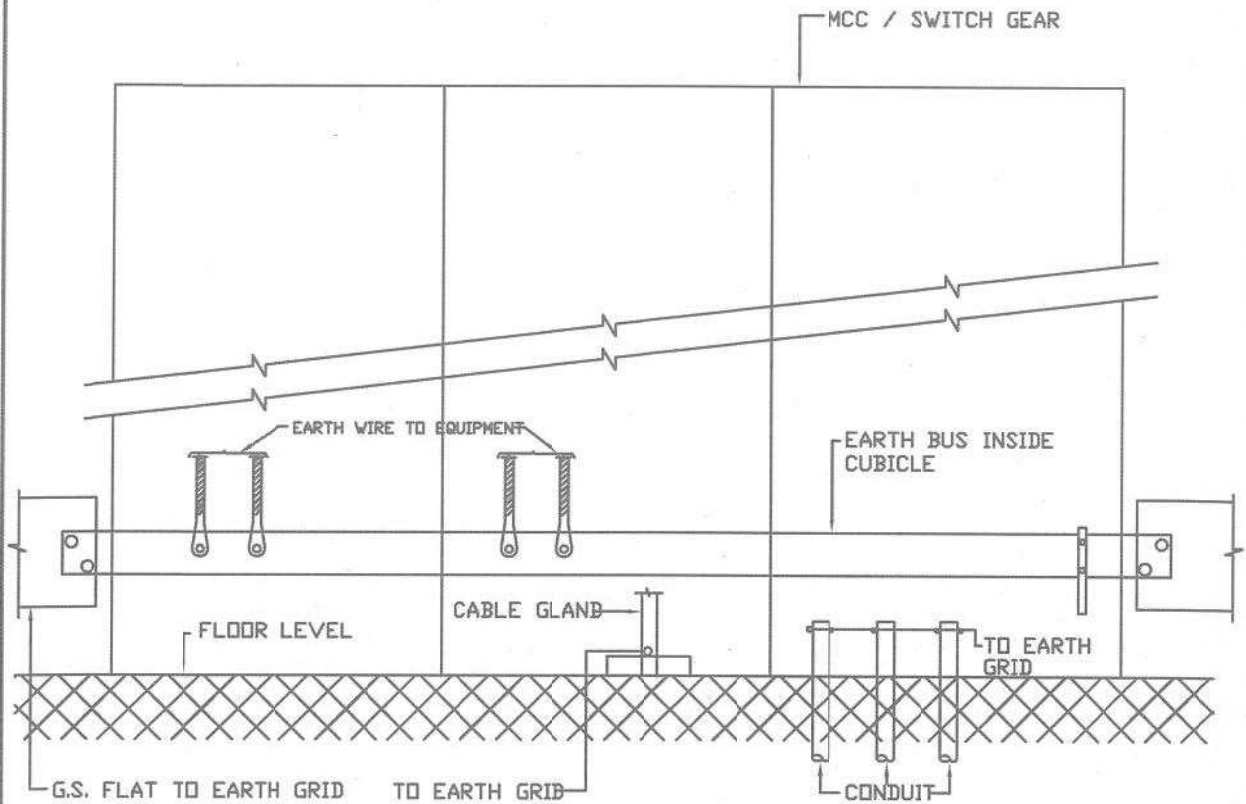


SEC. 5-5

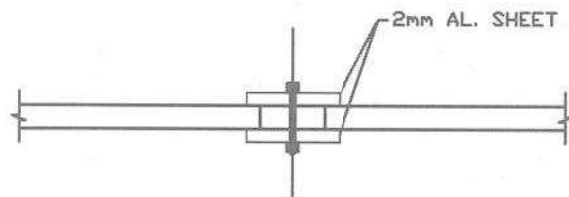
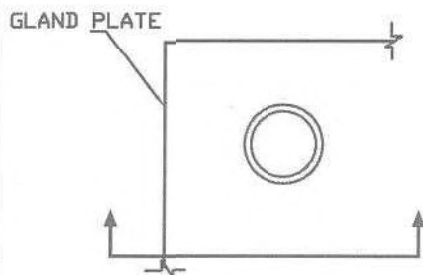
NOTE.
1. ALL DIMENSIONS ARE IN mm.

RC	FOR TENDER PURPOSE	M3	M3	RVI	-	11	-	-	-	AS	05.07.15
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	05.07.15
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	27.08.09
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
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PROJECT STANDARD											
TITLE EARTHING DETAILS											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-043								REV. NO. RC	

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EARTHING DETAILS MCC AND SWITCHGEAR



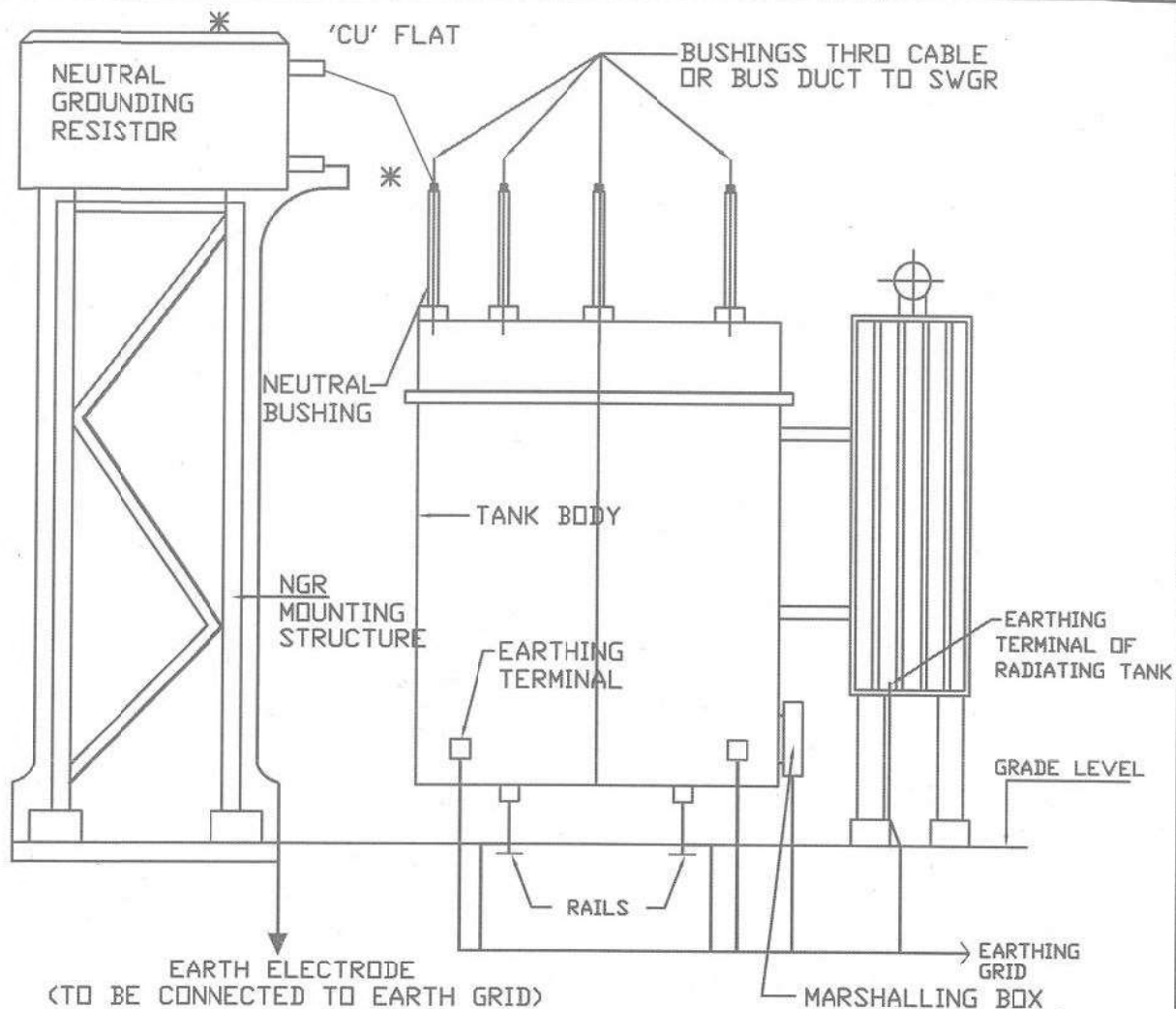
SEALING OF UNUSED CABLE OPENING

NOTE.

1. ALL DIMENSIONS ARE IN mm.

RC	FOR TENDER PURPOSE	13	13	REV	-	VV	-	-	-	AS	05.07/18
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	05.07.2006
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
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PROJECT STANDARD											
TITLE EARTHING DETAILS											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-044								REV. NO. RC	

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EARTHING DETAILS TRANSFORMER

NOTE.

1. ALL DIMENSIONS ARE IN mm.
2. THE TRANSFORMER NEUTRAL FOR HT TRANSFORMER SHALL BE EARTHED THROUGH FLATS AS SHOWN (SUPPLIED BY TRANSFORMER SUPPLIER)

RC	FOR TENDER PURPOSE	13	13	RXL	-	W	-	-	-	AS	05-02-10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	05-02-10
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	07-06-09
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											

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PROJECT

STANDARD

TITLE

EARTHING DETAILS

SIZE
A4

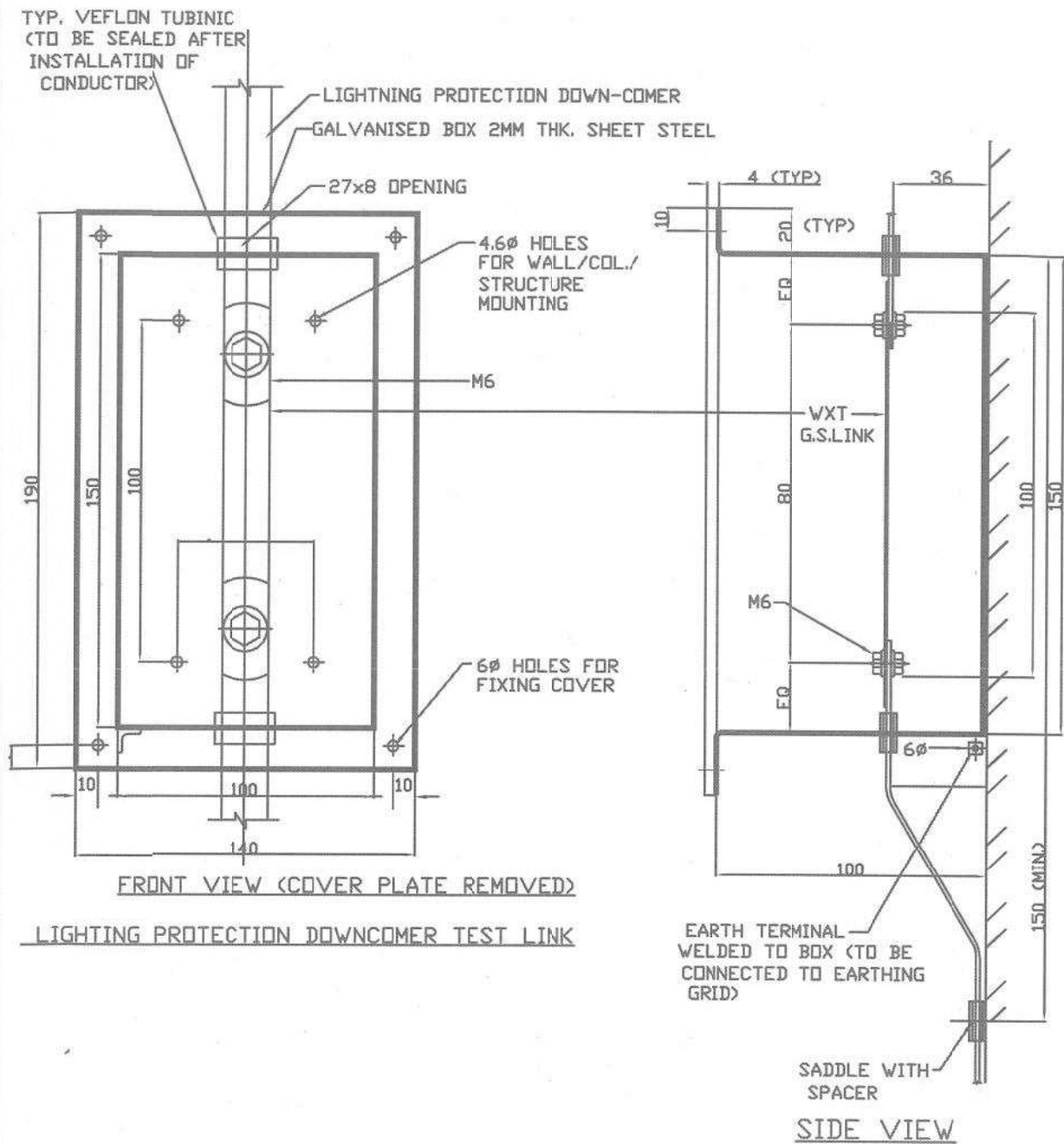
SCALE
NTS

DRG. NO.

0000-211-POE-A-045

REV. NO.
RC

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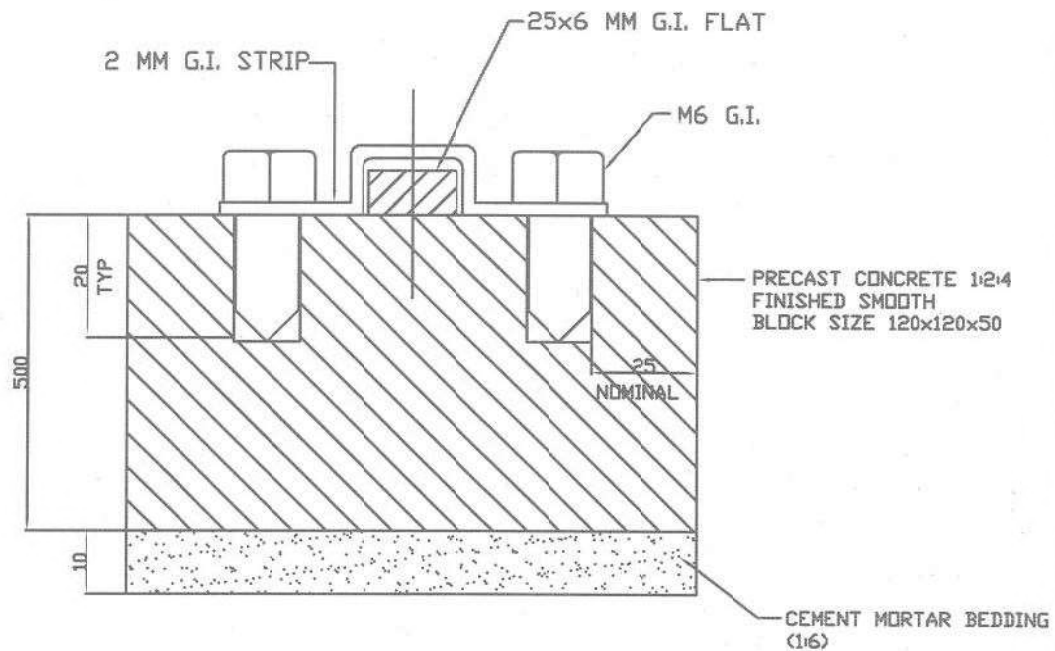


NOTE.

1. ALL DIMENSIONS ARE IN mm.
2. THE TEST LINK SHALL BE OF SAME WIDTH AND THICKNESS AS THE DOWNCOMER. THE NUTS, BOLTS AND WASHER TO BE OF Q.S.
3. THE DOWN COMER ENTRY AND EXIT POINTS IN TO BOX BE MADE WATER-TIGHT AFTER LAYING OF CONDUCTOR.

RC	FOR TENDER PURPOSE	M3	M3	rev	-	WV	-	-	-	-	05/07/10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	-	AS
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	27.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
Cleared By											
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PROJECT STANDARD											
TITLE LIGHTNING PROTECTION DETAILS.											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-047								REV. NO. RC	

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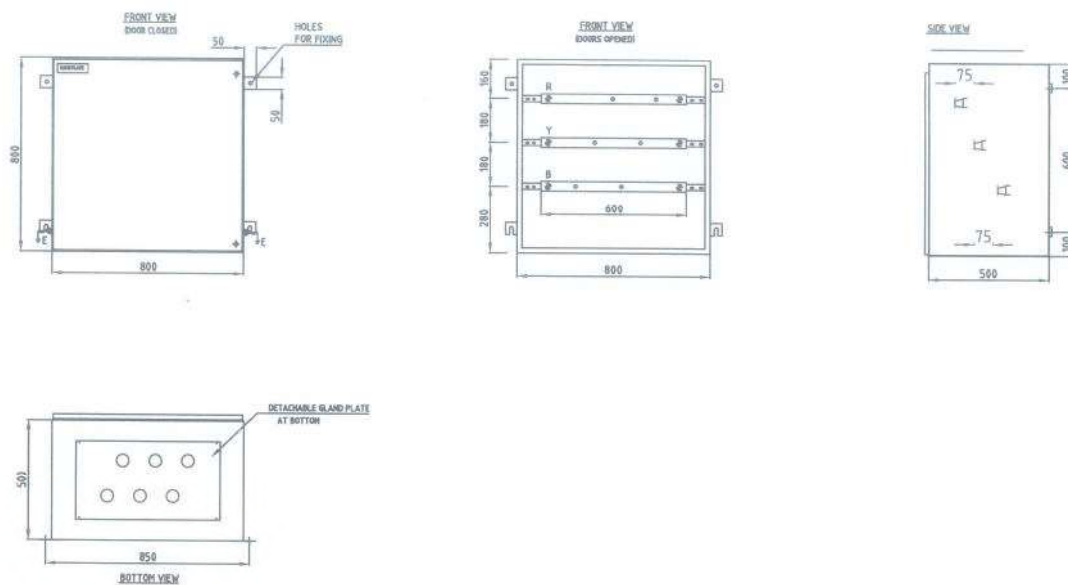


BLOCK SPACING 1000MM CENTRE TO CENTRE

TYPICAL DETAILS OF CLEATING HORIZONTAL CONDUCTOR OVER WATER PROOFING


NOTE.
1. ALL DIMENSIONS ARE IN mm.

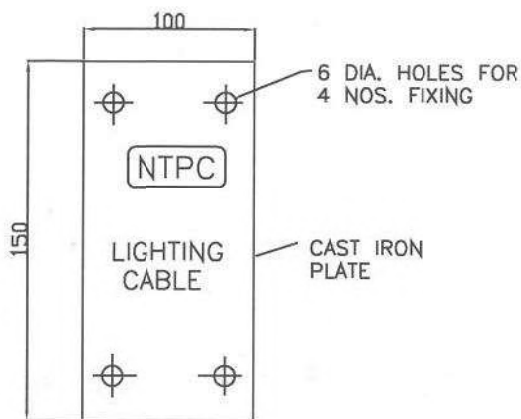
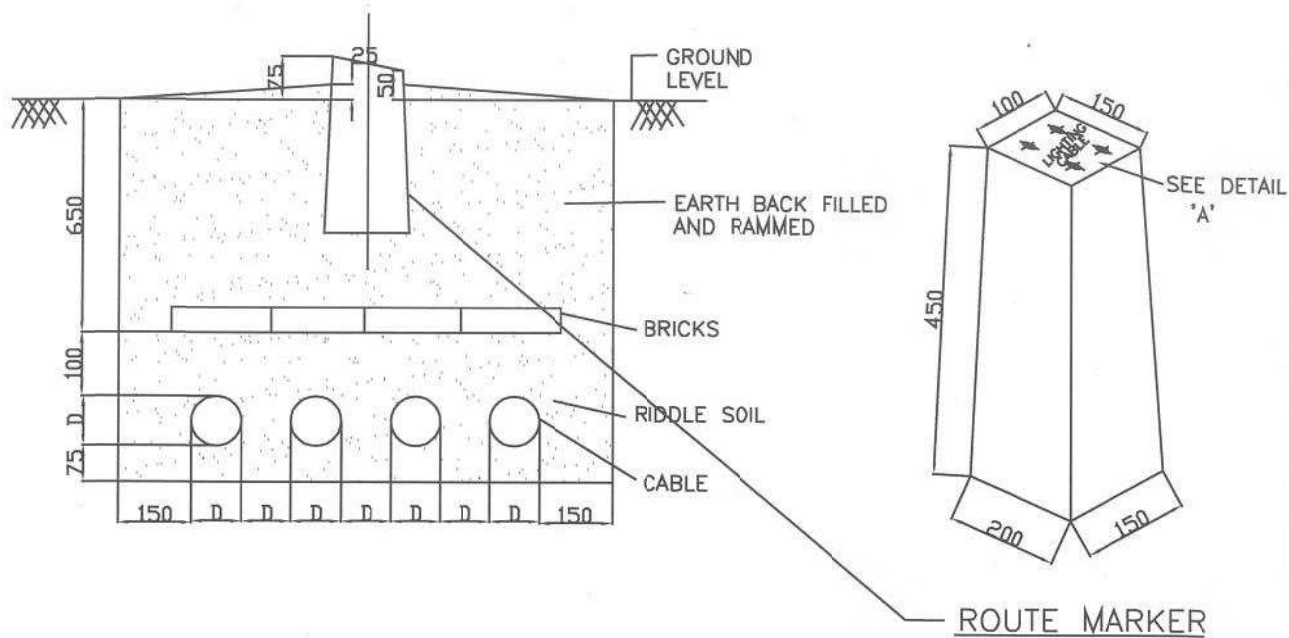
RC	FOR TENDER PURPOSE	1/2	1/3	2/4	-	VY	-	-	-	AS	05/02/00
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	05/02/00
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	05/02/00
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
<div>एन टी पी सी NTPC</div> <div>NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION</div>											
PROJECT STANDARD											
TITLE LIGHTNING PROTECTION DETAILS											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-048								REV. NO. RC	



GENERAL TECHNICAL PARTICULARS

1. ALL DIMENSIONS ARE IN MM.
2. TYPE: WALL/COLUMN/PEDESTAL MOUNTING TYPE.
3. SHEET: CRCA SHEET min. 2mm THK.
4. GLAND PLATE SHOULD BE OF 3MM THK ALUMINIUM, REMOVABLE TYPE WITH KNOCKOUT HOLE FOR I/C CABLE-1Cx300SQ.MM AL.-6NOS.
HOLE FOR O/G CABLE-1Cx185SQ.MM AL.-6NOS.
5. PAINT: PRETREATMENT POWDER COATING
6. SHADE: GREY RAL-9002
7. CABLE ENTRY: BOTTOM
8. BUSBAR: ELECTOLYTIC GRADE TINNED CU. OF Min. 40x10MM
9. IP-55
10. BUS BAR INSULATOR-SMC TYPE
11. BUS BAR ARRANGEMENT: HORIZONTAL
12. BUS BAR SHALL HAVE ONE HOLE DRILLED FOR CABLE CONNECTION OF EACH SIZE MENTIONED AT SL.NO 4 AND SUPPLIED WITH CORRESPONDING SIZE HIGH TENSILE STRENGTH ZINC COATED STEEL BOLTS.

RA	FOR TENDER PURPOSE ONLY	NE	VER	MA	W						
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
		NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT STANDARD											
TITLE ADAPTOR BOX FOR LT CABLES											
SIZE	SCALE	DRG. NO.								REV. NO.	



DETAIL - 'A'


NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ROUTE MARKERS SHALL BE CONSTRUCTED OF CONCRETE WITH CAST IRON PLATE, WITH THE ROUTE INFORMATION ENGRAVED ON IT, BOLTED ON TOP OF THE CONCRETE BLOCK AS SHOWN.
3. CAST IRON PLATE SHALL BE OF Min. 6.0mm THICKNESS.


RC	FOR TENDER PURPOSE	13	13	RKP	-	NV	-	-	-	AS	07/10
RB	FOR TENDER PURPOSE	RKG	RKG	VKM	-	SS	-	-	-	AS	01.11.2006
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											
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PROJECT STANDARD											
TITLE BURIED CABLE TRENCH DETAILS FOR LIGHTING											
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-049								REV. NO. RC	


SUB-SECTION-B – 11

LIGHTING


CLAUSE NO.	TECHNICAL REQUIREMENTS	
1.00.00	GENERAL	
1.01.00	This specification covers the general description of design, manufacture and construction features, testing, supply, installation and commissioning of the Station Lighting system equipment.	
2.00.00	CODES AND STANDARDS	
2.01.00	All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments & revisions as on date of bid opening. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards & codes.	
2.02.00	<p>Lighting Fixtures and Accessories</p> <p>IS:1913 General and safety requirements for luminaries.</p> <p>IS:2148 Flame proof enclosures of electrical apparatus.</p> <p>IS:1534 Ballast for fluorescent lamps.</p> <p>IS:1777 Industrial luminaire with metal reflectors.</p> <p>IS:2418 Tubular fluorescent lamps for general lighting services.</p> <p>IS:4013 Dust-tight electric lighting fittings.</p> <p>IS:8224 Electric Lighting fittings for Division 2 areas.</p> <p>IS:10276 Edison screw lamp holders.</p> <p>IS:10322 Luminaires.</p> <p>IS:13021 AC Supplied Electronic Ballasts for tubular fluorescent lamps.</p> <p>IS 16103 LED Luminaire Standards</p>	
2.03.00	<p>Lighting Panels, Switch-boxes, Receptacles and Junction Boxes</p> <p>IS:2147 Degree of protection provided by enclosures for low-voltage switchgear and control gear.</p> <p>IS:1293 Plugs & socket outlets of rated voltage upto and Including 250volts & rated current upto and including 16 Amps.</p> <p>IS:2551 Danger notice plates.</p> <p>IS:13947 Low voltage switchgear and control-gear</p> <p>IS:3854 Switches for domestic and similar purposes.</p> <p>IS:6875 Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto and including 1000 V AC and 1200 V DC.</p> <p>IS:13703 Low voltage fuses for voltages not exceeding 1000V AC or 1500 V DC.</p>	
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUBSECTION-B-11 STATION LIGHTING Page 1 of 22


CLAUSE NO.	<div> TECHNICAL REQUIREMENTS </div> <div> </div>			
2.07.00	<div> <div>IS 12063</div> <div>Classification of degree of protection provided by enclosures.</div> <div>IS 14700</div> <div>Electro magnetic compatibility (EMC) – Limits (Part 3/Sec. 2) for Harmonic current emission – THD < 15% (equipment, input current < 16 Amps. per phase.</div> <div>IS 9000 (Part 6)</div> <div>Environment testing: Test Z – AD: composite temperature/humidity cyclic test.</div> <div>IS 15885</div> <div>Lamp control gear: particular requirements for (Part 2/Sec. 13) DC or AC supplied electronic control gear IS 16004 – 1 and 2) for LED modules.</div> <div>IS 4905</div> <div>Method for random sampling</div> </div>			
	<div> Electrical Installation Practices & Miscellaneous </div> <div> <div>IS:1944</div> <div>Code of practice for lighting of public thorough fare</div> <div>IS:3646</div> <div>Code of practice for interior illumination.</div> <div>IS:5572</div> <div>Classification of Hazardous areas (other than Mines) having flammable gases and Vapours for electrical installation</div> <div>S:6665</div> <div>Code of practice for industrial lighting.</div> <div>.</div> <div>National Electrical Code</div> <div>-</div> <div>Indian Electricity Rules.</div> <div>IS:5</div> <div>Indian Electricity Act Colour for ready mixed paints & enamels.</div> <div>IS:280</div> <div>Mild steel wires for general engineering purposes.</div> <div>IS:374</div> <div>Electric ceiling type fans & regulators.</div> <div>IS:732</div> <div>Code of practice for electrical wiring installations.</div> <div>IS:1255</div> <div>Code of practice for installation and maintenance of power cables Upto and including 33KV rating.</div> <div>IS:2062</div> <div>Steel for general structural purposes</div> <div>IS:2629</div> <div>Recommended practice for hot-dip galvanizing of iron and steel.</div> <div>IS:2633</div> <div>Methods for testing uniformity of coating of zinc coated articles.</div> <div>IS:2713</div> <div>Tubular steel poles for overhead power lines.</div> <div>IS:3043</div> <div>Code of practice for earthing</div> </div>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUBSECTION-B-11 STATION LIGHTING	Page 3 of 22


CLAUSE NO.	TECHNICAL REQUIREMENTS		
	IS:5216	Guide for safety procedures and practices in electrical work.	
	IS:5571	Guide for selection of electrical equipments for hazardous areas.	
	BS:6121	Mechanical cable glands	
3.00.00	LIGHTING SYSTEM DESCRIPTION		
3.01.00	The illumination of various indoor and outdoor areas in the main plant & offsite area shall be provided as described here. The lighting system of various areas shall comprise of the following systems as identified in Annexure-B:		
	(a)	Normal AC Lighting System	
	(b)	Emergency AC Lighting System	
	(c)	DC Lighting System	
3.02.01	Normal AC Lighting System		
	Normal AC lighting system 415V, 3Phase, 4wire, will be fed from lighting panels (LPs) which in turn will be fed from the lighting distribution boards (LDBs)/Switch board MCC.		
3.02.02	Emergency AC Lighting System		
	This system shall be provided for certain important areas in the main plant. The lighting fixtures connected to this system shall be normally "ON" along with the normal AC system. These will be fed from emergency lighting panels (ELPs) which in turn will be fed 3-phase, 4-wire supply from the emergency lighting distribution boards (ELDB'S). These lights will go off for a few seconds in case of AC supply failure at Emergency Switchgear, but shall be automatically restored when Emergency Switchgear is energised by Diesel generator set.		
3.03.00	DC Lighting System		
3.03.01	At strategic locations in the main plant, a few lighting fixtures fed from 220V, DC supply, shall be provided to enable safe movement of operating personnel and access to important control points during an emergency, when both the normal AC and Emergency Lighting system fail. These lighting fixtures will be fed from 220V DC LDBs which in turn will be fed from DC lighting panels.		
3.03.02	The supply to the DC lighting panels shall be automatically switched ON in case of loss of AC supply at station service switchgear as well as Emergency switch-gear. The DC supply will be automatically switched OFF after about 3 minutes following the restoration of supply to normal AC or emergency AC lighting system.		
3.03.03	Emergency DC lighting is to be provided, through self-contained DC emergency fixtures with four hours back-up duration, at strategic locations, in auxiliary/offsite buildings wherever DC supply system is not available. The fixtures shall be switched 'ON' automatically in case of failure of AC supply.		
3.03.04	Not used		
4.00.00	DESIGN PHILOSOPHY		
	1.	A comprehensive illumination system shall be provided in the entire project areas under bidder's scope.	
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUBSECTION-B-11 STATION LIGHTING
			Page 4 of 22


CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<div><div><div>2.</div><div>All outdoor lighting system shall be automatically controlled by synchronous timer. Provision to bypass the timer shall be provided in the panel.</div></div><div><div>3.</div><div>The system shall include distribution boards, normal/ emergency lighting panels, lighting fixtures, junction boxes, receptacles, switch boards, lighting pole/masts, conduits, cables and wires, etc. The system shall cover all interior and exterior lighting such as area lighting, including Transformer yard & Switch yard area, aviation obstruction lighting, Street lighting, security lighting, etc. The constructional features of lighting distribution boards shall be similar to AC/DC distribution boards described in chapter of LT Switchgear. Outgoing circuits in LPs shall be provided with MCBs of adequate ratings.</div></div><div><div>4.</div><div>The illumination system shall be designed on the basis of best engineering practice and shall ensure uniform, reliable, aesthetically pleasing and glare free illumination. The lighting fixtures shall be designed for minimum glare. The design shall prevent glare/luminous patch seen on VDU/ Large video screens, when viewed from an angle. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection. The diffusers/ louvers used in fixtures shall be made of impact resistant polystyrene sheet and shall have no yellowing property over a prolonged period. The Lux levels to be adopted for various area are indicated at Annexure - A. (placed at the end of this Chapter).</div></div><div><div>5.</div><div>Different Lighting Systems envisaged for various plant areas are indicated in Annexure-B: While finalizing the detailed layout of lighting fixtures, the position/location and layout of equipments should be taken into account to have adequate illumination at desired locations. For CCR room Dimmable and Tunable downlighter fittings to be provided.</div></div><div><div>6.</div><div><div>LED Luminaires:</div><div>LED Luminaires shall be used for the lighting of all the indoor & outdoor areas in bidder's scope. However for DC lighting, hazardous areas & aviation lighting etc. conventional/LED type luminaires shall be used. However, aviation light in Lighting Mast shall be of LED type. In false ceiling area LED luminaires shall be recessed mounting type & in non-false ceiling area the LED luminaires shall be surface mounting type.</div><div>The individual lamp wattage for LED shall be upto 3 watt. Fractional wattage LEDs are also acceptable. The LED chip efficacy shall be min 120 Lm/W. The luminaire efficacy shall be not less than 100 Lm/W. Suitable heat sink shall be designed & provided in the luminaire. The LED used in the luminaires shall have colour rendering index (CRI) of Min 80. Colour designation of LED shall be "cool day light" (min 5700K) type for indoor areas. However for outdoor areas, the colour temperature of LED shall be min. 4000K, including rough & dust prone areas. The LED luminaries shall have a minimum life of 25000 burning hours with 80% of lumen maintenance at the end of the life. LED shall conform to the LM 80 requirements.</div><div>The max. junction temperature of LED shall be 85 deg C. Further the lumen maintenance at this temperature shall be min 90%. The THD of LED Luminaires shall be less than 10%. Further the EMC shall be as per IS 14700. The power factor of the luminaire shall not be less than 0.9. The marking on luminaire & safety requirements of luminaire shall be as per IS standards. Suitable heat sink with proper thermal management shall be designed & provided in the luminaire.</div><div>The connecting wires used inside the system, shall be low smoke halogen free, fire retardant type and fuse protection shall be provided in input side specifically for LED luminaires.</div></div></div></div>			
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	<p>Care shall be taken in the design that there is no water stagnation anywhere in the housing of luminaire. The entire housing shall be dust and waterproof protection as per IS 12063.</p> <p>7. Driver Circuit LED modules and drivers shall be compatible to each other. The LED module driver's ratings and makes shall be as recommended by corresponding LED chip manufacturer. LED Drivers shall have following control & protections: -</p> <ul style="list-style-type: none">• Suitable precision current control of LED.• Open Circuit Protection• Short Circuit Protection• Over Temperature Protection• Surge Protection <p>8. Apart from maintenance factor as given below, Temperature correction factor shall be considered in the lighting design for fixtures located in non air conditioned area.</p> <table><tr><td>(a.)</td><td>Office area (air conditioned)</td><td>:</td><td>0.8</td></tr><tr><td>(b.)</td><td>Office area (non air conditioned) and other indoor area</td><td>:</td><td>0.7</td></tr><tr><td>(c.)</td><td>Dust prone indoor and outdoor area</td><td>:</td><td>0.6</td></tr><tr><td>(d.)</td><td>Material Handling area etc.</td><td>:</td><td>0.5</td></tr><tr><td>(e.)</td><td>Not used</td><td></td><td></td></tr></table> <p>9. (i) All outdoor fixtures shall be weather proof and of min. IP65 degree of protection. (ii) For Indoor type of fixtures:- (a) Surface/Pendent mounting: - IP 54 class of protection. (b) Recess Mounting (False ceiling):- IP 20 class of protection.</p> <p>10. (a) Lighting panels shall be constructed out of 2 mm thick CRCA sheet steel. The door shall be hinged and the panel shall be gasketted to achieve specified degree of protection. Lighting panels shall be powder coated with color shade RAL9002. Lighting panels shall have min. IP55 degree of protection.</p> <p>(B) All MCBs/Isolators/Switches/Contactors etc. shall be mounted inside the panel and a fibre glass sheet shall be provided inside the main door such that the operating knobs of MCBs etc., shall project out of it for safe operation against accidental contact.</p> <p>(c) Terminal bocks shall be 1100 V grade, clip-on stud type, made up of polyimide 6.6 or better suitable for terminating multicore 35 or 70 Sq. mm. stranded aluminium conductor incoming cable and 10 Sq. mm. stranded aluminium conductor for each outgoing circuits voltage. All terminals shall be shrouded, numbered and provided with identification strip for the feeders.</p> <p>(d) MCB's shall be current limiting type with magnetic and thermal release suitable for manual closing and automatic tripping under fault condition. MCB's shall have short circuit interrupting capacity of 9 KA rms. MCB knob shall be marked with ON/OFF indication. A trip free release shall be provided to ensure</p>				(a.)	Office area (air conditioned)	:	0.8	(b.)	Office area (non air conditioned) and other indoor area	:	0.7	(c.)	Dust prone indoor and outdoor area	:	0.6	(d.)	Material Handling area etc.	:	0.5	(e.)	Not used		
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	<p>tripping on fault even if the knob is held in ON position. MCB terminal shall be shrouded to avoid accidental contact.</p> <p>(e) Contactors of AC lighting panels shall be 3 no's,63 A, single pole continuous duty MCB, with neutral link,load make-break type suitable for 415 V, 3 phase 4 wire system.</p> <p>(f) DC switches shall be rotary type, 2 pole, continuous duty, load break type, quick make quick break, suitable for 220 V DC, 2 wire system. Switch knob shall be provided with ON/OFF indication.</p> <p>(g) Programmable Digital Timer shall be Electronic Astronomical Almanac Time switch with battery backup of min. TEN years, 4 Digit LED display, 24 hours range, manual override facility, 10 Amp 3 relay output, with NO/NC Contacts suitable for operation on 240V single phase AC supply.</p> <p>(h) Each lighting panel (LP-3) shall be fed from a 415V/42V, 3 phase-4 wire, 3 KVA transformer. The transformer shall be located inside the lighting panel itself. Transformers shall be dry type, natural air cooled with class F insulation or better. Impedance of transformer shall be 5%. Transformers shall be tested as per IS:11171. Off-circuit tap changer with +/- 5% in steps of +/- 1.25% tapping shall be provided. One minute power frequency withstands voltage for lighting transformer shall be 2.5 KV.</p> <p>(i) Lighting Panels shall have 20% spare outgoing feeders and shall be of following types:-</p> <table><tr><th>TYPE</th><th>INCOMER FEEDER</th><th>OUTGOING FEEDERS</th><th>DETAIL OF CONTENTS</th></tr><tr><td>LP-1</td><td>3No. 415V, 63 A, SP MCB (31/2Cx70sq.mm cable)</td><td>18Nos.,20A, 240V MCB</td><td>415V, 63A(min.), AC2 duty contactor and Astronomical Programmable Digital Timer of 24 hour range 10A, 240V selector switch, fuse, etc. outdoor type and IP:55 degree of protection</td></tr><tr><td>LP-2</td><td>3No. 415V, 63 A, SP MCB (31/2Cx70sq.mm cable)</td><td>9 Nos.,20A, 240V MCB</td><td>415V, 63A(min.), AC2 duty contactor and Astronomical Programmable Digital Timer of 24 hour range 10A, 240V selector switch, fuse, etc. outdoor type and IP:55 degree of protection</td></tr></table>				TYPE	INCOMER FEEDER	OUTGOING FEEDERS	DETAIL OF CONTENTS	LP-1	3No. 415V, 63 A, SP MCB (31/2Cx70sq.mm cable)	18Nos.,20A, 240V MCB	415V, 63A(min.), AC2 duty contactor and Astronomical Programmable Digital Timer of 24 hour range 10A, 240V selector switch, fuse, etc. outdoor type and IP:55 degree of protection	LP-2	3No. 415V, 63 A, SP MCB (31/2Cx70sq.mm cable)	9 Nos.,20A, 240V MCB	415V, 63A(min.), AC2 duty contactor and Astronomical Programmable Digital Timer of 24 hour range 10A, 240V selector switch, fuse, etc. outdoor type and IP:55 degree of protection
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Type	Switch rating	Socket & plug rating	Type & make of plug & Socket	Terminal Block size	
RA	20 A, SP240V AC(Industrial)	20A, 3 pin240 V AC	NTPC appd. make	1-4 way, suitable for loop-in loop- out of 10 sq.mm. Al. Conductor	
RB	16A, S.P240V AC	6A+16A6 Pin decorative Piano-key Type Switch	NTPC appd.make	1-4 way, suitable for loop-in loop- out of upto 10 sq.mm. Al. Conductor	
RC	20 A, SP24 V AC(Industrial)	20A, 3 pin24 V AC	NTPC appd. make	1-4 way, suitable for loop-in loop- out of 2 core -16 sq.mm. Al. Cable.	
	14.	In the hazardous areas like fuel oil handling areas or any other gas/ liquid fuel storage/ handling areas in bidder's scope, lighting shall be flame proof.			
	15.	The type of fixtures, LP, JB, and receptacle used in Hydrogen generation plant building shall be suitable for group II C as per IS: 2148 or class I, Division II as per NEC 70-428.			
	16.	All fluorescent lamps shall be have "Cool day light" colour designation. The mirror optics type fixtures shall have no iridescence effect. Fixtures with better efficiency and upgraded proven system may also be considered In candescent lamps may be used only with DC Lighting.			
	17.	Aviation warning lights shall be provided as per the recommendations of ICAO and Director general of civil aviation, India. The arrangement of light should be marked such that the object is indicated from every angle in azimuth. The aviation warning lighting system shall also conform to the latest Indian standard IS 4998.			
	18.	Contractor shall demonstrate the average lux level achieved for different areas as per specification requirements, after completion of the lighting work, at site to the satisfaction of engineer-in-charge.			
	19.	70W (min) LED light fixture shall be provided at every column of MPH/MCC/pump house/shed/store/buildings etc for the peripheral lighting. 120W (min) LED fitting shall be provided wherever column spacing is more than 5m.			
4.01.00	-NOT USED.				
4.02.00	All luminaires and their accessories and components shall be of type readily replaceable by available Indian makes.				
4.03.00	Fans & Regulator				
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
4.03.01	Ceiling Fans, to be provided in non air-conditioned office/control room area. Further tentatively one (1) no. ceiling fan shall be provided for 10 sq.m area, at suitable mounting height. The ceiling fans shall be suitable for operation on 240 V +/-10%, 50 Hz, AC supply comprising of class 'E' or better insulated copper wound single phase motor, 1200mm sweep, aerodynamically designed well balanced AL blades (3 Nos.), down rod, BEE 5 star rated,die cast aluminium housing, capacitor, suspension hook, canopies etc. finished in stove enameled white or with electro static powder coating. Power factor of fans shall not be less than 0.9. Fan regulators shall be stepped electronic type suitable for operation on 240V +/-10% AC supply.			
4.04.00	Junction Boxes, Conduits, Fitting & Accessories, Pull Out Boxes: Junction box for indoor lighting shall be made of fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. Junction boxes for street lighting poles and lighting mast if applicable , shall be deep drawn or fabricated type made of min. 1.6 mm thick CRCA Sheet. The box shall be hot dip galvanized. The degree of protection shall be IP55. All switches and receptacles upto 16A shall be modular type. These shall be provided with pre-galvanized/galvanized modular switchbox & plate. Conduits, Pipes and Accessories Galvanised heavy duty steel conduits for normal area and galvanised heavy duty steel conduits with an additional epoxy coating for corrosive area shall be offered. Alternatively glass reinforced epoxy conduits with comparable compressive and impact strength with that of heavy duty steel conduits may be offered. Conduits in walls and ceilings in buildings with RCC and masonry structure such as Administrative, Service, Canteen, Time Office, Auditorium, IT building etc shall be concealed.Rigid steel conduits shall be heavy duty type,hot dip galvanised conforming to IS : 9537 Part-I & II shall be suitable for heavy mechanical stresses, threaded on both sides and threaded length shall be protected by zinc rich paint. Conduits shall be smooth from inside and outside. Flexible conduit shall be water proof, rust proof, made of heat resistant steel with temperature rating of 150 deg C Pull out boxes shall be provided at suitable interval in a conduit run .Boxes shall be suitable for mounting on Walls, Columns, Structures, etc.. Pull-out boxes shall have cover with screw and shall be provided with good quality gasket lining. Pull out boxes used outdoor shall be weather proof type suitable for IP: 55 degree of protection and those used indoor shall be suitable for IP: 52 degree of protection. Pull out box & its cover shall be hot dip galvanized.			
4.05.00	Lighting Wires			
4.05.01	Lighting wires shall be 1100 V grade, light duty PVC insulated unsheathed, stranded copper/aluminium wire for fixed wiring installation. Colour of the PVC insulation of wires shall be Red, Yellow, Blue and Black for R, Y, B phases & neutral, respectively and white & grey for DC positive & DC negative circuits, respectively. Minimum size of wire shall not be less than 1.5.sq.mm. for copper and 4 sq.mm. for aluminium.			
4.06.00	Lighting Poles			
4.06.01	The Street Light system and peripheral lighting shall be designed generally in line with design guidelines. The Poles shall be mounted above ground using base plate and minimum height of pole shall be 8 mtrs The poles shall be hot-dip galvanized as per IS2629/ IS2633/ IS4759. The average coating thickness of galvanizing shall be min. 70 micron. The System shall be capable of withstanding the appropriate wind load etc as per IS 875 considering prevailing soil/ site condition considering all accessories mounting on pole.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>The street light poles shall have loop in loop out arrangement for cable entry and light fixture / wiring protected with suitably rated MCB.</p>		
4.07.00	<p>Lighting Masts</p>		
4.07.01	<p>Suitable number of lighting masts shall be provided for entire plant..Lighting Mast shall be of continuously tapered polygonal cross section hot dip galvanised. The Mast shall be of 30 M or suitable height with lantern carriage to enable raising/lowering for ease of maintenance, including the Head Frame, Double Drum Winch, continuous stainless steel wire rope, in built power tool, luminaires, suitable aviation warning light, lightning alongwith necessary power cables within the mast. The mast shall be delivered in not more than three sections & shall be joined together by slip stressed fit method at site. No site welding or bolted joints shall be done on the mast</p> <p>The Mast together with the fixtures shall be capable of withstanding the appropriate wind loads as per IS: 875. The Mast shall be fabricated from special steel plates conforming to BS-EN10-025 and folded to form a polygonal section.</p> <p>Suitable feeder pillar with TPN MCB, contactors, timer, MCB and other necessary accessories for operation & protection of the mast and fixtures shall be provided.</p>		
4.08.00	<p>Lighting fixtures shall generally be group controlled directly from lighting panel. However, in office areas, control shall be provided through switch boxes. Each switch shall control a maximum of three fluorescent fixtures.</p>		
4.09.00	<p>A.C. normal, AC emergency and DC system wiring shall run throughout in separate conduits. Wires of different phase shall run in different conduits.</p>		
4.10.00	<p>Lighting panels, etc. shall be earthed by two separate and distinct connections with earthing system. Switch boxes, junction boxes, lighting fixtures, fans, single phase receptacles etc. shall be earthed by means of separate earth continuity conductor. The earth continuity conductor 14 SWG GI wire shall be run alongwith each conduit run. Cable armours shall be connected to earthing system at both the ends.</p>		
4.11.00	<p>Alternately Vendor may offer technically superior and proven product subject to approval of employer.</p>		
4.12.00	<p>Occupancy based Passive Infra-red sensors</p> <p>Reliable occupancy based Passive Infra-red sensor shall be provided in air conditioned office rooms suitable to cater the controlled lighting systems. The detection area shall be minimum 5 metres for standard room height of 3mt. All the calibrated settings shall be stored in non-volatile memory of PIR sensor which shall be unaffected by power supply fluctuations. If necessary, contactor shall be supplied along with sensor & may be located inside the switch box/Panel.</p>		
5.00.00	<p>TESTS</p>		
5.01.00	<p>For LED Fixture</p> <p>a) The contractor shall carry out the type tests as listed in this specification on the following types of LED fixtures to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant price schedule of bid document and the same shall be considered for the evaluation of the bids.</p> <p>LED fixtures (Type test shall be conducted on one rating each of following type of LED fixtures. Rating for test conduction shall be decided by the employer during detailed engineering)</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>													
	<div><div><div>a) High bay fixture.</div><div>b) Well glass fixture.</div><div>c) Street light fixture</div><div>d) Surface mounted type fixture.</div><div>e) Recessed mounted type fixture.</div></div><div>The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.</div></div>																
5.02.00	For all other Station lighting equipment:																
5.03.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.																
5.04.00	Selection of samples for type test, acceptance test & routine test and acceptance criteria for all the items shall be as per relevant I.S																
5.05.00	Type test reports of the following items as per technical specification requirements/ standards shall be submitted for approval.																
	SL NO.	DESCRIPTION															
	i.	Lighting fixtures of each type															
	ii.	Lighting panel of each type (Degree of Protection)															
	iii.	Junction Box of each type.															
	Type test reports for LED as per standards for following shall be submitted for approval.																
	<table><tr><td>1. Visual and Dimension check</td></tr><tr><td>2. Proof of procurement of LEDs</td></tr><tr><td>3. Safety tests</td></tr><tr><td> a) Marking</td></tr><tr><td> b) Construction</td></tr><tr><td> c) Provision for Earthing</td></tr><tr><td> d) External and Internal wiring</td></tr><tr><td> e) Protection against electrical shock</td></tr><tr><td> f) Endurance and Thermal</td></tr><tr><td> g) Insulation resistance & electrical strength</td></tr><tr><td> h) Resistance to heat fire & tracking</td></tr><tr><td> i) Resistance to Humidity</td></tr><tr><td>4. Fire Retardant test</td></tr></table>				1. Visual and Dimension check	2. Proof of procurement of LEDs	3. Safety tests	a) Marking	b) Construction	c) Provision for Earthing	d) External and Internal wiring	e) Protection against electrical shock	f) Endurance and Thermal	g) Insulation resistance & electrical strength	h) Resistance to heat fire & tracking	i) Resistance to Humidity	4. Fire Retardant test
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	5. Performance tests (electrical, Photometric color and Life)			
	6. Burn-in Test			
	7. Power Cycling			
	8. Temperature rise test			
	9. Emission Tests			
	a) Radiated & conducted emission			
	b) Harmonics & flickers			
	10. Immunity tests			
	In addition, following test reports to be submitted for LED chip/LED luminaire:			
	a) LED parameters like Lumen per watt, CRI, Beam angle from manufacturer.			
b) LM 80/IS: 16105 report.				
c) LM 79/IS: 16106 report.				
5.06.00	Acceptance Test and Routine Test			
5.06.01	All lighting fixtures, lamps and other items shall be subjected to acceptance and routine test, as per relevant specified standards.			
5.06.02	Junction boxes, switch boxes, receptacle enclosure etc. shall be subjected to physical and dimensional checks also. Switch boxes shall be made of 1.6 mm thick MS sheet with 3 mm thick decorative, Perspex cover. Switch box shall be hot dip galvanized.			
	Switch boxes shall be of following types :			
	TYPE No.	Switch	Fan Regulator*	Socket
	SWB 1	5 A - 2 Nos.	-	-
	SWB 2	5 A - 3 Nos.	-	5A - 1.No.
	SWB 3*	5 A - 5 Nos.	1	5A - 1.No
	SWB 4*	5 A - 7 Nos	3	5A - 1.No.
	SWB 5**	5 A - 5 Nos	-	5A - 1.No.
	* Space provision shall be kept for fan regulator in switch boxes.			
	** Shall have the provision for mounting the 16 A contactor.			
5.07.00	Galvanizing Tests			
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5.07.01	The quality of galvanizing shall be smooth, continuous, free from flux stains and shall be inspected visually.			
5.07.02	In addition following tests shall be conducted as acceptance tests.			
	(a)	Uniformity of coating - The coating of any article shall withstand for one (1) minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.		
	(b)	The quality of cadmium/zinc plating on items with screw threads shall be free from visible defects such as unplated areas, blisters and modules and shall be inspected visually.		
	(c)	In addition, the plating thickness shall be determined microscopically/ chemically or electronically.		
6.00.00	COMMISSIONING CHECKS			
	1.	On completion of installation work, the Contractor shall request the Project manager for inspection and test with minimum of fourteen (14) days advance notice.		
	2.	The Project manager shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor.		
	3.	The installation shall be then tested and commissioned in presence of the Project manager.		
	4.	The contractor shall provide all, men material and equipment required to carry out the tests.		
	5.	All rectifications repair or adjustment work found necessary during inspection, testing and commissioning shall be carried out by the Contractor without any extra cost. The handing over the lighting installation shall be effected only after the receipt of written instruction from the Employer/his authorized representative.		
	6.	The testing shall be done in accordance with the applicable Indian Standards and codes of practices. The following tests shall be specifically carried out for all lighting installation.		
	(a)	Insulation Resistance.		
	(b)	Testing of earth continuity path.		
	(c)	Polarity test of single phase switches.		
	(d)	Functional checks.		
	7.	The lighting circuits shall be tested in the following manner:		
	(a)	All switches ON and consuming devices in circuit, both poles connected together to obtain resistance to earth.		
	(b)	Insulation resistance between poles with lamps and other consuming devices removed and switches ON.		
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	ANNEXURE-A			
	SI No.	Location**	Average Illumination Level (Lux)	Type of Fixture
	(a)	Engine Hall operating floor	200	High/medium bay LED luminaire
	(b)	Engine Hall Other Platforms	200	LED high/medium bay, LED well glass fixtures
	(c)	Switchgear rooms, Charger, Rectifier room	200	Industrial type LED Luminaire
	(d)	Control room, computer room, control equipment room	350	LED luminaire equivalent to Mirror optics with anti-glare features or down-lighter.
	(e)	Offices, conference rooms, etc.	300	Decorative mirror optics Type LED luminaire or LED down-lighter
	(f)	Battery rooms	100	Totally enclosed corrosion Proof LED Luminaire
	(g)	Transformer yard	20 (general) 50 (on equipment)	LED Luminaire
	(h)	Platforms	100	LED well glass fixtures,
	(i)	Diesel generating room /enclosure, Compressor room, pump house etc.	150	LED medium bay/ Industrial type LED Luminaire
	(j)	Fuel oil pump house	150	Flame proof fluorescent fixtures suitable for division-2 hazardous area
	(k)	Cable galleries/vault	50	Industrial type LED Luminaire
	(l)	Street lighting- primary roads secondary roads	20 10	LED street lights
	(m)	Outdoor storage handling and unloading area	20	LED Luminaire
	(n)	Cement stores	150	Industrial dust proof type LED Luminaire
	(o)	Chemical stores/House	150	Corrosion proof LED Luminaire
	(p)	Permanent stores	150	LED high/medium bay / Industrial trough LED Luminaire
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2		SUBSECTION-B-11 STATION LIGHTING
				Page 15 of 22

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	(q)	Workshop. Building	150	LED high/medium bay / Industrial trough LED Luminaire
	(r)	Laboratory General Analysis area	150 300	Corrosion proof LED Luminaire
	(s)	Garage/Car Parking	50	Industrial type LED Luminaire
	(u)	AIS Switchyard and Substation	20(general 50(on strategic equipment)	LED Luminaire
	(v)	Transfer points, Sheds, tunnels, bunker house, Crusher house, Conveyor Gallery etc. in bidders scope	100	LED Dust tight/Well glass type Luminaire
	(w)	Facility building, canteen etc	150	Industrial type LED Luminaire
	(x)	Hydrogen Plant Building	150	Explosion proof HPMV/ Fluorescent fittings suitable for class-I and Division –IIC
	(y)	DC Lighting- Control room	-	LED down light fixtures, Decorative recessed type with cylindrical reflector
	(z)	DC Lighting- Other Area	-	LED Industrial Bulkhead
	(aa)	Corridors, Walkways	50	LED Luminaire
	(ab)	Building Periphery Lighting	10	LED Street Light fixture/ LED Luminaire
	(ac)	Security Lighting along Boundary	10	LED Street Light fixture/ LED Luminaire
	(ad)	ESP platform	150	LED well glass fixtures
	(ae)	Gate complex/Time Office	150	LED Luminaire
	(af)	GIS Hall	150	LED medium bay/ Luminaire
	(ag)	DM plant, water treatment plant CW Pump house, Raw water PH, Fire Water PH	150	LED high/medium bay / Industrial trough LED Luminaire
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2		SUBSECTION-B-11 STATION LIGHTING
Page 16 of 22				

CLAUSE NO.	TECHNICAL REQUIREMENTS						<div>एनटीपीसी NTPC</div>
	ANNEXURE-B						
	Sl.	Plant Areas	Normal AC Lighting System	Emergency AC Lighting System	220 V DC Lighting System	Portable DC Fixtures	
	1	Engine Building(Engine hall, switchgear room etc)	80%	20%	√	—	
	2.	Platform	80%	20%	√		
	3	DG Area/ Room	80%	20%			
	4	Compressor Room				√	
	5	Not used					
	6	Unit Control Room	70%	30%			
	7	Switchyard Control Room	80%	20%			
	8	Battery Room	80%	20%			
	9	Cable Spreader Room/ Vault	80%	20%	√		
	10	Not used					
	11	Chemical House	100%			√	
	12	Fuel Oil Pump House	100%			√	
	13	Not used					
	14	Water Treatment Plant	100%			√	
	15	Not used					
	16	Cooling Towers	100%				
	17	Workshop	100%			√	
	18	Service Building	100%				
	19	Area Lighting	100%				
	20	Street Lighting	100%				
	21	Transformer Yard and Storage Yard	100%				
	22	Not used					
	23	GIS Hall	80%	20%			
24	AIS Switchyard	80%	20%				
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2		SUBSECTION-B-11 STATION LIGHTING		Page 17 of 22	

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>																																																																					
	<div>DC Emergency Lighting:</div> <table><tr><th>Sl.</th><th>Area</th><th>Average Lux Level</th></tr><tr><td>1</td><td>Unit Control Room</td><td>100</td></tr><tr><td>2</td><td>Control Equipment Room</td><td>100</td></tr><tr><td>3</td><td>Switchyard Control Room</td><td>20</td></tr><tr><td>4</td><td>Strategic Control Points (In Engine Building, Switchgear room, SWAS, Battery Room, UPS Area, Engine Hall, Lube oil Room etc</td><td>20</td></tr><tr><td>5</td><td>Cable Vault & Galleries</td><td>1 fixture at every 20 metres spacing along walkways</td></tr><tr><td>6</td><td>Stair Case</td><td>1 fixture at every 20 metres spacing along walkways</td></tr><tr><td>7</td><td>Exit/ Entry of Main Plant Building</td><td>1 fixture</td></tr><tr><td>8</td><td>Fire Exit Sign</td><td>1 fixture</td></tr></table> <div>LIGHTING POLES SHALL BE OF FOLLOWING TYPES:</div> <table><tr><th>NTPC</th><th>Overall Pole Height</th><th>Overhang Projection</th><th>Application</th></tr><tr><td>A1</td><td>9m</td><td>1.2m</td><td>For single street Light fixture</td></tr><tr><td>A2</td><td>11m</td><td>1.75m</td><td>For single street Light fixture</td></tr><tr><td>A3</td><td>11m</td><td>1.75m</td><td>With double arm for two street light fixtures</td></tr><tr><td>C1</td><td>9m</td><td>-</td><td>For Flood Light fixture</td></tr><tr><td>C2</td><td>11m</td><td>-</td><td>For Flood Light fixture</td></tr><tr><td>E1</td><td>4m</td><td>-</td><td>For Post Top lanterns</td></tr><tr><td>Mast</td><td>30m</td><td>-</td><td>For Flood Light Fixture</td></tr><tr><td>J-Pole</td><td>3.5 m</td><td>R250mm</td><td>For Platform lighting</td></tr></table> <div>JUNCTION BOXES</div> <table><tr><th>NTPC</th><th>Terminal Block Size</th><th>Remarks</th></tr><tr><td>TYPE-F</td><td>1No-2way, suitable for loop-in loop-out upto 2 numbers 10 sq mm aluminium conductor and tap off of 1.5 sq mm copper conductor</td><td></td></tr></table>				Sl.	Area	Average Lux Level	1	Unit Control Room	100	2	Control Equipment Room	100	3	Switchyard Control Room	20	4	Strategic Control Points (In Engine Building, Switchgear room, SWAS, Battery Room, UPS Area, Engine Hall, Lube oil Room etc	20	5	Cable Vault & Galleries	1 fixture at every 20 metres spacing along walkways	6	Stair Case	1 fixture at every 20 metres spacing along walkways	7	Exit/ Entry of Main Plant Building	1 fixture	8	Fire Exit Sign	1 fixture	NTPC	Overall Pole Height	Overhang Projection	Application	A1	9m	1.2m	For single street Light fixture	A2	11m	1.75m	For single street Light fixture	A3	11m	1.75m	With double arm for two street light fixtures	C1	9m	-	For Flood Light fixture	C2	11m	-	For Flood Light fixture	E1	4m	-	For Post Top lanterns	Mast	30m	-	For Flood Light Fixture	J-Pole	3.5 m	R250mm	For Platform lighting	NTPC	Terminal Block Size	Remarks	TYPE-F	1No-2way, suitable for loop-in loop-out upto 2 numbers 10 sq mm aluminium conductor and tap off of 1.5 sq mm copper conductor	
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GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUBSECTION-B-11 STATION LIGHTING	Page 18 of 22																																																																					

Detailed Description for Lighting Fixtures

Type No.	Description	Type of Installation	Power Consumption
IB	100W LED industrial bulk head fixtures comprising die cast aluminum body finished powder coated, heat resistant glass, neoprene/ synthetic gasket, MS powder coated wire guard, lamp, etc. complying to IP 54 class of protection.	Surface mounting on Column/ wall/ ceiling	100 W
IR	100W LED down light fixtures, electrochemically brightened, anodi-sed, high purity aluminium reflector comprising of lamp, galvanized / Powder coated mounting bracket, etc.	Recessed mounting in false ceiling areas	100 W
IW	100W LED well glass fixtures comprising die cast housing finished powder coated, heat resistant glass, MS powder coated wire guard, neoprene/ synthetic gasket, lamp, etc. complying to IP 65 class of protection.	Mounting on structures/ hand rails/ columns	100 W
LSR	Rectangular panel type LED luminaire with external body of CRCA sheet, powder coated, alongwith uniform diffuser front glass, comprising LED chips, mounted on suitable designed aluminium heat sink with high thermal conductivity for better heat dissipation, fitted with integral drivers, stainless steel toggle clips & neoprene/ synthetic rubber gasket lining complying to IP 54 class of protection, Colour temperature shall be 5700K (cool day light).	Surface/ pendent mounting	35W (max. power consumption including driver circuit load)
LSR-1	Rectangular panel type LED luminaire with external body of CRCA sheet, powder coated, alongwith uniform diffuser front glass, comprising LED chips, mounted on suitable designed aluminium heat sink with high thermal conductivity for better heat dissipation, fitted with integral drivers, stainless steel toggle clips & neoprene/ synthetic rubber gasket lining complying to IP 54 class of protection, Colour temperature shall be 5700K (cool day light).	Surface/ pendent mounting	18W (max. power consumption including driver circuit load)
LSRC	Rectangular panel type LED luminaire with totally enclosed, corrosion proof, ABS/Polycarbonate Canopy, alongwith uniform diffuser front glass, comprising LED chips, mounted on suitable designed aluminium heat sink with high thermal	Surface/ pendent mounting	35W (max. power consumption including driver circuit load)

TECHNICAL REQUIREMENTS

Type No.	Description	Type of Installation	Power Consumption
	conductivity for better heat dissipation, fitted with integral drivers, stainless steel toggle clips & neoprene/ synthetic rubber gasket lining complying to IP 54 class of protection, Colour temperature shall be 5700K (cool day light).		
FH	Twin 36 W, flame proof fluorescent/LED lighting fixtures suitable for division 2 hazardous area.	Surface / pendent mounting	36W
LRR	Rectangular sleek panel type LED luminaire with external body of CRCA sheet, white powder coated, alongwith high clarity uniform diffuser removable front glass, comprising LED chips, mounted on suitable designed aluminium heat sink with high thermal conductivity for better heat dissipation, fitted with integral drivers, neoprene/ synthetic rubber gasket lining complying to IP 23 class of protection, Colour temperature shall be 5700K (cool day light).	Recess mounting (false ceiling)	35W (max. power consumption including driver circuit load)
LRS	Square sleek panel type LED luminaire with external body of CRCA sheet, white powder coated, alongwith high clarity uniform diffuser removable front glass, comprising LED chips, mounted on suitable designed aluminium heat sink with high thermal conductivity for better heat dissipation, fitted with integral drivers, neoprene/ synthetic rubber gasket lining complying to IP 23 class of protection, Colour temperature shall be 5700K (cool day light).	Recess mounting (false ceiling)	35W (max. power consumption including driver circuit load)
LSF-1	LED flood light type luminaire housing shall be of corrosion free, pressure die cast aluminium, comprising of toughened clear front glass, LED chips, mounted on suitable designed aluminium heat sink with high thermal conductivity for better heat dissipation, fitted with integral drivers, stainless steel toggle clips & neoprene/synthetic rubber gasket lining complying to IP 65 class of protection, Colour temperature shall be 5000K	Base mounting on structure/masts	180W (max. power consumption including driver circuit load)
LSF-2	LED flood light type luminaire housing shall be of corrosion free, pressure die cast aluminium, comprising of toughened clear	Base mounting on masts/struct	260W (max. power consumption

Type No.	Description	Type of Installation	Power Consumption
	front glass, LED chips, mounted on suitable designed aluminium heat sink with high thermal conductivity for better heat dissipation, fitted with integral drivers, stainless steel toggle clips & neoprene/ synthetic rubber gasket lining complying to IP 65 class of protection, Colour temperature shall be 5000K	ures	including driver circuit load)
LSH-1	LED high bay type luminaire housing shall be of corrosion free, pressure die cast aluminium, comprising of toughened clear front glass, LED chips, mounted on suitable designed aluminium heat sink with high thermal conductivity for better heat dissipation, fitted with integral drivers, stainless steel toggle clips & neoprene/ synthetic rubber gasket lining complying to IP 65 class of protection, Colour temperature shall be 5000K	Suspension mounting	90W (max. power consumption including driver circuit load)
LSH-2	LED high bay type luminaire housing shall be of corrosion free, high purity aluminium, pressure die cast, comprising of toughened clear front glass, LED chips, mounted on suitable designed aluminium heat sink with high thermal conductivity for better heat dissipation, fitted with integral drivers, stainless steel toggle clips & neoprene/ synthetic rubber gasket lining complying to IP 65 class of protection, Colour temperature shall be 5000K	Suspension mounting	160W (max. power consumption including driver circuit load)
LSH-3	LED high bay type luminaire housing shall be of corrosion free high purity aluminium, pressure die cast, comprising of toughened clear front glass, LED chips, mounted on suitable designed aluminium heat sink with high thermal conductivity for better heat dissipation, fitted with integral drivers, stainless steel toggle clips & neoprene/ synthetic rubber gasket lining complying to IP 65 class of protection, Colour temperature shall be 5000K	Suspension mounting	260W (max. power consumption including driver circuit load)
LSS-1	LED street light type luminaire housing shall be of corrosion free, pressure die cast aluminium, comprising of clear acrylic bowl, LED chips, mounted on suitable designed aluminium heat sink with high thermal conductivity for better heat dissipation, fitted	Street light pole mounting	90W (max. power consumption including driver circuit load)

TECHNICAL REQUIREMENTS

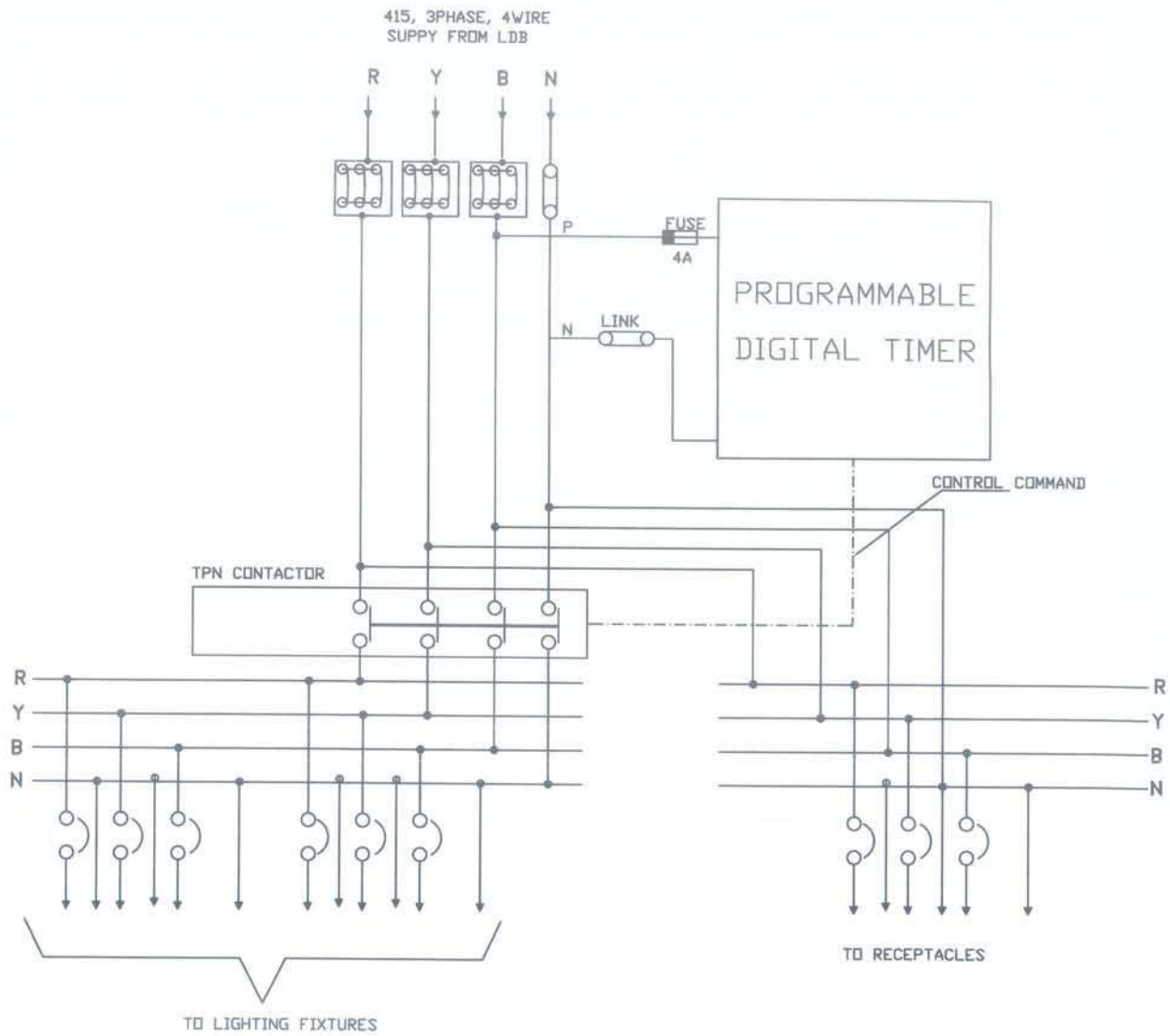
Type No.	Description	Type of Installation	Power Consumption
	with integral drivers, stainless steel toggle clips & neoprene/ synthetic rubber gasket lining complying to IP 65 class of protection, Colour temperature shall be 5000K		
LSS-2	LED street light type luminaire housing shall be of corrosion free, pressure die cast aluminium, comprising of clear acrylic bowl, LED chips, mounted on suitable designed aluminium heat sink with high thermal conductivity for better heat dissipation, fitted with integral drivers, stainless steel toggle clips & neoprene/ synthetic rubber gasket lining complying to IP 65 class of protection, Colour temperature shall be 5000K	Street light pole mounting	180W (max. power consumption including driver circuit load)
LSW-1	LED well glass type luminaire housing shall be of corrosion free, pressure die cast aluminium, comprising of clear well glass with white powder coated wire guard, LED chips, mounted on suitable designed aluminium heat sink with high thermal conductivity for better heat dissipation, fitted with integral drivers, stainless steel toggle clips & neoprene/ synthetic rubber gasket lining complying to IP 65 class of protection, Colour temperature shall be 4000K	Mounting on structures/ hand rail/ columns	38W (max. power consumption including driver circuit load)
LSW 2	LED well glass type luminaire housing shall be of corrosion free pressure die cast aluminium, comprising of clear well glass with white powder coated wire guard, LED chips, mounted on suitable designed aluminium heat sink with high thermal conductivity for better heat dissipation, fitted with integral drivers, stainless steel toggle clips & neoprene/ synthetic rubber gasket lining complying to IP 65 class of protection, Colour temperature shall be 4000K	Mounting on structures/ hand rail/ columns	90W (max. power consumption including driver circuit load)
PF	Self contained emergency lighting fixture with 2x10W LED with nickel cadmium battery, charger etc.	Wall / column mounting	20W

Type No.	Description	Type of Installation	Power Consumption
LRC	Circular downlighter type LED luminaire with external body of CRCA sheet, white powder coated, alongwith high clarity uniform diffuser front glass, comprising LED chips, mounted on suitable designed aluminium	Recessed	20W (max. power consumption including driver circuit

	heat sink with high thermal conductivity for better heat dissipation, fitted with integral drivers, stainless steel toggle clips & neoprene/ synthetic rubber gasket lining complying to IP 23 class of protection, Colour temperature shall be 5700K (cool day light).		load)
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NOTE: 1) Make and Type shall be subject to NTPC QA's approval.
2) Catalogue no. shall be decided during detail engg.

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RC	FOR TENDER PURPOSE	✓	✓	✓	-	✓	-	-	-	✓	15.06.2000
RB	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	27.04.2000
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	17.01.2000
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
<div>एन टी पी सी NTPC</div>		<div>NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION</div>									
PROJECT STANDARD											
TITLE SCHEMATIC DIAGRAM FOR LIGHTING PANELS											
SIZE		SCALE		DRG. NO.				REV. NO.			

RC	FOR TENDER PURPOSE	✓	✓	✓	-	✓	-	-	-	✓	15/05/20
RB	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	27/04/20
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	-	19/04/20
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											



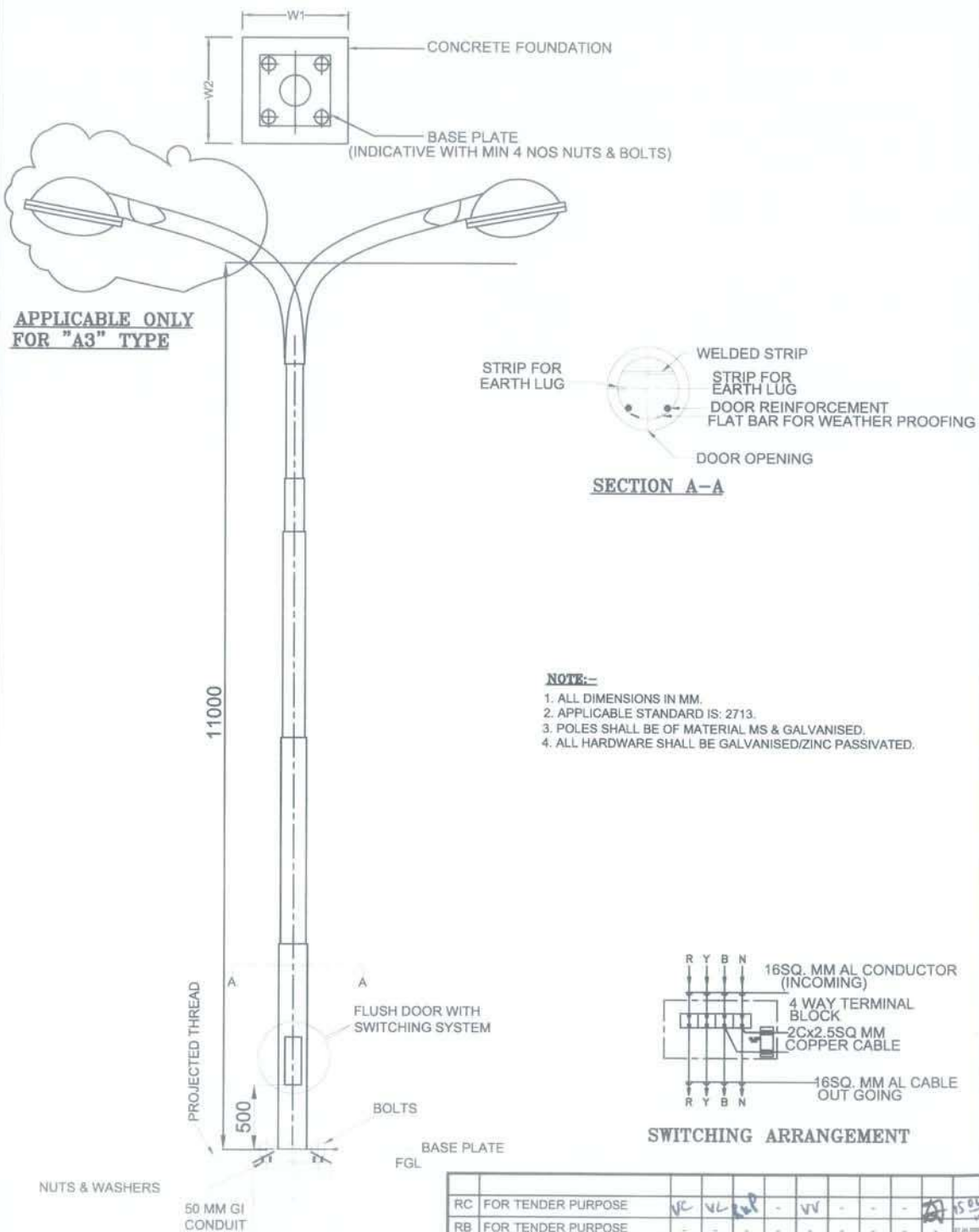
NTPC

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ENGINEERING DIVISION

PROJECT	STANDARD		
TITLE			
SCHEMATIC DIAGRAM OF JUNCTION BOX WIRING			
SIZE	SCALE	DRG. NO.	REV. NO.

		NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION	
PROJECT			
STANDARD			
TITLE			
GENERAL ARRANGEMENT FOR STREET LIGHTING POLES			
SIZE	SCALE	DRG. NO.	REV. NO.
A4	NTS	0000-217-POE-A-001 SH. & OF. 26	RC

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TYPE-A2/A3

RC	FOR TENDER PURPOSE	VC	WL	LP	-	VV	-	-	-	15.05.20	
RB	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	17.04.2020	
RA	FOR TENDER PURPOSE	-	-	-	-	-	-	-	-	17.04.2020	
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPO	DATE
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ENGINEERING DIVISION

PROJECT											
STANDARD											
TITLE											
GA OF STREET LIGHTING POLE TYPE A2 & A3.											
SIZE	SCALE	DRG. NO.	0000-217-POE-A-002						REV. NO.	RC	
A4	NTS										

		NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION	
PROJECT:		STANDARD	
TITLE GENERAL ARRANGEMENT FOR FLOOD LIGHTING POLE			
SIZE A4	SCALE NTS	DRG. NO. 0000-217-POE-A-001 SH. 5 OF 20	REV. NO. RC

[illegible]

Technical drawing showing the top section of a pole with two lighting fixtures. The fixtures are labeled "LIGHTING FIXTURE (TYPICAL)". The pole structure is labeled "ISMC-150", "C.G. BOX", "MS FLAT", and "POLE (TOP SECTION)". Dimensions are indicated: 75, 240, 500, 240, and 75.

L B

└── A

Figure 1.1 is a technical drawing of a pole structure. It shows a cross-section of the pole with a circular top. The dimensions are as follows:

- Total height: 3700 mm
- Top section diameter: 100 mm
- Main body width: 225 mm
- Base width: 100 mm
- Labels: ISMC-150, C.G. BOX, MS FLAT, POLE

A schematic diagram showing a lighting fixture assembly. At the top, a 'FIXTURE (TYPICAL)' is shown, which is a bell-shaped luminaire with a bulb. It is connected to a 'POLE' via a 'FLEXIBLE CONDUIT'. The conduit runs vertically down the pole and then turns horizontally to connect to a 'C.G. BOX (TYPICAL)' (Control Gear Box). The pole is shown with a cross-section indicating internal wiring or structural details.

VIEW-AA

ALL DIMENSIONS ARE IN MM.

[illegible]

L8.DWG

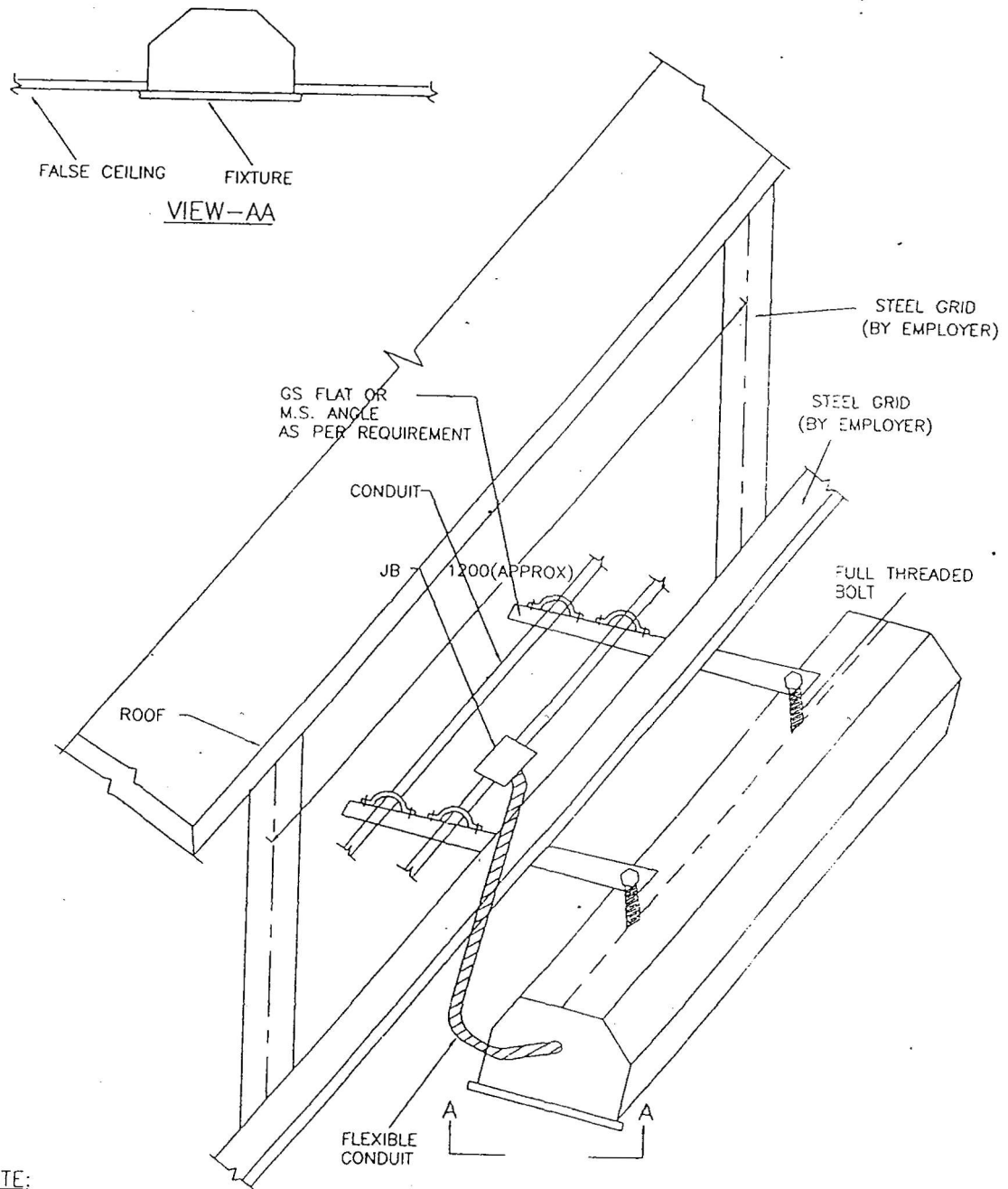
A technical diagram showing a cross-section of a sliding bracket system. A horizontal bar at the top represents the 'FALSE CEILING'. A 'G.I. CONDUIT' runs horizontally from the left, connected to a 'CONDUIT JB' (junction box). From the junction box, a 'FLEXIBLE CONDUIT' (depicted with a corrugated pattern) leads down to a 'FIXTURE' mounted on a 'SLIDING BRACKET'. The bracket is designed to move vertically along the false ceiling. The entire assembly is supported by a base structure.

NOTE:

[illegible]


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NOTE:

1. ALL DIMENSIONS ARE IN MM.
2. MINIMUM CLEAR DISTANCE BETWEEN FALSE CEILING AND STRUCTURE SHALL BE 300MM (APPROX.)

RB	FOR TENDER PURPOSE	REC	CHK	LD	-	LD	-	-	-	-	1	20/10
RA	FOR TENDER PURPOSE	NS	CHK	LD	-	LD	-	-	-	-	1	20/10
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE	
Cleared by												
		NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION										
PROJECT STANDARD												
TITLE TYPICAL MOUNTING DETAIL OF FIXTURES IN FALSE CEILING AREA												
SIZE A4	SCALE NTS	DRG. NO. 0000-217-POE-A-001								REV. NO. RB		
SH. 11 OF 20												

Technical drawing illustrating two methods of ceiling fixture installation:

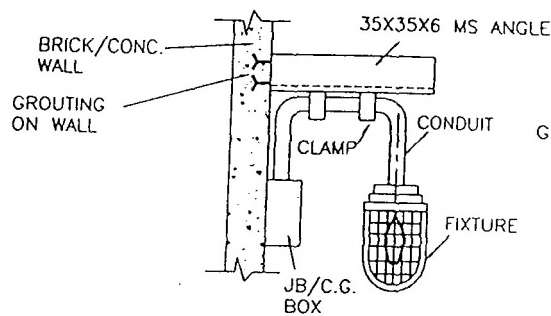
- BALL & SOCKET ARRANGEMENT WITH CONDUIT BOX:** Shows a fixture connected to a ceiling via a 20 DIA G.I. CONDUIT, which is secured by a BALL & SOCKET ARRANGEMENT WITH CONDUIT BOX.
- CANOPY WITH BALL & SOCKET ARRANGEMENT:** Shows a fixture connected to a ceiling via a 20 DIA G.I. CONDUIT, which is secured by a CANOPY WITH BALL & SOCKET ARRANGEMENT.
- RAWL PLUG:** Indicated as the fastener used to secure the conduit to the CEILING.
- CEILING:** The surface to which the fixture is attached.
- 20 DIA G.I. CONDUIT:** The rigid conduit used for wiring.
- REFER DETAIL 'A':** Points to the connection point between the conduit and the fixture.
- DETAIL - 'A':** A close-up view of the connection point, showing the conduit and the fixture mounting.

A schematic diagram of a test fixture. A horizontal rod, labeled "CONDUIT RUN", passes through a "CIRCULAR BOX" at its right end. Two vertical rods, labeled "20 DIA. (TYP)", are attached to the horizontal rod via circular joints. Each vertical rod is secured with a "CLAMP". The bottom ends of the vertical rods rest on a "FIXTURE", which is depicted as a stack of horizontal plates.

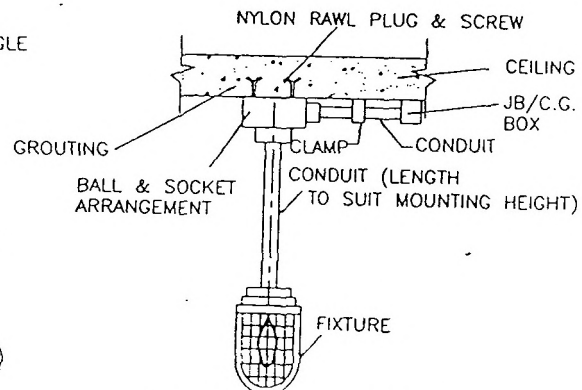
Diagram illustrating a wall/corner joint. A vertical line is labeled "WALL/COLUMN". A horizontal line extends from the wall, and a diagonal line branches off at a 30-degree angle, indicated by an arc and the label "30°".

RB	FOR TENDER PURPOSE		RA	FOR TENDER PURPOSE		REV. NO.	DESCRIPTION		DRG. NO.	DESIGN	CHECK	M	E	C	C&I	ARCH	APPRO	DATE
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="border: 1px solid black; padding: 5px; text-align: center;"> एन टी पी सी लिमिटेड NTPC </div> <div style="text-align: center;"> <h2>NTPC Limited</h2> <p>(A GOVERNMENT OF INDIA ENTERPRISE)</p> <p>ENGINEERING DIVISION</p> </div> </div>																		
<div style="display: flex; justify-content: space-between;"> <div style="width: 20%;">PROJECT</div> <div style="width: 60%; text-align: center;">STANDARD</div> <div style="width: 20%;"></div> </div>																		
<div style="display: flex; justify-content: space-between;"> <div style="width: 20%;">TITLE</div> <div style="width: 80%; text-align: center;">TYPICAL MOUNTING DETAIL OF FLUORESCENT FIXTURE</div> </div>																		
SIZE A4		SCALE NTS		DRG. NO.		0000-217-POE-A-001										REV. NO. RB		
SH. 12 OF 20																		

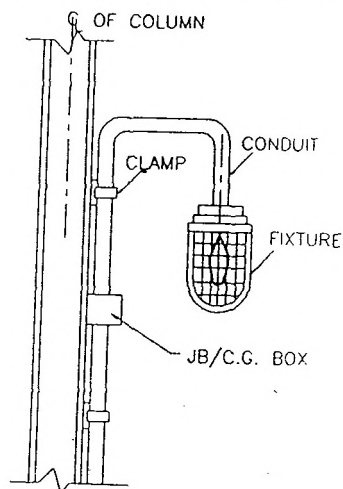
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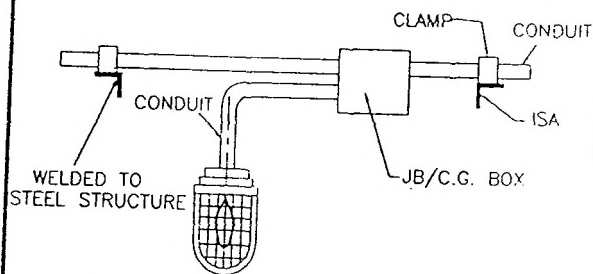
WALL MOUNTING (TYPE-E)



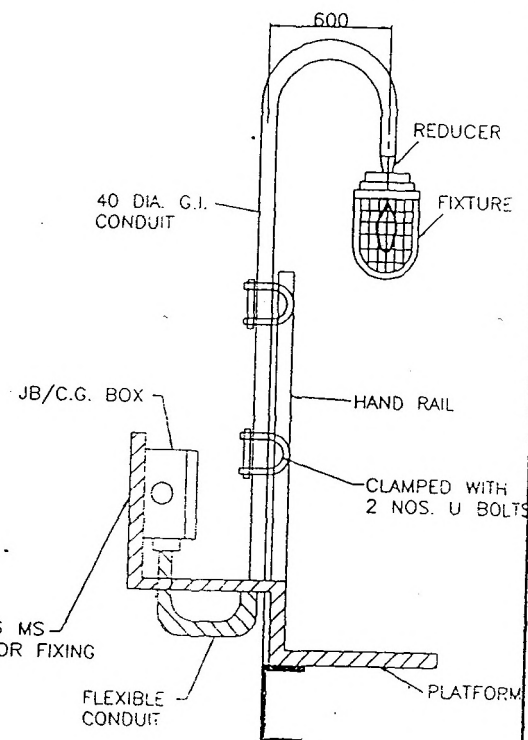
CEILING MOUNTING (TYPE-F)



COLUMN MOUNTING (TYPE-G)



STRUCTURE MOUNTING (TYPE-H)

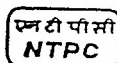


HAND RAIL MOUNTING (TYPE-I)

NOTES:

ALL DIMENSIONS ARE IN MM.

RB	FOR TENDER PURPOSE	NS	DESIGN	CHKD	-	12	-	-	-	1	20/11/00
RA	FOR TENDER PURPOSE	NS	DESIGN	CHKD	-	12	-	-	-	1	20/11/00
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPO	DATE
CLEARED BY											



NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT

STANDARD

TITLE

TYPICAL MOUNTING DETAIL OF
WELL GLASS FIXTURE

SIZE
A4

SCALE
NTS

DRG. NO.

0000-217-POE-A-001
SH. 13 OF 20

REV. NO.
RB

Diagram illustrating the mounting of a lighting fixture to a wall. The fixture is mounted to a horizontal support structure (35X35X6 MS ANGLE) which is secured to a vertical wall (CONCRETE GROUTING). The mounting bracket is labeled 750 MAX. The fixture is connected to the wall via a G.I. CONDUIT. The fixture is labeled FIXTURE.

Diagram illustrating the installation of a fixture using a nylon rawl plug and screw into a ceiling. The components labeled are: CEILING, NYLON RAWL PLUG & SCREW (TYP), G.I. CONDUIT, JB CLAMP, and FIXTURE.

Diagram illustrating the connection of the 35x35x6 MS angle to the structure steel support for the platform (typ). The angle is welded to the support, and a fixture is attached to the angle.

Diagram illustrating the installation of a lighting fixture. The components and labels are:

- STRUCTURE STEEL COLUMN
- WELD
- JB/CG
- 35X35X6 MS ANGLE
- FLEXIBLE CONDUIT
- 750 MAX
- FIXTURE
- G.I. CONDUIT

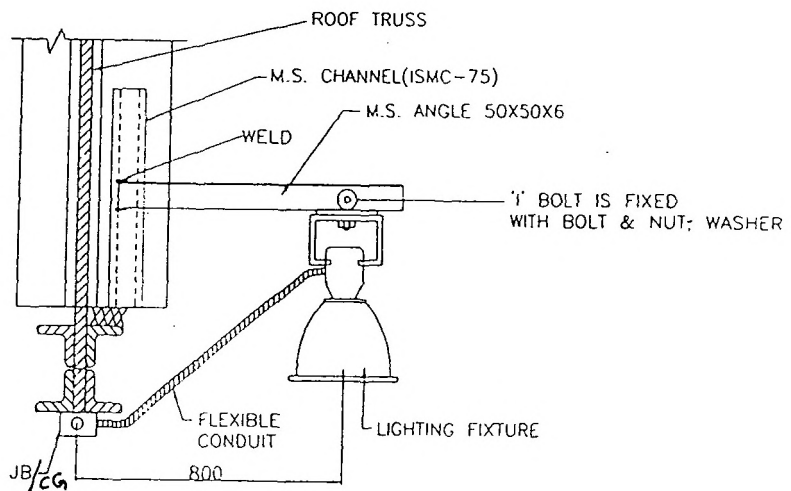
NOTES:

ALL DIMENSIONS ARE IN MM.

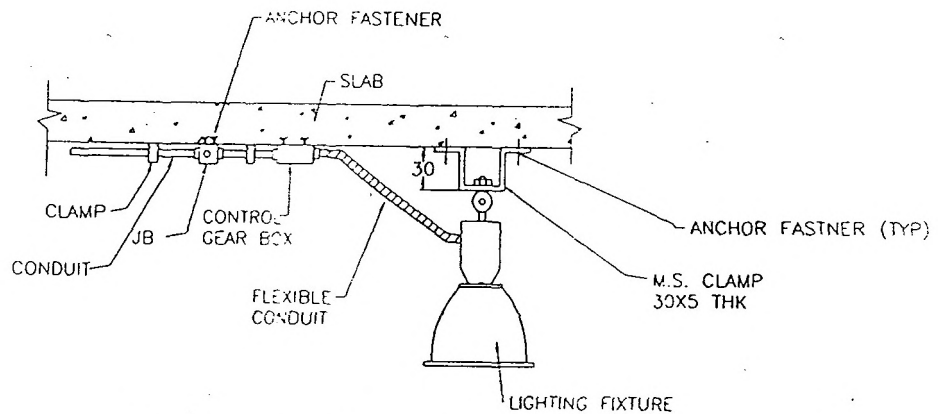
④ In case of non-integral CG box

L13.DWG

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STRUCTURE MOUNTING (TYPE-N)



CEILING MOUNTING (TYPE-O)

NOTES:

ALL DIMENSIONS ARE IN MM.

RB	FOR TENDER PURPOSE	REV	DESIGN	CHKD	APPR	DATE	12/11/00				
RA	FOR TENDER PURPOSE	NS	DESIGN	CHKD	APPR	DATE	12/11/00				
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPR	DATE
Cleared By											
<div style="text-align: center;">  NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION </div>											
PROJECT STANDARD											
TITLE TYPICAL MOUNTING DETAIL OF HIGHBAY FIXTURES											
SIZE A4	SCALE NTS	DRG. NO. 0000-217-POE-A-001						REV. NO. RB			
											SH. 15 OF 20

A technical cross-section diagram illustrating the installation of a lighting fixture on a roof. The diagram shows a horizontal roof structure. A flexible conduit, depicted with a corrugated texture, runs from a light fixture on the roof down to a vertical section. The fixture is mounted on the roof using an anchor fastener and is labeled 'FIXTURE'. The roof surface is labeled 'ROOF' and contains 'SUITABLE BRICK MASONARY BLOCK'. The flexible conduit is labeled 'FLEXIBLE CONDUIT'. It connects to a rigid 'G.I. CONDUIT' (Galvanized Iron Conduit) that passes through a vertical wall. A 'CLAMP' is shown securing the flexible conduit to the rigid conduit. Below the rigid conduit is a 'CONTROL GEAR BOX'. A dimension line indicates a distance of '100' units from the roof surface to the top of the control gear box.

STRUCTURE STEEL COLUMN

WELD

M.S. ANGLE 50X50X6

CONTROL GEAR BOX

CLAMP

G.I. CONDUIT

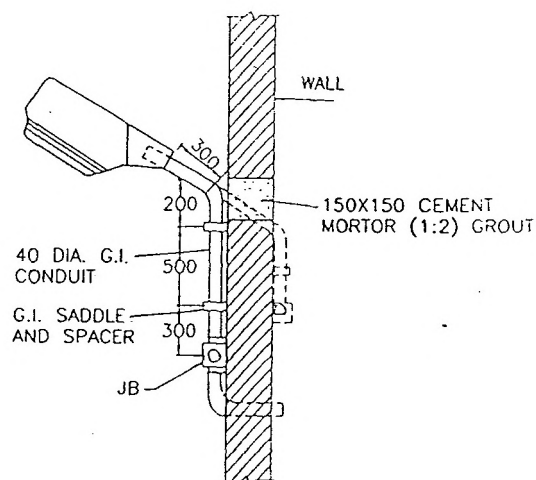
ELEVATION

NOTES:

RB	FOR TENDER PURPOSE										20/11/00
RA	FOR TENDER PURPOSE										14.1.00
REV. NO.	DESCRIPTION	DRAWING	DESIGN	CHKD	M	E	C	C&I	ARCH	APPO	DATE
CLEARED BY											
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PROJECT STANDARD											
TITLE TYPICAL MOUNTING DETAIL OF AREA LIGHTING FIXTURES											
SIZE A4	SCALE NTS	DRG. NO. 0000-217-POE-A-001 SH. 16 OF 20							REV. NO. RB		

WALL MOUNTING (TYPE-R)

VIEW-'AA'

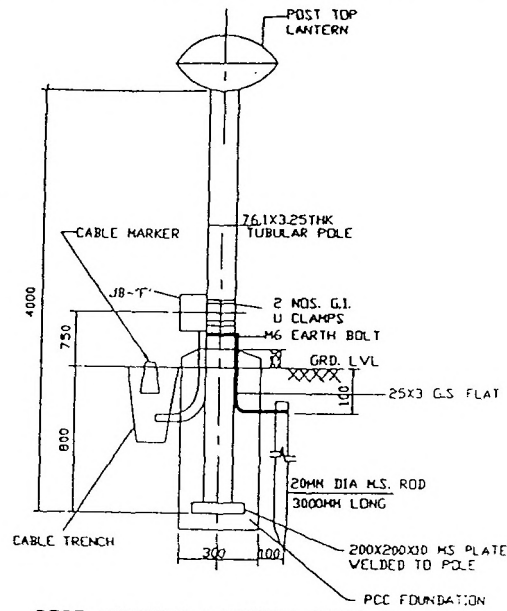


WALL MOUNTING (TYPE-S)

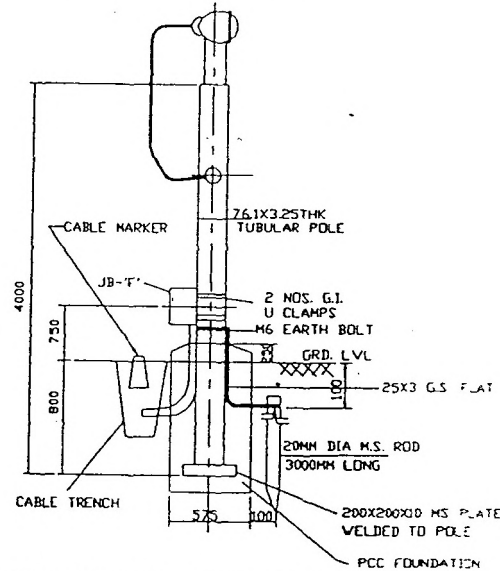
ALL DIMENSIONS ARE IN MM.

RB	FOR TENDER PURPOSE	RA	FOR TENDER PURPOSE	REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHECKED	M	E	C	C&I	ARCH	APPRO	DATE
Cleared By															
<div style="border: 1px solid black; padding: 5px; display: inline-block;">एन टी पी सी NTPC</div> NTPC, Limited (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION															
PROJECT STANDARD															
TITLE TYPICAL MOUNTING DETAIL OF AREA LIGHTING FIXTURES															
SIZE A4	SCALE NTS	ORG. NO. 0000-217-POE-A-001 SH.17 OF 20										REV. NO. RB			

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POST MOUNTED LANTERN TYPE-E1

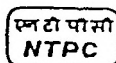


POST MOUNTED FLOOD LIGHT TYPE-E2

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. FOUNDATION DIMENSIONS SHOWN ARE TENTATIVE ONLY.

RB	FOR TENDER PURPOSE	REV	DESIGN	CHKD	-	APPD	-	-	-	1	20 ¹¹ / ₀₆
RA	FOR TENDER PURPOSE	NS	DESIGN	CHKD	-	APPD	-	-	-	1	20 ¹¹ / ₀₆
REV. NO.	DESCRIPTION	DRWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
CLEARED BY											



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PROJECT

STANDARD

TITLE

GENERAL ARRANGEMENT OF POST MOUNTED FIXTURES

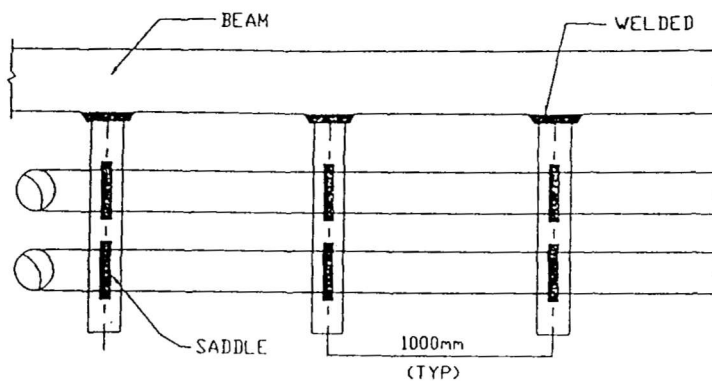
SIZE
A4

SCALE
NTS

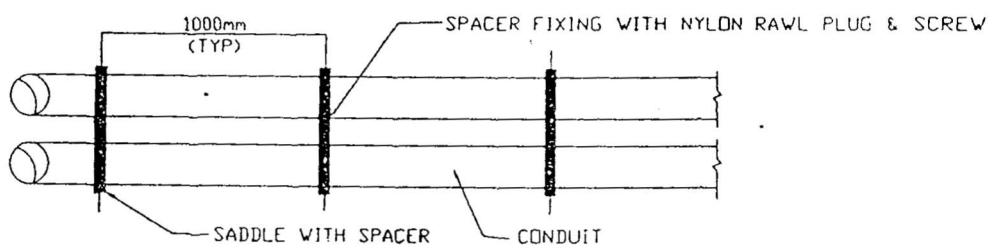
DRG. NO. 0000-217-PDE-A-001
SH. 19 OF 20

REV. NO.
RB

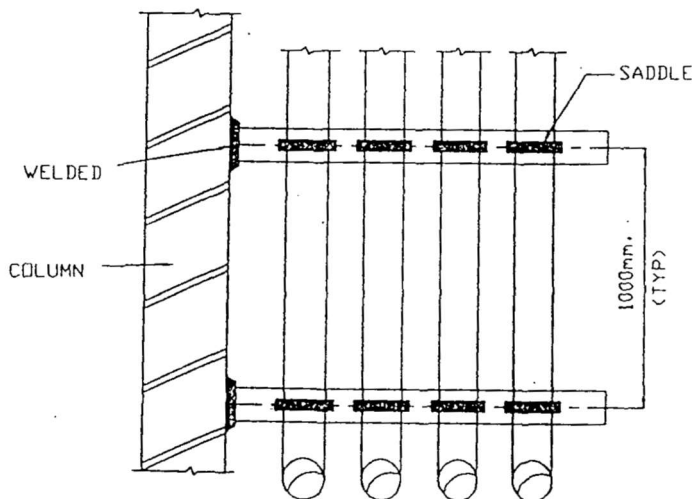
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CONDUIT FIXING ARRANGEMENT OF STEEL STRUCTURE



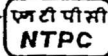
CONDUIT FIXING ARRANGEMENT OF CEILING/WALL



NOTES:

1. THE CONDUIT SUPPORT SHALL BE PROVIDED AT AN INTERVAL OF 1000mm.
2. SIZE OF STEEL FOR:
 - a) SINGLE RUN OF CONDUIT- 25X5 MS FLAT.
 - b) TWO & THREE RUNS OF CONDUIT- 25X25X3 MS ANGLE.
 - c) FOUR RUNS OF CONDUIT ONWARD- 35X35X6 MS ANGLE.
- 3) ALL STEEL FABRICATION SHALL BE PAINTED WITH COATS OF METAL PRIMER FOLLOWED BY THE TWO COATS OF AL. PAINT.

RB	FOR TENDER PURPOSE			Rev	Rev	Rev	Rev	-	-	-	1	100%
RA	FOR TENDER PURPOSE			Rev	Rev	Rev	Rev	-	-	-	1	100%
REV. NO.	DESCRIPTION			DRAWN	DESIGN	CHECK	M	E	C	C&I	ARCH	APPRO. DATE
CLEARED BY												



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ENGINEERING DIVISION

PROJECT												
STANDARD												
TITLE												
CONDUIT FIXING ARRANGEMENT (TYPICAL)												
SIZE	SCALE	DRG. NO.	0000-217-PDE-A-001							REV. NO.		
A4	NTS		SH. 20 OF 20							RB		

REV. NO.

SUB-SECTION-B – 12

FIRE PROOF CABLE PENETRATION SEALING SYSTEM

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	FIRE PROOF CABLE PENETRATION SEALING SYSTEM		
1.00.00	CODES AND STANDARDS		
1.01.00	The fire proof cable penetration (FPCP) sealing system shall conform to the requirement of latest edition including amendments of BS:476 Part-20 Fire tests on Building materials and structures.		
1.02.00	Fire penetration seal complying with any other international standards will also be considered if it ensures performance equivalent or superior to standard listed above.		
1.03.00	The Bidder shall clearly indicate the standards adopted and furnish a copy of the English version of the latest editions of standards along with the bid, and shall clearly bring out the salient features for comparison.		
2.00.00	SYSTEM DESCRIPTION		
2.01.00	<p>The fire proof cable penetration sealing system shall be of the following types;</p> <p>i) Type - A</p> <p>Type A fire sealing system is either Silicone foam or equivalent foam system or using individual blocks for each cable along with suitable frame work rated for one hour. Type A is to be implemented at floor openings below C&I panels, control panels/Boards etc. in CER & CCR/Control Room/switchyard control room/offsite control room etc.</p> <p>ii) Type-B</p> <p>Type B fire sealing system is any proven fire sealing system rated for one hour. This will comprise of rest of wall and floor crossings of cables/cable trays, opening below HT/LT Switchgears/board other than those covered under Type A.</p>		
2.02.00	The penetration system, shall be installed immediately after the completion of cable termination in a particular switchboard/control panel/area after clearance from the Project Manager.		
3.00.00	GENERAL INFORMATION		
3.01.00	The cables shall generally be laid in cable trays/racks, conduits, ducts. The fire proof cable penetration system shall be designed in such a way that the existing supporting structure/cable is not disturbed.		
3.02.00	The penetration system shall be suitable for site condition at 50 ⁰ C ambient temperature and relative humidity of 100%.		
3.03.00	The penetration system of each wall/floor crossing shall be adequately designed/sized such that 20% addition of cables is possible at any later date without disturbance/wastage of material in the penetration system.		
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB SECTION B-12 FIRE PROOF CABLE PENETRATION SEALING SYSTEM
			Page 1 of 7

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.04.00	<p>Contractor shall plan the schedule of supply of the materials in consultation with Project Manager and use the material within stipulated shelf life of material. After award of work, drawings for each penetration seal shall be prepared by the contractor after verifying the actual installation of cables at site and approval shall be taken from the Project Manager's representative before proceeding with the actual work. The requirement of fire sealing material shall be quantified accordingly.</p> <p>Fire sealing material to be supplied shall be based on the net area to be sealed, wastage, thickness, density and other parameters as per the type test report approved under this contract.</p>		
4.00.00	TECHNICAL REQUIREMENTS		
4.01.00	The fire proof cable penetration system shall fully comply with the requirements of BS:476 Part-20 and also to the requirements specified in this specification.		
4.02.00	The penetration system shall prevent spreading of fire in cable beyond the seal system in case of fire and shall have minimum 1 hour fire resistance rating.		
4.03.00	The penetration system shall be physically, chemically, thermally stable and shall be mechanically secure to the masonry/concrete/structural members. The system shall be mechanically robust and capable of giving satisfactory performance under vibrations encountered in power stations.		
4.04.00	The penetration system shall be capable of withstanding mechanical loads, foot traffic drop loads, vibrations, wind pressure, etc.		
4.05.00	The penetration system shall be completely gas and smoke tight.		
4.06.00	The penetration system shall retain integrity and perform satisfactorily even after remaining in water for long period.		
4.07.00	The materials used in FPCP sealing system shall be non-toxic and harmless to the working personnel.		
4.08.00	The penetration materials shall have no reaction with cable sheath/galvanising/painting of structural steel.		
4.09.00	The penetration materials shall have anti-rodent and anti-termite properties.		
4.10.00	The penetration materials shall have no shrinkage or cracking after the setting for the complete life of the power Plant.		
4.11.00	Under normal load, short circuit and fire conditions, cables may be subjected to movement and vibration. The FPCP sealing system shall be designed to withstand and perform satisfactorily under these conditions.		
4.12.00	The penetration system shall not affect the current carrying capacity of cables passing through it.		
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB SECTION B-12 FIRE PROOF CABLE PENETRATION SEALING SYSTEM	Page 2 of 7

CLAUSE NO.	TECHNICAL REQUIREMENTS		
4.13.00	Asbestos shall not be used in the construction of fire penetration seal system.		
4.14.00	The penetration system shall have life expectancy of 40 years.		
4.15.00	The penetration system shall not emit any corrosive or toxic fumes or smoke on the unexposed face of the barrier.		
4.16.00	Any wastage of the compound during the process of mixing for preparing the FPCP sealing compound shall be to Contractor's account.		
4.17.00	For foam type of systems, only the foam shall form the penetration seal of specified rating, having the damming board removed after curing of the foam.		
5.00.00	PACKING AND STORAGE		
5.01.00	All materials and components of penetration system shall be supplied in packing to avoid contamination of materials due to dust/moisture and temperature during transit and storage. All packing shall be of durable quality and the date of expiry and the date of manufacture shall be printed on it.		
6.00.00	INSTALLATION		
6.01.00	The contractor shall take adequate care to ensure that cables are not damaged in any manner during penetration system installation.		
6.02.00	Wherever the floor/wall opening provided in the vicinity of penetration seals larger or smaller than that required for the cable fire penetration, these opening size can be reduced or increased in an approved manner by the contractor using the same materials as provided around the opening and of the same thickness. Generally the walls in the power station comprises of brickwork and the floors are made of RCC/steel work.		
6.03.00	The work to be carried out under this specification shall be done under the supervision of Project Manager’s representative.		
6.04.00	All work shall be carried out in accordance with the agreed “field quality plan” and approved drawings. The “field quality plan” shall additionally specify the fire sealing material thickness, minimum cured density and other related parameters achieved in the approved type tests for the contract. The work shall be done to the satisfaction of the Project Manager and the same shall be subject to Project Manager’s approval for acceptance.		
6.05.00	The installation shall be carried out in a neat workmen like manner by the skilled, experienced and competent workmen.		
6.06.00	Installation work at site shall be properly coordinated with other services.		
6.07.00	All materials being supplied or consumed during installation by the Contractor in the process of installation shall be of the best quality and according to standards. All materials shall be inspected and approved by the Project Manager before the same is used for		
<div><div>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</div><div>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</div><div>SUB SECTION B-12 FIRE PROOF CABLE PENETRATION SEALING SYSTEM</div><div>Page 3 of 7</div></div>			

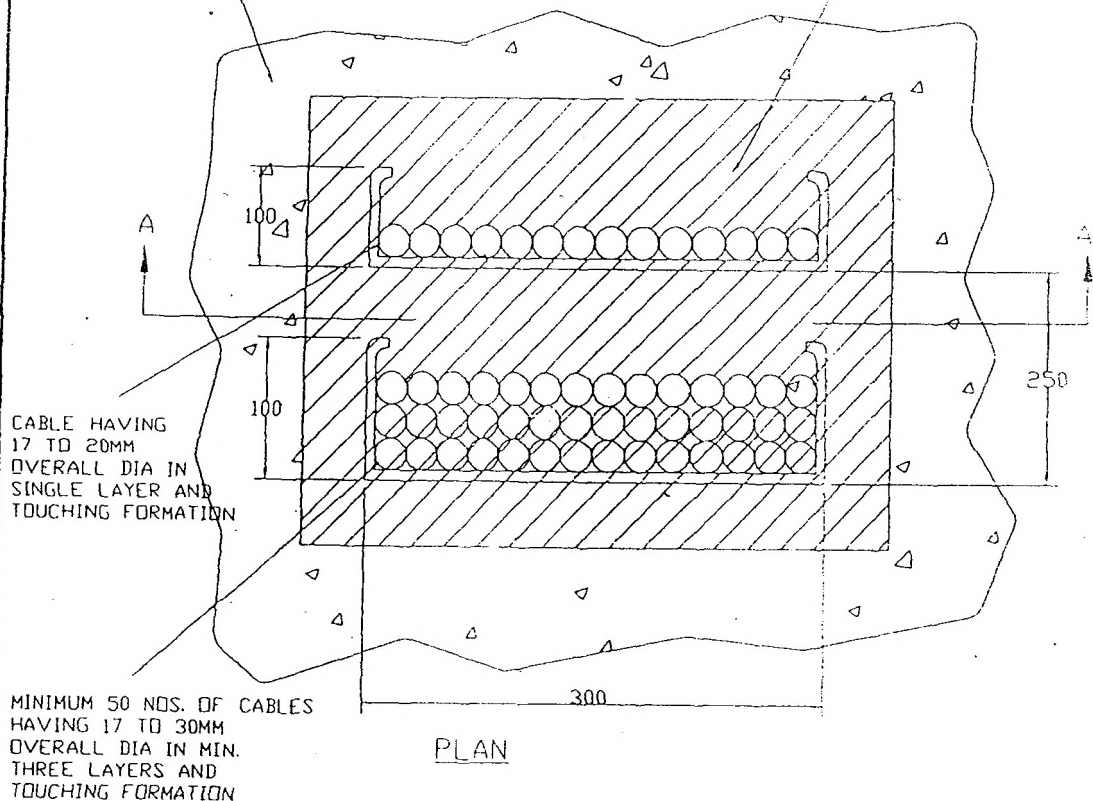
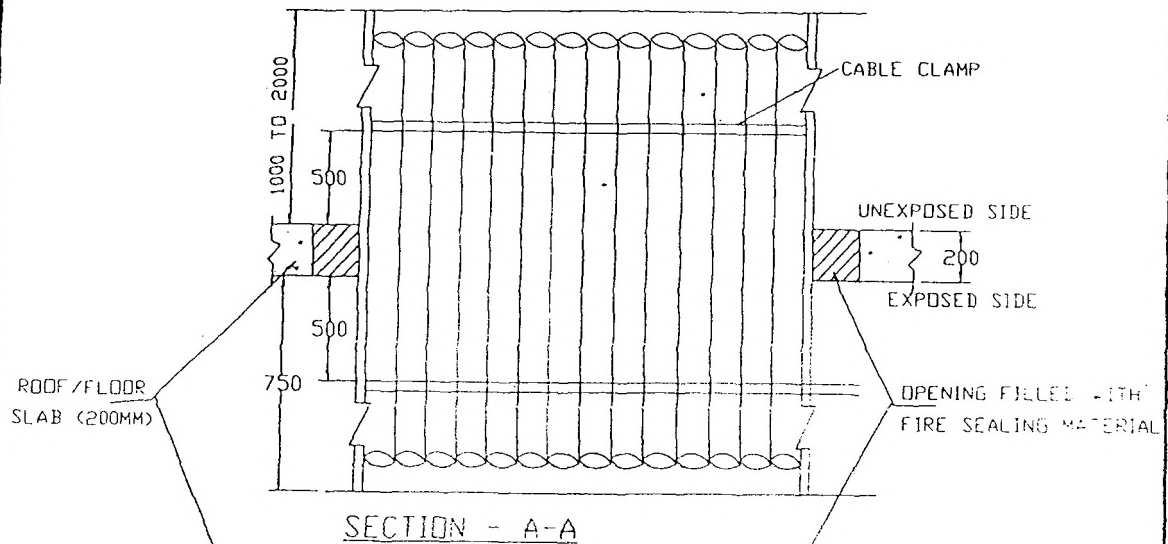
CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>installation work. Also regarding inspection of work, the engineer shall have the right to inspect at any stage during installation, testing and commissioning.</p>		
6.08.00	<p>The drilling and welding of building-steel or fixing supports etc. shall be carried out by contractor after taking prior approval of Project Manager.</p>		
7.00.00	TYPE TESTS, ROUTINE & ACCEPTANCE TESTS		
7.01.00	<p>All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.</p>		
7.02.00	<p>However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.</p>		
7.03.00	<p>All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.</p>		
7.04.00	<p>The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design change". Minor changes if any shall be highlighted on the endorsement sheet.</p>		
7.05.00	<p>Following Type test reports as per the setup and procedures given in subsequent clauses for the Fire proof cable penetration sealing system shall be submitted:</p> <div><div>a)</div><div>The accelerated ageing test</div><div>b)</div><div>Water absorption test</div><div>c)</div><div>Fire rating test</div><div>d)</div><div>Hose stream test</div><div>e)</div><div>Vibration test followed by fire rating test</div></div>		
7.05.01	<p>Tests a, b, c and d should have been carried out on same test sample subsequently one after the other without any touching up/repair/modifications in the same sequence and in accordance with the clause 9.00.00. The test sample shall be assembled as per clause 8.00.00.</p>		
7.05.02	<p>Test indicated in clause 7.05.00 (e) above should have been carried out on a separate sample and as per the procedure indicated under clause 9.05.00.</p>		
<div><div><div>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</div></div><div><div>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</div></div><div><div>SUB SECTION B-12 FIRE PROOF CABLE PENETRATION SEALING SYSTEM</div></div><div><div>Page 4 of 7</div></div></div>			

CLAUSE NO.	TECHNICAL REQUIREMENTS				
7.05.03	Physical, chemical and mechanical properties of various components/ingredients used should have been also be tested as a part of type tests.				
7.05.04	Test reports shall contain the following information: 1. Type of penetration material tested 2. Details of various components/ingredients used alongwith their catalogue. 3. Physical, chemical and mechanical properties of various components/ ingredients used. 4. Description of the various test assemblies tested. 5. Details of method of conditioning. 6. The observations as called for in BS:476 Part-20 and technical specification.				
7.06.00	ROUTINE & ACCEPTANCE TESTS Routine and acceptance tests to be carried out on Type-A and Type-B cable fire sealing system shall be mutually agreed based on the type of fire sealing material offered before placement of award.				
8.00.00	TEST SPECIMEN ASSEMBLY				
8.01.00	The test specimen shall be assembled as per enclosed drawing and shall resemble typical floor crossing cable penetration system.				
8.02.00	The test specimen shall be designed to seal an opening of adequate size in a concrete slab of 200 mm thickness. Two lengths of 300/600 mm wide ladder type cable tray shall be assembled with required layer of XLPE/PVC insulated, PVC sheathed unarmoured cables in touching formation. Type and number of cables in the cable tray shall be as per enclosed drawing. Cables shall be adequately clamped with tray at both the sides of the penetration as shown in the drawings. However, for penetration system with blocks which require staggered arrangement, cables can be clamped at an adequate distance from the penetration and the tray need not pass through the penetration seal.				
8.03.00	The opening in the test specimen then shall be sealed with fire proof cable penetration sealing materials.				
9.00.00	TEST PROCEDURES				
9.01.00	ACCELERATED AGEING TEST The test specimen assembled as per clause 8.01.00 with damming board removed shall be subjected to accelerated ageing test by storing in air furnace where the temperature of the inside air shall be maintained at 85 degree centigrade for 168 hours. The temperature controlled furnace should have 7 air changes per hour approx.				
9.02.00	WATER ABSORPTION TEST				
<table><tr><td>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</td><td>SUB SECTION B-12 FIRE PROOF CABLE PENETRATION SEALING SYSTEM</td><td>Page 5 of 7</td></tr></table>		GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB SECTION B-12 FIRE PROOF CABLE PENETRATION SEALING SYSTEM	Page 5 of 7
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB SECTION B-12 FIRE PROOF CABLE PENETRATION SEALING SYSTEM	Page 5 of 7		

CLAUSE NO.	TECHNICAL REQUIREMENTS		
9.02.01	The test specimen shall be immersed in fresh clean water at a temperature of 20 deg. C \pm 2 deg C. The test specimen must be separated from the bottom and sides of the soak tank by at least 10 mm and it shall be covered by approximately 25 mm of water. At the end of the 24 hour soak period the specimen shall be removed from water and mopped up with a damp cloth.		
9.03.00	FIRE RATING TEST		
9.03.01	The test specimen after withstanding water absorption test shall be subjected to fire rating test as per BS: 476 part-20.		
9.03.02	Oil/Gas fired furnace shall be used for heating. The furnace shall have achieved standard time/temperature characteristics for fire tests as per BS:476 part-20.		
9.03.03	The pressure inside the furnace at the time of test shall be within 1.5 \pm 0.5 mm water gauge.		
9.03.04	Cables in the test specimen shall be anchored on the hot side to a structure independent of the barrier and its penetrations. This is to ensure that any differential movement between the penetration and the cable that could occur during a fire, is produced in the type tests and the reliability of the integrity of the penetration is checked.		
9.03.05	Cables shall be protruding between 1 to 2 metre, from the penetration face on the unexposed side and protruding into the furnace as far as it is practicable with a minimum length 750 mm. The ends of the cables shall be capped on the unexposed face to prevent gases and fumes to escape from the furnace during the fire.		
9.03.06	The test specimen shall be subjected to fire test with surface exposed to controlled fire in the furnace confirming to time/temperature characteristics specified in BS:476(20).		
9.03.07	During the test the temperature of both the faces of the fire stop i.e. one which is exposed to fire and other unexposed shall be measured by calibrated thermo couples after regular interval of 5 minutes.		
9.03.08	<p>Atleast 3 thermo couples shall be provided for temperature measurement of each face. The results at the end of the test shall be interpreted for failure criteria as under.</p> <div><div>1.</div><div>The system is deemed to have failed to maintain stability if there is a total collapse of the fire proof seal.</div></div> <div><div>2.</div><div><div>In case cracks are seen on the face of the fire stop or cracks through which the flame/ hot gas can pass the systems deemed to have failed to maintain integrity.</div><div>The development of crack is characterised by appearance of black soot on cotton wool held near the penetration on the unexposed surface at a distance of about 100mm.</div></div></div> <div><div>3.</div><div>Failure shall be deemed to have occurred when the mean temperature of the unexposed surface of the specimen assembly increases by more than 140⁰C above the initial temperature or if the temperature of the unexposed surface is increased at any point by more than 180⁰C above the initial temperature.</div></div>		
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW \pm 5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB SECTION B-12 FIRE PROOF CABLE PENETRATION SEALING SYSTEM	Page 6 of 7

CLAUSE NO.	TECHNICAL REQUIREMENTS		
<p>9.03.09</p> <p>9.04.00</p> <p>9.04.01</p> <p>9.04.02</p> <p>9.04.03</p> <p>9.05.00</p> <p>9.05.01</p> <p>9.05.02</p>	<p>During the test the specimen shall meet all the three criteria simultaneously.</p> <p>Temperature measurement on the unexposed side of penetration seal shall be measured by thermocouples at a distance of 25 mm from unexposed side of fire stop.</p> <p>HOSE STREAM TEST</p> <p>A hose stream test shall be conducted on the test specimen immediately following a fire resistance test on that assembly. The specimen must first be removed from the furnace since the hose stream is to be applied to the exposed face. This must be done quickly since it is the intention of the test that the stream be applied to the specimen whilst it is hot.</p> <p>The hose stream shall be long range narrow angle, (20° - 90° set at 30° included angle). High velocity water spray provided from a 28 mm hose discharging through an appropriate nozzle. The water pressure shall be 5 bar calculated at the base of the nozzle and the minimum flow rate shall be 4.7 litres/second. The stream shall be supplied perpendicularly to the exposed face of the test specimen with nozzle 3 m away from the exposed face.</p> <p>Application shall be for minimum of two and a half minutes per 9 sq.m. of the test specimen including the barrier.</p> <p>VIBRATION TEST</p> <p>The test assembly is to comprise a single ladder rack penetration in 1 m x 1m high normal section of fire barrier which is securely supported. The penetration seal shall be formed in the middle of the barrier around 1 m length of 600 mm ladder rack. The tray shall be fully loaded with cables in touching formation. The penetration assembly shall be formed symmetrically through the fire barrier as in service. The penetration sealant material shall then be allowed to cure for atleast as long as the time required for conditioning to constant mass. A vibration test shall then be conducted on the sample as set out below.</p> <p>The vibration shall be of 100 Hz frequency and of 0.5 mm amplitude (1.0 mm peak to peak) and this shall be applied to one rail of the ladder rack or the centre of a cross member secured to the two rails at 250 mm from the centre line of the penetration. This vibration shall be applied to the sample for the minimum period of 3 hrs. Immediately following this vibration test the barrier/ penetration assembly shall be successfully subjected to a fire test in accordance with clause no. 9.03.00.</p>		
	<p>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</p>		
	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</p>		
	<p>SUB SECTION B-12 FIRE PROOF CABLE PENETRATION SEALING SYSTEM</p>		
	<p>Page 7 of 7</p>		

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NOTES:

1. IN CASE OF BLOCK TYPE SYSTEM ARRANGEMENT SHALL BE WITH FRAME & BLOCKS HOWEVER NUMBER OF CABLES SHALL REMAIN SAME.
2. ALL DIMENSIONS ARE IN MM ONLY.
3. CABLES TO BE USED SHALL BE OF DIFFERENT DIA. ALL THE CABLES SHALL NOT BE OF SAME DIA.

RB	FOR TENDER PURPOSE	RE	8/8/81	8/8/81	-	-	-	-	15	7/86	
RA	FOR TENDER PURPOSE	NI	8/8/81	8/8/81	-	-	-	-	15	7/86	
REV. NO.	DESCRIPTION	DRW	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
		NTPC Limited (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		FIRE PROOF CABLE PENETRATION SYSTEM TEST SETUP									
SIZE	SCALE	DRG. NO.							REV. NO.		
A4	NTS	0000-211-POE-A-051							RB		

SUB-SECTION-B – 13

SUBSTATION AUTOMATION SYSTEM

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p style="text-align: center;">SUBSTATION AUTOMATION SYSTEM (SAS)</p> <p>The Substation Automation System (SAS) shall be based on the latest edition of communication protocol IEC 61850, IEEE1686 and applicable parts of NERC CIP for cybersecurity.</p> <p>1.00.00 General Requirements</p> <p>1.00.01 The Substation Automation System (SAS) shall be based on the communication protocol IEC61850. SAS shall ensure multi-vendor interoperability using standardized SCL files (SSD, ICD, SCD).</p> <p>1.02.00 The point-to-point testing of all signals for the EHV network at the plant end, protection equipment end and the terminal end (Substation Controller and Operator Workstations) at the Substation shall be the responsibility of the contractor.</p> <p>1.03.00 The point-to-point testing of all signals of the Main Plant DDC gateway shall also be the responsibility of the contractor. The contractor shall be responsible for all the works on switchyard SAS.</p> <p>1.04.00 The architecture for the SAS is enclosed in the attached “Substation Automation System Architecture”. The Contractor shall provide full details of the offered system Architecture with the Bid.</p> <p>1.05.00 The SAS shall be a computer-based system that shall integrate independently operating subsystems such as Bay Control Units, Bay Protection units, alarm annunciation into a unified data acquisition, monitoring, protection and control system in the substation. The Substation Controllers, Bay Control Units, Bay Protection Units, Disturbance Recorders, Time Synchronizing Equipment, and relay test kit offered should meet the provenness criteria specified elsewhere. The contractor shall state any limitations in this regard during bidding and provide details of any similar systems supplied by the contractor that are in successful operation.</p> <p>1.06.00 The SAS architecture shall be flexible to allow future extensions in switchyard. Only IEC 61850 protocols shall be used for inter-device communication.</p> <p>1.07.00 The SAS at substation level and the communication network(s) shall be designed in a dual redundancy configuration. No single failure of any component/module of the SAS, including the communication links, shall cause loss of functionality of the SAS of more than a single bay.</p> <p>1.08.00 Each component/module of the offered system, including all the communication links, shall be provided with built-in supervision and self-diagnostic features and any failures shall be alarmed to the operator.</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.09.00	The SAS shall be designed such that no periodic testing and maintenance is required for various subsystems comprising SAS. On-line testing routines for various subsystems of SAS shall be provided.		
1.10.00	SAS shall be designed such that maintenance, modification or extension of its components / modules shall not cause shutdown of the complete SAS.		
1.11.00	The SAS and all its components shall be synchronized from a GPS time referenced clock receiver. The Time Synchronization equipment shall also be in contractor's scope of supply. A timing accuracy of better than 1 milli sec shall be achieved for all the devices within the SAS.		
1.12.00	The Bidder shall provide all the documentation required during project implementation and during the life cycle of system for operation and maintenance. These shall include but not limited to complete engineering, configuration, and cybersecurity documentation .		
1. 13.00	Owner intends to ensure interoperability of any third party IEC61850 compatible IEDs to be incorporated in future with the SAS. Bidder to provide all necessary data, configuration files, information etc. in this regard.		
1.14.00	Contractor shall also provide adequate training for site personnel for operation, maintenance and troubleshooting of total system for a duration of 5(Five) working days at site.		
1.15.00	The SAS supplied as per this specification shall be designed and constructed to meet all specification requirement for 15 years. Further, the contractor should guarantee for hardware and software support for 15 (Fifteen) years to guard against obsolescence. All requirements/devices of the SAS that are not listed under recommended spares shall have a normal life expectancy exceeding the specified expected life of the SAS.		
1.16.00	-NA-		
1.17.00	Bidder shall offer the Bay Level Units for the EHV system (each circuit breaker with associated dis-connector, Earth switches and instrument transformer shall comprise one bay) complete with Bay Control Units (BCUs) and Bay Protection Units (BPUs). Bay Level Units, FOTE / PLCC panels/communication panels of transmission lines, Auxilliary panels for transformers and switchgears etc. shall be placed in AC Switchyard control room. Station HMI, LVS and other workstation/gateways etc. shall be located as shown in the enclosed SAS architecture diagram.		
1.18.00	BCUs shall be provided for the control of breakers pertaining to 415V switchyard service switchgear from SAS. One additional LAN switch for switchyard LT switchgear is to be supplied loose.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.19.00	NA			
1.20.00	NA			
1.21.00	Dedicated Bay Control Units and Bay Protection Units shall be provided for each 132kV switchyard bay in the Contractor's scope of work as per offered bay configuration . For 33kV switchgear bays to be controlled through SAS, optimisation can be done without compromising the desired functionality and redundancy as outlined in this specification.			
1.22.00	One set of Relay test kit including Test Plugs shall also be supplied.			
2.00.00	SAS Reliability Requirements			
2.01.00	Each component and equipment offered by the Contractor shall be of established reliability. The minimum target reliability of each piece of equipment like each electronic module/card, power supply, peripheral etc. shall be established considering its failure rates/meantime between failures (MTBF), meantime to repair (MTTR), such that the availability of the complete system is assured. The guaranteed annual system availability shall not be less than 99.9% for the equipment under present scope of supply.			
2.02.00	The contractor shall submit reliability and maintainability values including detailed calculation for the projected overall system availability along with all assumptions supported by relevant standard for each device/equipment/system module which, with the help of a schematic of various systems connected in series or in parallel as the case may be , and Mean Time Between Failures (MTBF) and Mean Time to Repair (MTTR) values for the various equipment shall show that availability calculation is as specified in IEEE standard-P-1046 or equivalent.			
2.03.00	The contractor shall furnish in the bid a composite list of bought out items (i.e. items not from their own manufacturing range) which the contractor has included in their proposal along with the name of proposed sub-vendors, as a part of their proposal. However, the make and model of all bought out items supplied by the contractor shall be approved by the Owner during the detailed engineering stage.			
3.00.00	SAS Performance Requirements			
3.01.00	The existing SAS has duty cycle and other performance criterion as listed below. The bidder shall ensure that the same is maintained after integration of the bays under present scope. Any hardware/software augmentation required shall be in bidder's scope. It shall be the responsibility of the contractor to predict and indicate in the bid, the worst-case loading conditions and design the system accordingly to meet the same. The worst-case loading conditions shall include the following tasks as a minimum.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.01.01	All analog inputs scanning and processing is in progress, and all the data is being transmitted over the system bus every one second.		
3.01.02	Four operator comments for information from any Operator Workstation within a base period of one minute.		
3.01.03	A burst of 200 alarms are generated over a period of 10 s.		
3.01.04	One operator control is generated every 5 s.		
3.01.05	Data collection for logs/reports is in progress.		
3.01.06	Data collection for historical storage and trend function in progress.		
3.01.07	Data collection of fault records is in progress.		
3.01.08	All health monitoring functions/diagnostics in progress.		
3.01.09	All output devices are in operation with rated performance/speed.		
3.01.10	All data are transferred to the Operator Workstations.		
3.02.00	Duty Cycle Time The Substation Controller processor spare duty cycle (free time): Under the worst-case loading conditions, each processor shall have: i. 50% free time when measured over any two second period ii. 70% free time when measured over any one-minute period		
3.03.00	Inter Bay Bus and Substation Network Spare Duty (free time) The Inter Bay Bus and Substation Network shall have minimum 50% free time during the worst-case loading conditions measured over any two-second period. The Bidder shall furnish all necessary data to fully satisfy the Owner that the processor spare duty cycle figures quoted by the contractor are realistic and based on configuration and computational capability of the offered system and these shall be actually implemented system as commissioned at project site.		
3.04.00	Display Response Time The display response time under worst case conditions for all displays shall not be worse than 1.0 sec for HMI displays. The display response time is defined as the time interval between the pressing of the last key demanding a display and completion of the requested display on CRT with full foreground and background information, and/or the updating of status indications according to plant changes, and/or the updating of event / alarm register according to alarm conditions.		
4.00.00	Software License and Upgrades		
4.01.00	The contractor shall provide all software licenses for all the software being used under the present scope. The license shall be provided on a site license basis and shall be valid for the plant / equipment life cycle. The license shall not be hardware / machine specific i.e. if any hardware / machine is changed / upgraded, the same software license shall be valid, and the Owner shall not have to seek fresh license or renewal		
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CLAUSE NO.	TECHNICAL REQUIREMENTS						
4.02.00	<p>of license. The contractor shall provide the license considering sufficient number of I/Os catering to the complete switchyard as shown in Tender SLD.</p> <p>In the case of anti-virus software, the license shall include regular updates until the end of warranty period.</p> <p>The Bidder shall guarantee that all software is defect free and meet the system specifications and undertake to fix any defects which may arise during the life of the system at no cost to the Owner.</p>						
	<p>All software versions in components of the system shall be the latest official releases as on the date of shipment from works and shall include all software updates etc. released till that date. A certificate to this effect shall be furnished by the contractor at the time of pre-dispatch inspection for each software package. All new software revisions and/or patch updates that are released before the end of the warranty period which addresses system defects shall be implemented on site and the system re-tested to validate system integrity by the contractor at no cost to the Owner (This excludes new revisions which provides additional functionality). The Bidder shall periodically inform the designated officer of the Owner about software updates / new releases that would be taking place after the system is commissioned.</p>						
	5.00.00						
	Design and Operating Requirement of SAS						
	5.01.00						
5.02.00	<p>The control hierarchy and control levels of the SAS shall be based on the logical structure of the SAS which is as follows:</p> <div><div>Control Level 3</div><div>Remote Control Centre (OS Control Room)</div><div>↑ ↓</div><div>Control Level 2</div><div>Substation Level (HMI)</div><div>↑ ↓</div><div>Control Level 1</div><div>Bay Control Units</div><div>↑ ↓</div><div>Control Level 0</div><div>Switchyard Equipment</div></div>						
	<p>The data exchange between Control level 3 and Control level 2 shall take place via the communication links provided by the owner for remote telemetry and control of the substation using IEC 60870-5-101/104/OPC protocol.</p>						
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.03.00	The data exchange between Control Level 2 and Control Level 1 should take place via the inter-bay/ Station communication bus using the IEC61850 protocol. The inter-bay communication bus shall support peer-to-peer communications capability.		
5.04.00	The data exchange between Control Level 1 and Control Level 0 should be by means of hard-wired status / control signals between Switchgear Equipment and Bay Control /Protection Units and analog signals from CTs / CVTs.		
6.00.00	Substation Level Functionality		
6.01.00	Control Functions: - <ul style="list-style-type: none">i. The SAS shall perform control functions on various switchyard equipment based on the status, analog and logical inputs acquired by SAS from various bay control units.ii. It shall be possible to monitor and control all the switchyard bays in the Bidder's scope and the status of the Generator plant (status and analog signals such as MW, MVAR, Generation voltage, GRP Relay status, information etc.) from any of the existing and new Operator workstations at control level 2 i.e. either from switchyard control room or Main Plant control room. However, in case of maintenance, failure or emergency, it shall be possible to control the individual bays from the Bay Control Units at Control Level 1.iii. Clear control priorities shall ensure that operation of particular bay equipment (Circuit Breaker or Isolator) cannot be initiated simultaneously from more than one of the control levels. The priority shall always be on the lowest enabled control level. The selected control level shall be indicated at all the levels so that the operator is aware of his control capabilities-iv The SAS shall have provision of Device Tagging for all the substation devices. This function is to block the control of any substation device in such a manner that its command is prevented from Operator's Workstations.v Interlocking shall be implemented and shall ensure that no illegal switch operation can be performed by any control initiated from Control Level 3, Control Level 2 or Control Level 1. Interlocking shall be implemented on bay level as specified in relevant section of this specification.		
6.02.00	Sequence of Events and Alarm Management <ul style="list-style-type: none">i. The SAS shall be capable of reporting on all Operator workstation and printers, the time sequenced record of events occurring in the substation. Separate logs shall be created for alarms and events and both the logs shall be time-tagged. Suitable filters, based on date and time, bay number, device number, function etc. shall be provided for both alarm as well as event logs for ease of viewing. Configuration of events pertaining to Stage-I/II bays shall be in the scope of Bidder.ii. All changes of alarms and statuses of switchyard equipment, including the alarms generated by Bay Control and Bay Protection units shall be recorded in non-volatile memory of SAS. It shall be possible to print historic events and real-time		
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CLAUSE NO.	TECHNICAL REQUIREMENTS
6.03.00	<p>(unacknowledged and non-cleared) alarms after a system failure or reset with no loss of information.</p> <ul style="list-style-type: none"> iii. All the alarms and events shall be time tagged at the Bay Controller or Bay Protection unit with a time resolution of 1 ms. iv The SAS shall include all the alarms and changes of plant statuses of the EHV networks. v The SAS shall acquire the alarm signals from Bay Control Units and Bay Protection Units with pre-set priorities and on receipt of an alarm shall generate an audible signal and report it either upon request or automatically to the respective printer. vi The Owner shall approve the list of alarms and plant statuses to be wired for Sequence of Events log and Alarm Management, during detailed engineering stage. <p>Historical Data Management and Trending</p> <ul style="list-style-type: none"> i. The SAS shall maintain historical data in bulk non-volatile memory. The Historical Data shall be available for review and editing by authorized user. ii. The SAS shall monitor specified incoming information for historical data base, perform calculations on some of the incoming data and store incoming and calculated data in the non-volatile memory as historical data. iii. The historical data shall include Digital Fault Records and Sequence of Event logs received from bay protection units and bay control units. iv. It shall be possible to trend any measurement signal or summation of signals available in real time or data available in the historical database, in the shape of trend curves.
6.04.00	<p>Operations Log</p> <p>It shall be possible to create a daily operations log, in a user-defined format, about the substation operations as well as any failures / tripping therein. It shall also be possible to include on daily basis all the information required to keep a historical record of equipment behaviour.</p>
6.05.00	<p>Reports</p> <p>The SAS should be capable of generating different types of reports, which can be presented in the operator interface screens upon request or programmed for automatic presentation in printers. It shall be possible to generate reports with information from both historical data base and real time information.</p>
6.06.00	<p>Mass Storage Back up</p> <p>External NAS with RAID1 configuration shall be provided to permit mass storage of all information existing in the computer hard disks such as application programs, database configuration, historical data, operations log etc. The solution should support automatic backup scheduling and cybersecure storage.</p>
<p>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6401-001-2</p> <p>SUB SECTION B-13</p> <p>SAS</p> <p>7 of 45</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.07.00	<p>System Security</p> <ul style="list-style-type: none">i. Security features shall be provided at each level for safeguarding against unauthorized access. An alarm message will be displayed at the control centre and recorded in the logs for any unauthorised access attempts. The contractor shall provide software locks and passwords to the Owner's engineers at site for all operating and application software at all levels.ii. The system shall maintain a tamper-proof audit logs, recording all configuration changes made along with user ID, IP address, date, time and area of the system modified. Logs shall be stored in secure, redundant storage and exportable in syslog format for compliance.iii. No single failure either of equipment or power source shall result in rendering any part/subsystem of SAS inoperative, except that the information related to failed part/component is not available.iv. To ensure system security, the complete functionality of SAS shall be divided into various system security levels, to be decided by Owner during detailed engineering. Each security level shall offer certain functionality of the SAS to users' e.g.<ul style="list-style-type: none">Security level 0 – Display only Graphics, Real Time data and Historical DataSecurity level 1 – Normal Control Operations, Access to acknowledge alarm logsSecurity level 2 – Restricted Control Operations, access to edit/defeat bay interlocksSecurity level 3 – Complete access, engineering and maintenance of configurations and databases.v. The users shall be grouped into various user-groups with each user having a user name and password. The level of accessibility to each user shall be pre-defined.vi. The system administrator group shall have complete access to SAS and shall be able to add /remove users and redefine access rights.vii. The various system security levels and various user groups shall be defined by the owner during detailed engineering.		
6.08.00	<p>Remote Interface with RLDC</p>		
6.08.01	<p>The SAS shall have provision for interfacing with remote SLDC/RLDC through suitable gateways, communication complying with IEC 60870-5-104 (preferred for IP-based systems) or IEC 60870-5-101 for legacy serial links. Security measures for encryption and authentication should be implemented for IEC 62351 compliance. Redundant gateways with:</p> <ul style="list-style-type: none">a) minimum 2 Ethernet ports (1 Gbps) for station LANb) Minimum 2 serial ports (RS-232/RS-485) for legacy PLCC/OPGW links.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>The Modems for legacy PLCC/OPGW shall comply with V.24/V.28 CCITT standards.</p>			
6.08.02	<p>Only selected information such as bus voltage, frequency, active / reactive power through various feeders, status of OLTC, open/close status of circuit breakers, isolators etc. is required to be shared with RLDC. However, actual list of information to be shared with RLDC shall be furnished during detailed engineering, The Contractor shall have to demonstrate the availability of desired information at the output of modem at site.</p>			
6.08.03	<p>Necessary hardware/software to ensure provision for Remote Interface with RLDC shall also be provided by the contractor.</p>			
6.08.04	<p>Provision for interfacing with owners PI (Plant Information) system on OPC:-</p>			
6.08.04.01	<p>OPC Server requirement (As applicable):</p> <ol style="list-style-type: none">1. OPC UA server with backward compatibility for OPC DA 2.05a shall be provided. It shall be interoperable with OSIsoft PI system and other third-party OPC clients.2. All data like MW, MVAR, CB status, Metering Master Station data etc. shall be communicated through this OPC server. The number of tags to be licensed for the OPC Server as well as the maximum number of tags the OPC server can support shall be approved during detailed engineering.3. Timestamp of the tags shall reflect actual measurement time (not server time) and the latency between measurement and OPC availability shall be less than 500ms.4. Vendor should inform method of testing the OPC compliance. Vendor should demonstrate that data is accessible from the OPC Server using a standard 3rd party OPC client such as PI-OPC client of OSIsoft, OPC client of Matricon			
6.09.0	<p>Main Plant DDC Interface(As applicable)</p>			
6.09.01	<p>Suitable hardware and software, to provide secure Ethernet connectivity with VLAN segregation, shall be provided to interface the switchyard SAS with each of the Main Plant DDC as shown in “Substation Automation System Architecture”.</p>			
6.09.02	<p>Also, necessary data such as status of EHV circuit breakers, associated isolator and Earth switch, Bus Voltage/frequency etc. can be provided to the main plant.</p>			
6.09.03	<p>The exact signals shall be finalised during detailed engineering. (Note: The I/O list for above shall be made available to the bidder during detailed engineering).</p>			
6.09.04	<p>The cable and associated hardware (Industrial grade managed Ethernet switch, Firewall etc.) required for connecting SAS network to the main plant DDC terminal shall also be provided by the contractor.</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS																																								
6.10.0	Interface with other Third-party Devices/Substation Automation System (SAS)																																								
6.10.01	A fibre-optic extension of the substation Network LAN from switchyard to the Main Plant is to be provided by the contractor along with all associated hardware.																																								
6.10.02	The HMI software at substation level shall also be so designed that it will require insignificant changes during interface with third party devices in the future. In any case, such an interface would not impair the working of existing SAS in anyway. Further, no shutdown of the SAS shall be required to achieve this integration.																																								
6.11.0	Technical Requirements for Standalone Network Firewall																																								
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.00.0	<p>Substation Controllers and Operator workstations</p> <ul style="list-style-type: none"> i. Redundant Controllers and Operator workstations shall be provided and shall be based on industrial-grade servers and ruggedized workstations suitable for substation environments. ii. The main memory shall be sized sufficient to meet the functional and parametric requirements as specified. The bulk memory shall be sized at least 1.5 times the capacity required sufficient to meet the functional and parametric requirements. However, both the main and the bulk memory shall be subject to minimum hardware specification. The exact system configuration and sizing shall be approved by the Owner during detailed engineering. iii. Graphic Mimic display for entire switchyard shall be provided in each OWS. iv. All operator's functions shall be possible from any of the OWS at any point of time regardless of which controller is active. Each OWS shall be able to access all the substation information related data under all operating conditions. v. Single failure in any controller shall not lead to non-availability of any of the OWS. Controllers shall support hot-standby failover with zero data loss. vi. The workstation shall be based on industry standard hardware and software which will ensure easy connectivity and portability of all the software being provided for various IEDs under this contract. vii. Power Fail Auto Restart (PFAR) facility, with automatic time synchronisation to GPS time shall be provided. The only operation required will be the login of operators. viii. All AC powered workstations, communication and/or other SAS devices shall be powered from 2X100% Inverter supply connected to the station batteries so as to have bump less changeover in case of failure of one of the inverters or Un-interruptible Power Source (UPS) providing a standby time equal to the specified battery standby time. ix. All DC (Station Battery) powered SAS components shall also be acceptable. x. One workstation shall also be provided in each of central Control room, to enable the operators in the power station to monitor the status of the EHV substation network and alarms. The ability to control the switchyard from this workstation will only be possible in emergency situations, and subject to the security level implementation. A fibre-optic extension of the Substation Network LAN is to be provided in the central control room/ Control equipment rooms as shown in the tender drawing for this purpose. xi. A colour wall mounted MIMIC display (LED/LCD based technology, min 75 inch) shall be provided in the SWITCHYARD control room on which a dynamic substation overview display screen is projected. The MIMIC shall be flat. The MIMIC shall be suitable for continuous operation in a substation control room environment and shall be clearly visible during all hours from the operator positions at the control desk. 			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.01.00	<p>Display of Mimic view selected from any of the OWS in the SWITCHYARD Control Room shall be possible. Details of the MIMIC offered shall be provided during bidding, with an indication of the maintenance required and typical operating cost of the unit.</p> <p>Functional Requirement of the HMI</p> <ul style="list-style-type: none"> i. The HMI shall have an intuitive graphical design to ensure effective use of the SAS with minimal confusion. The amount of keyboard typing needed for using the SAS shall be minimized. ii. The HMI shall be strictly divided into various levels depending on the system security levels. iii. The complete single line diagram of the EHV network, including the status of the plant equipment, shall be displayed on or more graphical displays. A high-level overview display shall be provided with the ability to zoom to more detailed displays. Different colours shall be used to differentiate voltage levels, earthed network components, selected object on screen, selected object for command, blocked/tagged equipment etc. on the graphical displays. A library of standard existing symbols shall be used to represent switchyard equipment on the graphical displays. The same symbols and colours used on the EHV network SAS shall be used. The graphic displays shall be subject to Owner's approval. iv. The process status of the complete switchyard in terms of actual values of currents, voltages, frequency, active and reactive powers, summated MW/MVAR of all GT bays, as well as the positions of the circuit breakers, isolators and earth switches, tap positions, winding temperatures etc. shall be displayed on the station single line diagram. iv. All the Substation Level Functionality described in relevant Clause of this specification shall be possible through HMI. v. Highest degree of security shall be maintained to prevent unwanted operation of any equipment through SAS. Simultaneous switching of more than one device from the same or different Control Levels shall not be possible. Once a device is "Selected" for operation, the operator shall be able to recognize the "Selected" device on all the graphical and other displays. All other devices shall be blocked as long as a device is selected for operation. The "execution" of a command shall be possible only if the device is not blocked and no interlocking condition is being violated. The interlocking scheme, implemented at the Bay Level, shall be checked before releasing the "execute" command. The operator shall receive suitable feedback about the successful or unsuccessful execution of the command. In case of unsuccessful execution, the reason for non-execution of command shall be indicated to the operator, which shall include details of the blocking condition in the interlocking logic. In case of successful execution, the operator shall receive confirmation about the new switching position of the equipment depending on the command. The ability to override the interlocking shall also be available, subject to the security access <u>(see section 6.07.00)</u>. 			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<div>vi. The following functionality shall be available at the Engineer and Fault Recording Workstation of bays under present scope.<div>a) Formulation and Implementation of interlocking logic for various bay equipment into Bay Control Units.</div><div>b) Downloading or altering the protection relay settings in the Bay Protection Units.</div><div>c) Automatically upload, archive, review and analyse graphically the Digital Fault Data available from the BCU and Bay Protection Units.</div><div>d) Ability to export fault records in COMTRADE format.</div></div> <div>vii. All workstations shall work on the same operating system, preferably Windows LTSC (latest version) or secure Linux distribution. Latest anti-virus and end-point protection software shall be supplied on all workstations. Offered systems should also support remote patching and update without system downtime.</div>		
8.00.00	Communication Network Bus		
8.01.00	General <div>i. The Data communication network (substation/inter-bay bus) shall have bus configuration with either ring or star topology. The dual redundant buses, in case of star topology, shall be physically separate and shall be routed separately. Typical network architecture with ring topology is enclosed as “Substation Automation System Architecture”.</div> <div>ii. The contractor shall submit details regarding the communication system like communication protocol, bus utilization calculations etc. during detailed engineering.</div> <div>iii. Built-in network monitoring tools(SNMP, RSTP/PRP supervision) shall be provided for easy fault detection and alarm any single bus failures.</div> <div>iv. All network components shall meet IEC 61850-3 for harsh substation environments (EMI, temperature, humidity).</div> <div>v. The system architecture shall support multiple application protocols (IEC 61850 MMS, GOOSE, SV, OPC UA) on the same LAN.</div>		
8.02.00	Substation Network Bus <div>i. The substation network LAN configuration/protocol shall be as per the Tender drawing. The substation network LAN shall be an Ethernet LAN based on IEEE802.3 Ethernet standard using the IP protocol supporting IEC 61850 Edition 2.1.</div> <div>ii. CAT6A or better UTP cables or fibre optic cables shall be employed for all Ethernet data communication bus. The data exchange between the electronic devices on bay and station level shall take place via the communication infrastructure. This</div>		
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8.03.00	<p>shall be realized using fibre-optic cables, thereby guaranteeing disturbance free communication. Data exchange is to be realized using IEC 61850 protocol with a redundant managed switched Ethernet communication infrastructure. The communication shall be made in 1+1 mode, excluding the links between individual bay IEDs to switch, such that failure of one set of fibre shall not affect the normal operation of the SAS. Each fibre optic cable shall have four (4) spare fibres.</p> <p>Fibre optic cables shall be used for all inter-room or greater than 50 m connections. The Contractor shall ensure that structured cabling philosophy and good engineering practices as per internationally accepted standards are followed, for ease of maintenance and traceability, and that fibre-optic cables are adequately protected. Fibre Optic cables Fiber shall be armored and laid in GI conduits for underground routes.</p> <p>iii. The LAN shall have a data communication speed of minimum 1 Gbps. It shall be sufficient to meet the responses of the system in terms of displays, monitoring and control commands according to the design.</p> <p>iv. Suitable hardware and software interface shall be provided to link Employer's OPC Compliant main plant DDC station bus.</p> <p>EHV Inter Bay Network Bus</p> <p>i. An Inter Bay Communication bus shall be provided for the EHV network, which shall support peer-to-peer communication, and communication to the Substation Controller.</p> <p>ii. The communication protocol used for all devices including Bay Control Units and Bay Protection Units shall be the IEC61850 protocol. No hardwiring of alarms shall be permitted between Bay Protection Units and Bay Control Units. As a minimum, all Bay Controller Units and primary relays/ protection relays, Bus-Bar protection and multi-functional Over current and Earth fault protection relays offered shall support IEC 61850 MMS and GOOSE.</p> <p>iii. Fibre optic cables shall be used for Inter Bay/Station Level Communication Bus. Contractor shall ensure that structured cabling philosophy and good engineering practices as per internationally accepted standards are followed, for ease of maintenance and traceability. Electrical data connections may only be used within a cubicle of the same bay.</p>			
8.04.00	NIL			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
09.00.00	<p>Bay Level Functionality</p> <ul style="list-style-type: none"> i. The Bay Level Functionality shall be built in Bay Control Units (BCUs) and Bay Protection Units (BPUs). ii. Dedicated Bay Control units and bay Protection units shall be provided for each bay in the contractor's scope of work. Also, one number BCU shall be provided for the control of SWYD service LT Switchgear. Controls shall be provided as specified elsewhere in this specification. iii. BCUs and Bay Protection Units shall be provided at Control Level 1 i.e. Bay Level of Logical Architecture, to facilitate control, monitoring and protection of switchyard equipment. One Bay Control Unit shall provide complete functionality for one EHV bay. Each set of BCUs shall have sufficient analog and digital inputs to acquire the status of each and every circuit breaker, isolator, earth switch, Transformer parameters / tap position etc. of present scope of bays in Bidders scope. A minimum of 64 Digital Inputs and 24 Digital Outputs per bay shall be provided in associated Bay Control Units. A minimum number of 16 Analogue input channels per bay shall also be provided in the associated BCU. Rating of the various analogue input channels (110 V /1 A /4-20 mA) shall be decided during detail engineering. iv. All the Bay Control Units and Bay Protection Units at Plant end shall be installed in the AC kiosks in SWITCHYARD. BCU & BPU shall be mounted in different panels. All BCUs and Bay Protection Units shall be provided with self-diagnosis and supervision functions to ensure maximum availability. BCUs shall require no periodic routine maintenance and testing. An alarm contact shall be provided for hardware failures, failures of internal and external auxiliary supplies etc. Special algorithms shall be provided to check the microprocessor's memories. A watchdog function shall supervise the execution of program by the microprocessor. vi. Distribution of BPU/BCU panels shall be finalised during detailed engineering. Adequate number of additional kiosks shall be provided for common protections like bus bar protection, islanding scheme, metering scheme etc. as well. Employer intends to make Line Reactors switchable in future. Space provision to locate BCUs of switchable line reactor bays to be kept in relevant Line Bay control panel. vii. Space for mounting Controlled Switching Device of circuit breaker shall be provided in respective BCU Panel. viii. The layout of equipment/panels in AC kiosks shall be subject to Owner's approval. The kiosk shall be provided with fire alarm system with at least two smoke detectors, and it shall be wired to SAS. The air conditioner provided in kiosk shall be controlled and monitored from SAS. 			
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09.01.00	Bay Control Units (BCU)			
09.01.01	Control and Protection Features of BCUs			
	The Bay Control Units shall have following built-in functions:			
	i. Mimic control panel to display graphically the bay configuration, status of the plant, analog measurements, alarms, and offer bay level control.			
	ii. Switching of Switchyard Bay Equipment depending on conditions such as interlocking, synch-check, control mode, or external status condition. Adequate safety features like prevention of double operation, command supervision, block/de-block, over-riding the interlocking etc. shall be provided. All such security features shall be finalized and approved by Owner during detailed engineering.			
	iii. Status Supervision of switchyard equipment			
	iv. Interlocking Function to prevent unsafe operation of switchyard equipment such as circuit breakers, isolators, earth switches etc. Interlocking shall be implemented on bay level, by user-friendly, menu-driven configuration software within the BCU, Interlocking shall operate independent from the Substation Controller. Signalling of statuses between bays shall be performed by inter-bay communication (peer-to-peer) i.e. Goose messaging. The auxiliary contacts of each of the equipment shall be wired to the BCU for this purpose. However, for that equipment, which are required for interlock of other bay equipment, two sets of their contacts shall be wired to BCUs of two different bays. Such interlocks involving more than one bay equipment shall be realized through goose messaging. An over-riding / bypass function for bay-level interlocking shall be provided at appropriate security level for maintenance or during emergency conditions. Failure of any one BCU shall not affect the interlocking at any other bay, only the bay with failed BCU shall not be able to operate. This shall be achieved by providing a backup mechanism in case of failure of one BCU which affects the interlocking in another BCU (e.g. a backup mechanism for monitoring the status of the bus bar earths), to allow the remainder BCUs to function with full interlocking . The interlocking logic shall be defined during the details engineering phase to prevent illegal operation.			
	v. Analog Measurements for bay voltage (per phase), current (per phase), frequency, MW and MVAR, tap position / gas parameters / winding temperature of Transformers. These measurements shall not require the use of any intermediate transducers. The accuracy of measurement shall be 0.5% for voltage, current and frequency, and 1.0% for MW and MVAR. The measured and computed values shall be displayed locally on BCU and on operator’s workstation located in central control room.			
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	<p>vi. Event and Alarm Handling: BCUs shall acquire all the bay level alarms and events from field inputs with a resolution and time tagging of 1 milli sec and shall transfer these to operator's workstation over substation LAN.</p> <p>vii. Synchronization Check Feature: Synchronization Check feature shall determine the difference between the amplitudes, phase angles and frequencies of two voltage vectors. Checks shall be provided to detect a dead line or bus bar. The voltage difference and phase angle difference settings shall be adjustable.</p> <p>09.02.00 Bay Protection Units</p> <p>09.02.01 General</p> <p>i. Trip commands from Bay Protection Units shall be hard-wired directly to appropriate switchyard equipment. Also, critical interlocking data between Bay Protection Units and Bay Control Units, including the substation level interlocks such as bus bar protection trip etc. shall also be hard-wired to ensure complete bay level functionality even in case of failure of substation LAN. The interlocking information to be hard-wired between Bay Protection Units and Bay Control Units shall be decided by Owner during detailed engineering stage.</p> <p>ii. NIL</p> <p>iii. The interface of Bay Protection Unit for EHV lines with PLCC/communication panels shall be in contractor's scope.</p> <p>iv. Relay parameterization for SWYD/GRP relays shall be possible from the EWS.</p> <p>09.02.02 General Requirements of Numerical Relays and Auxiliary Relays</p> <p>i. All numerical relays, auxiliary relays and devices comprising the Bay Protection Units shall be of types, proven for the application, satisfying the requirements specified elsewhere and shall be subject to the Owner's approval.</p> <p>ii. The necessary auxiliary relays, trip relays, etc. required for complete scheme, interlocking, alarm, logging, etc. shall be provided. No control relay, which shall trip the circuit breaker when the relay is de-energized, shall be employed in the circuits.</p> <p>iii. Relays shall be provided with self-reset contacts except for the trip lockout, which shall have contacts with a manual reset feature. Manual resetting shall be possible from Control Level 2 (OWS) as well as Control Level 1 (BCU) with suitable authorization.</p>			
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	<div>iv. Transients present in CT & VT connections due to extraneous sources in the EHV system shall not cause damage to the numerical and other relays. CT saturation/transients shall not cause mal operation of numerical relays.</div> <div>v. Only DC/DC converters shall be provided in the solid-state devices / numerical relays wherever necessary to provide a stable auxiliary supply for relay operation. Except for event logging, alarm and annunciation type of non-trip functions, protective relay contact multiplication shall be done through high-speed trip relay only.</div> <div>vi. DC batteries inside protective relays necessary for relay operation shall not be acceptable. Equipment shall be protected against voltage spikes in the auxiliary DC supply.</div> <div>vii. Each numerical relay shall have a serial interface on the front for local communication to a Personal Computer and Printer. Additionally, facilities shall be provided to access each discrete protection function including modification in relay settings and monitoring of the relay from an HMI or a separate Protection / Disturbance Recorder Station provided and permanently wired to all the numerical relays comprising various Bay Protection Units as shown in tender drawing. For numerical relays of switchyard, the HMI shall be located in SWYD control room at the Substation Level and for those in GRP, dedicated engineering/DR workstation has to be provided in CER. A print out of all settings, scheme logic, event records etc. shall be accessible through the HMI. The display of various measured parameters during normal as well as fault conditions on a segregated phase basis shall be provided. LEDs and a backlit LCD screen shall be provided for visual indication and display of messages related to major trips / alarms. Necessary multilevel password protection shall be provided.</div> <div>viii. The Bay Protection Units shall be arranged to provide two independent, high performance and reliable systems housed in different panels with separate DC supplies, separate CT/VT cores, separate cables and trip relays to obtain 100% redundancy. Associated trip relays of the two systems shall be separate, having a sufficient number of contacts for all the functions.</div> <div>ix. The numerical relays shall be provided with built-in disturbance recording functionality. The data from DR function shall be available in IEEE/COMTRADE format and shall be compatible with the dynamic relay test system.</div> <div>x. The manufacturer of the numerical protection system offered shall carry out the complete engineering, testing and commissioning on site of the offered protection equipment including the associated relays and protection panels. The testing and commissioning protocols for the numerical protection systems offered shall be approved by the Owner before commissioning on site.</div>		
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09.02.03	<p>xi. Pick up range of the Binary inputs shall be minimum 70 V DC/AC.</p> <p>xii. All the numerical relays shall have adequate processor capability to carry out programmable scheme logics (PSL) required for implementing approved protection and control schemes over and above its inbuilt protection functions algorithm.</p> <p>xiii. All numerical relays shall be supplied with all the protection function/features in disabled condition. Relevant features/protection function shall be enabled at the time of commissioning at site as per approved logic and relay settings.</p> <p>xiv. BPU offered shall have adequate I/Os for function realization. Use of auxiliary relays (contact multiplication) shall be permitted only when the entire product range does not support any further hardware augmentation for additional I/Os.</p> <p>xv. Configuration/ scheme logics /relay settings shall be submitted by the Contractor for approval during detailed engineering.</p> <p>Protection for Main Generator Circuit</p> <p>i. For protection purpose, each Main Generator Circuit comprising of the Generator and Generator Transformer. Dedicated Protection Units (PUs), comprising numerical relays for various protection functions listed in following clauses, shall be provided for each Main Generator Circuit to achieve comprehensive protection for all types of faults and abnormal operating conditions. Numerical relays constituting the PUs shall meet the requirements of <u>Clause 09.02.00</u> and <u>Clause 09.02.01</u> above.</p> <p>ii. The PU for each Generator Circuit shall be mounted in Generator Relay Panels located in the Control Equipment Room (CER) for respective Generator Unit. The Engineering and Fault Recording Stations shall be connected to the Substation Level LAN operating on IEC 61850.</p> <p>iii. The Engineering Stations shall allow following functionality related to Numerical Relays for all the Generator Circuits:</p> <p>a) Extract all the alarms, events and fault data captured by numerical relays.</p> <p>b) Change / upload Relay Settings for various numerical relays.</p> <p>iv. The numerical relays constituting the PU for each Main Generator Circuit, shall be configured into two independent Numerical Protection Systems, each fed from a separate DC supply, such that one numerical protection system shall be always available to detect and operate for any type of fault in the Generator Circuit, under condition of failure of the other numerical protection system AND/OR on failure of the associated DC supply systems of other numerical</p>			
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	<p>protection system. Group II of Generator protection shall be on a different hardware platform than Group I protection. The individual protection systems shall be connected to independent set of hand re-set trip relays. Trip circuit supervision shall be provided for continuous monitoring of trip relays, trip circuit and associated trip coils and the discontinuity shall be annunciated in Unit Control Room as applicable. Further the system shall have facilities to accept digital input signals of various alarms and trip conditions of the Step-Up Transformer, Station Service transformer and the Unit Service Transformer with complete galvanic separation. All interface and coordination requirements with the control, interlock and protection schemes provided for the switchyard shall be achieved.</p> <p>v. The alarm/status of each individual protection function and trip operation shall be communicated to Main Plant DDC/PLC. The numerical system shall have built-in features/ hardware interface to provide such inputs to DDC/PLC for analogue/digital values.</p> <p>vi. Protection function of two different equipment shall not be clubbed.</p> <p>The Numerical Generator Protection System shall comprise the protections indicated in the following table:</p> <table><tr><th>S. No.</th><th>Protection Function</th><th>Remarks</th></tr><tr><td>1</td><td>Generator Differential Protection (87G)</td><td></td></tr><tr><td>2</td><td>Voltage restrained overcurrent (51V)</td><td></td></tr><tr><td>2</td><td>Stator Standby Earth Fault Protection covering 95% of winding (trip) (64G)</td><td></td></tr><tr><td>3</td><td>Inter-turn Fault Protection (95G)</td><td></td></tr><tr><td>4</td><td>Loss of field protection (40G1/2)</td><td></td></tr><tr><td>5</td><td>Back up Impedance Protection, three pole (21G)</td><td></td></tr><tr><td>6</td><td>Duplicated Negative Sequence Current Protection, alarm and I_2^{2t} element for trip (46G) matching with the machine characteristics</td><td></td></tr><tr><td>7</td><td>Low-Forward Power / Reverse power Interlock for steam turbine generator (37/32G), (with a minimum setting range of 0-1%) each having following two stages:</td><td></td></tr></table>	S. No.	Protection Function	Remarks	1	Generator Differential Protection (87G)		2	Voltage restrained overcurrent (51V)		2	Stator Standby Earth Fault Protection covering 95% of winding (trip) (64G)		3	Inter-turn Fault Protection (95G)		4	Loss of field protection (40G1/2)		5	Back up Impedance Protection, three pole (21G)		6	Duplicated Negative Sequence Current Protection, alarm and I_2^{2t} element for trip (46G) matching with the machine characteristics		7	Low-Forward Power / Reverse power Interlock for steam turbine generator (37/32G), (with a minimum setting range of 0-1%) each having following two stages:	
S. No.	Protection Function	Remarks																										
1	Generator Differential Protection (87G)																											
2	Voltage restrained overcurrent (51V)																											
2	Stator Standby Earth Fault Protection covering 95% of winding (trip) (64G)																											
3	Inter-turn Fault Protection (95G)																											
4	Loss of field protection (40G1/2)																											
5	Back up Impedance Protection, three pole (21G)																											
6	Duplicated Negative Sequence Current Protection, alarm and I_2^{2t} element for trip (46G) matching with the machine characteristics																											
7	Low-Forward Power / Reverse power Interlock for steam turbine generator (37/32G), (with a minimum setting range of 0-1%) each having following two stages:																											
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1.02.02		a) Short time delayed interlocked with turbine trip (0-10 sec) b) Long time delayed independent of turbine trip (0-60 sec)		
	8	Two Stage Rotor Earth Fault Protection (64F) based on injection principle. The relay should be capable of monitoring the healthiness of injection circuit and raising an alarm in case of open discontinuity in injection circuit.	Setting Range for Rotor E/F Protection (Alarm/Trip) – 1KΩ to 20KΩ	
	9	Definite Time Delayed Over-Voltage Protection (59G)		
	10	Generator Under Frequency Protection (81G) with df/dt elements		
	11	Generator/GT Overfluxing (24G)		
	12	Excitation Transformer Differential Protection, (87ET) *		
	13	Excitation Transformer back-up over current protection (51ET) *		
	14	Generator pole slipping protection (98G)		
	15	Generator Accidental Back Energisation Protection (50GDM)		
	16	Generator Circuit Breaker Failure Protection*		
	17	Following general functions shall also be provided a) VT fuse failure relay (based on voltage balance principle) b) Trip relays as required Trip circuit supervision / trip relay / DC supervision		
	* - IF APPLICABLE			
	METERING for Generator circuit			
	The following integrating meters shall be provided in the generator circuit:			
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<p>9.2.4</p>	<p>a) ABT meter for generator circuit.</p> <p>b) Meter shall be as per the requirements outlined in clause 10.00.00. These meters will be located in Generator Relay Panel.</p> <p>Protection for EHV System (EHV)</p> <p>a) The general protection requirements for the EHV systems are indicated in the tender drawing for switchyard protection SLD.</p> <p>b) The Total critical fault clearing time, including the circuit breaker operating time, from fault initiation in any part of the system under all conditions shall not be more than 80 ms for faults within zone-I reach (i.e. up to 80% of line length) and 100 ms for end zone faults including carrier transmission time of 20 ms.</p> <p>c) The SIR values for the operating time of Relays for the SWYD feeders shall be between 4 and 15. The Rated break time for the EHV circuit breaker, as offered, shall be considered for the purpose of circuit breaker operating time. The contractor shall furnish the operating time curves at various SIR values for all types of faults.</p> <p>9.2.5 EHV Line Protection</p> <p>9.2.5.1 NA</p> <p>9.2.5.2 The following protections shall be provided for each 132 kV line:</p> <p>i. Main-I: Numerical Line Distance protection scheme suitable for carrier aided protection.</p> <p>ii. Main-II: Back-up Directional over current Function/DEF based on numerical technology with various operating characteristics. This shall be connected to a different CT and a different DC supply other than Main-I protection.</p> <p>Main-I and Back-up directional overcurrent protection relays shall be connected to two different protection groups (main-I and Backup O/C to group-B) to meet the requirements of clause 9.2.2 above.</p> <p>9.2.6 Numerical Distance Protection Scheme</p> <p>a) The Numerical distance relays shall be the latest version meeting the in-service criteria specified elsewhere.</p> <p>b) The distance protection schemes shall be such as to facilitate compatibility with the protection at the remote ends of the EHV transmission lines.</p> <p>c) The reaches of relay for zones 1, 2 and 3 should be able to cover line lengths associated with this contract.</p> <p>d) The distance protection shall be of the non-switched type with separate measurements for all phase-to-phase and phase-to-ground fault types.</p>
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	<p>e) The protection shall have two independent, continuously variable time settings each with a range of 0 to 5 s for zone-2 and zone-3.</p> <p>f) The characteristics shall have adjustable characteristic angle setting ranges of 45° to 85°.</p> <p>g) Tripping characteristics shall be polygonal and/or mho circle with adjustable offset and with independently adjustable reactive and resistive reaches (for polygonal characteristics) separately settable for each zone. The type of tripping characteristic shall be user selectable.</p> <p>h) The protection shall operate correctly for close-up three phase faults and other adverse condition. It shall operate instantaneously when the circuit breaker is closed onto a zero volt 3-phase fault.</p> <p>i) The protection shall provide Phase segregated tripping i.e. single phase as well as three-phase tripping</p> <p>j) The protection shall have a maximum resetting time of 60 milliseconds.</p> <p>k) Zone 3 shall have a reverse offset capability adjustable to 10 to 20% of zone-3 setting or alternatively, an independent reverse zone 4 shall be provided.</p> <p>l) The earth fault measurements shall have zero sequence compensation variables from 0.5 to 5 (scalar Z0/Z1).</p> <p>m) The setting/reach should not be affected by mutual coupling effects.</p> <p>n) It shall have a continuous current rating of 2 times rated current. The relay shall also be capable of carrying a high short time current of 100 times the rated current without damage for a period of 1.0 s. The voltage circuit shall be capable of continuously withstanding 1.2 times the rated voltage and 1.7 times for 3 s.</p> <p>o) The protection shall include Power Swing Blocking protection. The power swing blocking feature shall:</p> <p> i. be of three pole type</p> <p> ii. Block/unblock tripping during power swing conditions, separately for each zone.</p> <p> iii. Have a continuously adjustable time delay on pick up of 0 to 5s.</p> <p> iv. Be in service during the dead time of a single pole Reclosing cycle.</p> <p> v. Have user configurable unblocking criteria in the case of fault detection during a power swing.</p> <p>p) Shall include Fuse Failure Protection, which shall:</p> <p> i. Monitor all the three fuses of the CVT and associated cabling against open circuit.</p> <p> ii. Inhibit trip circuits on operation and initiate annunciation.</p> <p> iii. Have an operating time of less than 7.0 ms.</p> <p> iv. Remain inoperative for system earth faults.</p> <p>q) It shall have user configurable scheme logic such as permissive under-reach (PUTT), Permissive over-reach (POTT), Direct Transfer Trip, blocking scheme etc. using communication channels. The scheme shall be complete so that the user can select any option on site without any modification. Non-carrier aided</p>		
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09.02.07	<p>schemes such as Zone-1 extension, Loss of Load etc. shall be provided to ensure high-speed clearance during channel failure.</p> <ul style="list-style-type: none"> r) The protection shall be able to distinguish between short circuit and heavy load conditions. s) It shall have supplementary over current and earth fault protection functions. t) The dead line charging feature shall have adjustable minimum and maximum voltages. u) The protection shall have a multiple settings group feature. It shall be possible to switch between the various available setting groups when the relay is in service without compromising the protection during the switch-over. v) The protection shall include the following additional functions: <ul style="list-style-type: none"> i. Weak-in feed tripping ii. Echo function iii. Current reversal guard iv. Switch onto fault logic v. Suitability for series compensated lines. <p>Digital Fault Recording</p> <p>A Digital Fault Recorder complying with IEEE C37.111 and IEC 60255-24 shall be provided for each EHV line. The Digital Fault Recorder shall meet the following requirements:</p> <ul style="list-style-type: none"> i. Shall be used to record the graphic form of the instantaneous values of analog inputs such as voltages and currents in all the three phases, open delta voltage and neutral current in the primary circuits in the case of a short circuit (fault) and a disturbance in the Power System, as per the required technical parameters. ii. Shall be provided with a self-monitoring facility. iii. Fault / disturbance logs shall be clearly identified by Fault ID, Fault date and time (hour, minutes, seconds and ms). Time stampings on fault records shall be synchronized with a GPS clock. iv. The disturbance recorder shall comprise distributed individual acquisition units, one for each feeder and an evaluation unit which is common for the entire substation. The acquisition units shall acquire the disturbance data for the pre-fault (more than 200ms), fault and post-fault periods (more than 5 sec) and transfer them to the evaluation unit automatically for storage on a mass storage device. The acquisition unit shall be suitable for inputs from current transformers with 1 A rated secondary and capacitive voltage transformers with 63.5 V (phase-to-neutral voltage) rated secondary. v. Shall have Scan rate of 1000 Hz or better for sampling each of the analog channels having a fundamental frequency of 50 HZ. The frequency response for these channels shall be DC on the lower side to 500 HZ or better on the upper side. Any interposing devices provided with the DFR system shall not compromise this frequency response. 			
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	<div>vi. Shall be provided with sensors based on threshold values of voltage, current and frequency and rate of change of system frequency. External signals if required can also be used for triggering the DR. The starting sensors of the DFR, and pick-up, shall preserve the disturbance/fault data on the non-volatile solid-state memory of the acquisition unit. The setting of the starting sensors shall be flexible and shall have reasonable range/steps. The settings of the starting sensors shall be field programmable.</div> <div>vii. The fault data from the Digital Fault Recording feature shall be available in IEEE / COMTRADE format. The data format shall be compatible for dynamic protection relay testing with the relay test kit to be supplied by the Contractor. The necessary equipment for interfacing and transfer of data shall also be supplied by the Contractor.</div> <div>viii. All the fault records shall be transferred to the Protection / DR Station at the Substation Level automatically or on request for further detailed analysis. The software for analysing the fault data shall be available at the Substation Level. The software shall be capable of the complete analysis of fault data, including the display of RMS/Peak envelop of any voltage / current, fundamental power frequency deviation, display of instantaneous values of Real Power (computed value), Reactive Power (computed value), power factor angle etc. A facility to edit the fault data shall also be provided.</div> <div>ix. Following analogue values shall be recorded – Currents (R-phase, Y-phase, B-phase and Neutral), Voltages (V_{RY}, V_{YB}, V_{RB}, Open Delta) 8 Analogue channels (IR, IY, IB, IN, VRY, VYB, VBR AND OPEN DELTA) 16 Nos. Digital Channel Amplitude Résolution of Analogue Channel (minimum) : 16 bits Event Resolution of Digital Channel (minimum): 1 milli sec Aux. voltage: 220VDC (+10%, -20%) DFR system offered shall also have a built-in Distance-to-Fault Locator Function. This function shall be an on-line function and shall be suitable for circuit-breaker operating times of 2 cycles. The computed distance-to-fault shall be available as a percentage of line length or kilometres without requiring any further calculations. It shall have a provision for mutual zero sequence compensation. It shall have an accuracy of 3% or better for all types of faults and fault levels. This accuracy shall not be impaired under following conditions: a) Presence of remote end in-feed b) Predominant DC component in fault current c) High fault arc resistance d) Severe CVT transients</div>		
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09.02.08	<p>e) Mutual zero sequence coupling between adjacent lines</p> <p>Digital Fault Recorder, having specified technical Parameters, as a built-in feature in Main Numerical Distance Relay is also acceptable.</p> <p>Sequence-of-Event Recording</p> <p>Sequence of event functionality pertaining to the main protection applications shall be provided as a part of the individual protection devices. Sequence of event recording pertaining to the monitoring of non-protection device status information, such as switchyard open and close status which are not catered by the main protection relays, shall be recorded by the bay controller.</p> <p>The sequence of event recording shall:</p> <ol style="list-style-type: none"> Have a time resolution of 1 millisecond or better. Be able to cope with up to 40 changes in any one 10 millisecond interval. The date and time should be printed to the nearest 1 millisecond followed by a tag describing the point which has operated. Events that occur while another event is in the process of being printed are to be stored for subsequent printing. Over 100 such events must be stored. <p>The event printouts shall contain at least the station identification, date and time (in hour, minutes, seconds and milliseconds), event number and event description (at least 40 characters).</p>			
09.02.09	<p>Auto-Reclose and Synchronizing Check</p> <p>Auto-reclose (AR) and Synchronizing Check (SC) functionality shall be provided in a separate device i.e. other than distance protection relay. The interfacing between BCUs and Bay Protection Units for achieving the AR function logic shall be achieved at Bay Level using communication LAN as well as standby hard-wired logic between BCU and Bay Protection Units. The intent of providing the hard-wired logic as a back-up to the software logic is to ensure that in the event of failure of Substation LAN, the bay level functionality is not hampered. The AR function shall meet the following criteria:</p> <ol style="list-style-type: none"> Be of single shot type Have single-phase and/or three phase Reclosing facilities. It shall have a user-selectable option of single phase, three phase, single & three phase Reclosing or non-auto reclosure mode. Incorporate a normal/delayed auto reclosure option with a time range of 1 to 60s. Have a continuously variable three-phase and single-phase dead time of 0.1 to 5s. Have a continuously variable reclaim time of 5 to 300 s. 			
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9.02.10	<p>f) Be properly configured for the breaker-and-a-half arrangement, permitting sequential closing of breakers.</p> <p>g) Incorporate the necessary auxiliary relays and timers to provide a comprehensive reclosing and synchronizing scheme.</p> <p>h) Have facilities for selecting check synchronizing or dead line charging features. The user shall have an option to change the required feature.</p> <p>The built-in Synchronization Check feature shall determine the difference between the amplitudes, phase angles and frequencies of two voltage vectors. Checks shall be provided to detect a dead line or bus bar. The voltage difference, phase angle difference and slip frequency settings shall be adjustable.</p> <p>Transformer / Reactor Protection</p> <p>a) The Bay Protection Unit offered for each transformer/ Reactor should be such that it provides a comprehensive protection for the transformer/ Reactor for all types of faults and abnormal operating conditions.</p> <p>b) The numerical relays, comprising the Bay Protection Unit, for each transformer / reactor shall be configured into two protection groups operating on two separate DC supplies, such that one protection group shall always be available to detect and operate for any type of fault in the transformer/ Reactor, under condition of failure of other protection group or of associated DC supply of the other protection group.</p> <p>c) Should the protection functions specified for a transformer/ Reactor be available as a single discrete numerical relay, two such relays shall be supplied to meet the requirements of relevant clause above. Differential, REF and Back-up protection of any transformer/shunt reactor shall be realized in separate numerical relays with Differential, Back-up E/F in one channel and REF, Back-up O/C in another channel.</p>			
	9.02.10.01	<p>Transformer/ Reactor differential protection shall:</p> <p>a) Be of numerical type and shall have continuous self-monitoring and diagnostic features</p> <p>b) Be three-pole type, with faulty phase identification/indication. The operating time of the relay shall not be greater than 30ms at 5 times the setting.</p> <p>c) Be stable for magnetizing inrush currents and shall be stable under normal over-fluxing conditions. Magnetizing inrush stability shall not be achieved through the use of an intentional time delay.</p> <p>d) Have an internal feature in the relay to take care of the angle and ratio correction.</p> <p>e) Have a disturbance recording feature to record the analogue form of instantaneous values of the current in all three windings (i.e. nine analog channels) during faults and disturbances for the pre-fault and post-fault periods. The disturbance recorder shall have the facility to record the following external digital channel signals in addition to the digital signals pertaining to the differential relay itself:</p> <p>HV breaker (main and tie) status</p> <p>LV breaker status</p> <p>Buchholz/On-load tap-changer Buchholz alarm/trip</p> <p>Winding temperature/Oil temperature/Pressure relief alarm/trip of transformer</p>		
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9.02.10.02	f) The necessary hardware and software for downloading the data captured by the disturbance recording function to a personal computer available in the substation shall be included in the scope.			
	g) Be acceptable with built-in features of definite time overload protection (alarm) relay provided the technical requirements of these relays specified under the relevant clauses are met.			
	Restricted Earth Fault Protection shall:			
	a) Be single pole type.			
	b) Be of current/voltage operated high impedance type.			
9.02.10.03	c) Have a suitable non-linear resistor to limit the peak voltage			
	d) Shall have setting range from 5-80%			
	Transformer/ Reactor over fluxing Protection shall			
	a) Operate on the principle of voltage to frequency ratio			
	b) Have inverse time characteristics compatible to transformer over fluxing withstand capability and also a separate high set feature.			
9.02.10.04	c) Provide an independent alarm with continuously adjustable time delay.			
	d) Tripping time shall be governed by V/ F vs time characteristic of the relay			
	e) Have a set of characteristics for various multiplier settings.			
	f) Have a resetting ratio of 98% or better.			
	Transformer/ Reactor Backup Over Current Protection (51) shall			
9.02.10.05	a) Be triple pole type			
	b) Be of definite time over current type			
	c) Have an adjustable setting range of 20-80% or 150-600% of rated current (as applicable) and 0.3 to 3.0 sec time delay.			
	d) Be provided with operation indicator			
	Transformer/ Reactor Backup Earth Fault Protection (51N) shall			
9.02.11	a) Be single pole type			
	b) Be of definite time over current type			
	c) Have an adjustable setting range of 10-80% of rated current as applicable and 0.3 to 3.0 sec. Time delay			
	d) Be provided with operation indicator			
	EHV Circuit-breaker Protection			
	Each circuit breaker in the EHV switchyard shall be provided with following protection functions:			
	i. Numerical Local Breaker Back up Protection Function: Duplicated LBB protection function shall be provided for each EHV circuit breaker in the EHV switchyard. The LBB protection function for each main circuit-breaker shall be interfaced with the Bus bar protection by hard-wired signals between the Bay			
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	<p>Protection Unit and the Bus bar protection panels. The intent of providing the hard-wired logic as a back up to the software logic is to ensure that in the event of failure of Substation LAN, the bay level functionality is not hampered. The LBB function as a built-in function of Bay Protection Unit is acceptable provided it meets all the requirements specified for the LBB function. However, Tie LBB of incomplete dia shall not be realized not be realized as in-built function of BB protection. In addition, the LBB protection function shall meet following criteria:</p> <p>a) Be three pole type having three single phase units</p> <p>b) Shall operate for stuck breaker conditions</p> <p>c) Have an operating/resetting time each of less than 15 ms.</p> <p>d) The LBB function shall be initiated by external trip contacts from the Bay Protection Units and after a set time delay shall energize the trip bus in the bus bar protection scheme on which the stuck breaker is connected for tripping of all breakers connected to the particular bus. For all EHV CBs, an instantaneous repeat trip command from LBB shall be given to the primary breaker through two separate self-reset trip relays on different DC source.</p> <p>e) Have a setting range of 5 to 80% of rated current</p> <p>f) Have a continuous thermal withstand of 2 times rated current irrespective of the setting.</p> <p>g) Have time delay feature with a continuously adjustable setting range of 0.1 to 1s.</p> <p>h) Shall be an individual phase comprehensive scheme.</p> <p>i) Shall not operate during the single-phase auto-reclosing period.</p> <p>j) Shall provide end-fault protection that initiates a direct transfer trip to the remote end.</p> <p>ii. Trip Coil Supervision: A Trip Coil supervision function shall be provided for each lockout trip relay and each of the circuit-breaker trip coils. It shall incorporate both the pre-close and post-close supervision of trip coils and associated trip circuits. An audible alarm shall be given in the event of operation of trip coil supervision function. It shall have a time delay on drop-off of not less than 200ms. Trip coil supervision function as a built-in feature of the BCUs / Bay Protection Units is also acceptable, provided it meets all other requirements specified here, including loss of DC supply.</p> <p>iii. High Speed Trip Relays supplied under this package shall be:</p> <p>a) With operating time of less than 10ms.</p> <p>b) With reset time of less than 20ms.</p> <p>c) Provided with operation indicator for each element/coil.</p> <p>d) Have adequate contacts to meet the scheme requirements of trip, interlock, LBB, auto-reclose, DR, fault locator, etc.</p>		
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9.02.12 9.02.12.1 9.02.12.2	<p>e) Hand reset or self-reset, depending on the application. Further, the trip relays shall be provided with a feature to receive manual reset command from engineering workstation located in remote.</p> <p>Bus bar Protection</p> <p>Each EHV bus bar shall be covered with a duplicated high-speed busbar protection scheme connected to two different CT cores. Bus bar protection of each EHV bus shall operate in a one-out-of-two mode so as to achieve better reliability.</p> <p>i. Each bus bar protection scheme shall:</p> <ul style="list-style-type: none">a) Be numerical having modular construction and three pole type.b) Main I and Main II shall be connected to different DC source such that even under the failure of either Main I or Main II relays AND/OR failure of the associated DC, the bus bar protection will operate in one out of two mode.c) Bay units shall be mounted in respective BPU Panels.d) Have a maximum operating time for all types of faults of 20ms at five times the setting value.e) Operate selectively for each bus bar.f) Give 100% security up to a 50kA fault level.g) Incorporate continuous supervision for the CT secondary against any possible open circuit and if it occurs, shall render the relevant zone of protection in-operative. The zone protection contact shall be bypassed automatically, and the affected zone shall be protected by the appropriate healthy zone only.h) Not give any false operation during normal load flow in bus bars.i) Shall not mal-operate for an out-of-zone fault, particularly with current transformer saturation under maximum through fault current with maximum DC offsetj) Shall provide independent zones of protection and incorporate clear zone indication.k) Include individual high-speed hand reset tripping relays for each bay/ feeder, as identified in single line diagram/ Tender SLD.l) Be transient free in operation.m) Incorporate protection "In-Out" switches for each zone.n) Be a biased differential type, have operate and restraint characteristics and self-monitoring facilities.o) Shall be of phase segregated type with three-pole trippingp) Shall include continuous DC supply supervisionq) Shall include modules/ bay units and high-speed hand reset trip relays for future bays as per Tender SLD.			
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<p>9.02.13</p> <p>9.03.00</p> <p>10.00.00</p> <p>10.01.00</p> <p>11.00.00</p>	<p>ii. The Bus bar protection relay shall be connected to the Inter Bay communication bus. Use of external CT-switching relays and CT ratio correction relays is not acceptable. The bus bar relay settings and analysis of bus bar fault data shall be possible from the Substation Level.</p> <p>NA</p> <p>NA</p> <p>Dummy Panels for Owner Supplied Energy Meters</p> <p>Dummy panels (complying with IEC 61439) shall be supplied for mounting of owner's supplied energy meters. These energy meters shall be two (2) nos for each EHV line bay and one (1) no. for each generator /generator transformer bay /transformer bay /reactors bay. Terminal blocks (disconnecting type) shall also be provided with these panels.</p> <p>Dimension of these panels shall be decided during detailed engineering. Max six no of energy meters can be placed in each panel.</p> <p>Time Synchronization Equipment</p> <p>i. Time Synchronization equipment shall be provided and shall be located one in the switchyard Control Room and one in CER-1. It shall receive Coordinated Universal Time (UTC) transmitted through Geo Positioning Satellite (GPS) for time synchronization of all components of the SAS/ generator relay panel.</p> <p>ii. Shall be complete in all respects including antenna, all cables, processing equipment, etc.</p> <p>iii. All auxiliary systems and special cables required for synchronization of the equipment shall be supplied and commissioned by the Contractor.</p> <p>iv. Shall work from DC supplies only and the Contractor to clarify if any built-in battery backup is provided, in which case, same shall be of long-life lithium batteries.</p> <p>v. Shall be immune to hostile electrical environment. Suitable protections are to be provided against lightning surges and over-voltages in power supply systems and antenna feeders.</p> <p>vi. The system shall be fully tested to the relevant international standards such as IEC: 61850-8-1, IEC:61000 (EMC) and IEC: 60255. One copy of all the test reports shall be enclosed with the bid.</p> <p>i. All components of the SWYD SAS, including Substation Controllers, Workstations, Bay Control Units (BCU) and Bay Protection units (BPU) and all numeric protection relays shall be synchronized with an accuracy of 1ms.</p> <p>ii. The system should be able to track more than 1 satellite at a time to ensure no interruptions of synchronization signals.</p> <p>iii. The system shall have provisions for combination of any of the following output signals:</p> <p style="padding-left: 40px;">a) NTP (network time protocol) 100Mbits Ethernet port</p> <p style="padding-left: 40px;">b) IRIG-B00x (TTL, pulse width modulated signal)</p>
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12.00.00	<div>c) 2 x Pulse per half-hour/ Pulse per minute/ Pulse per second outputs via potential free contacts</div> <div>d) Any other output port as may be required for the offered system.</div> <div>e) Alarm status contact indicating healthy status of system</div> <div>iv. These output ports shall be compatible with the requirement of the equipment to be synchronized i.e. BCUs and BPUs. The master clock in control room shall also be synchronized with the time synchronization system. The actual port requirements (no. /type) in line with the system offered shall be finalized during detailed engineering.</div> <div>v. The equipment should have a periodic time correction facility of one-sec. periodicity. The equipment shall also have real time display in hour, minute, second (24-hour mode) and have a separate time display unit to be mounted on top of the MIMIC panel, having display size of approx. 144mm height.</div>				
	Relay Test Equipment <div>i. The required relay test equipment shall comprise the following:<div>a) One Dynamic portable relay test system for allowing dynamic and steady state testing of IEC 61850 compatible IEDS also.</div><div>b) Any other auxiliary items like phantom loads, etc. required for testing all the protection relays supplied under this contract.</div></div> <div>ii. It shall have the capability to replay the Disturbance / Fault records acquired by the numerical relays / stand-alone DR in IEEE / COMTRADE format or EMTP simulations, to facilitate dynamic testing of all the numerical relays supplied under this contract. The required software for steady state/dynamic testing of all the numerical protection relays, energy meters and transducers, along with a laptop PC, shall also be supplied.</div>				
	<div>iii. All commissioning tests on protection relays, energy meters and transducers shall be carried out with this relay test equipment being supplied under this contract and test reports shall be maintained as per the agreed protocols.</div>				
13.00.00	NA				
14.00.00	Panels <div>i. All panels shall be free standing, floor mounting type and completely metal enclosed. Cable entries shall be from the bottom. Panels shall be of IP 31 class or better.</div> <div>ii. Panels shall have removable gland plates with glands made of brass and shall be suitable for armoured cables.</div> <div>iii. Thickness of panel sides shall be 2mm for Cold Rolled Sheet Steel, 2.5mm for Hot Rolled Sheet Steel.</div> <div>iv. Panels shall be painted. The colour of paint for exterior of the panel shall be as follows:<div>I. Ends: Colour-Blue, Shade-RAL5012</div></div>				
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6401-001-2		SUB SECTION B-13 SAS	32 of 45

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14.01.00	<div>II. Front and Rear: Colour-Grey, Shade-RAL9002</div> <div><div>i. Panels shall have a lockable front toughened glass door and a swing frame/ fixed rack. Panels shall facilitate direct access to any component mounted inside and shall have at least 20% free space for future expansion.</div><div>ii. Shall be supplied complete with interconnecting wiring between all devices mounted therein.</div><div>iii. All equipment mounted on front and rear side of the panels shall have individual name plates with equipment designation engraved. Each panel shall also have circuit/feeder designation name plate.</div><div>iv. Each panel shall be provided with a 240V AC fluorescent lighting fixture controlled by door switch as well as a 5A, 240V AC switch-socket unit.</div><div>v. Shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of AC & DC supplies for various circuits for control, signalling, lighting, interlocking, etc. Selection of main and sub-circuit fuse rating shall ensure selective clearance of the sub-circuit faults.</div><div>vi. Voltage circuits for protection and metering shall be protected by fuses. Suitable fuse failure relays shall be provided to give an alarm for voltage circuits of protection/metering. Voltage selection scheme based on relays shall be provided for meters wherever applicable.</div><div>vii. The DC supplies at the individual relay and protection panels shall be monitored and failure of DC supplies shall be enunciated.</div></div>				
	<div>Earthing</div> <div><div>i. The panels shall be equipped with an earth bus of at least 50x6mm² galvanized steel flat bar or equivalent copper.</div><div>ii. Earth buses of adjoining panels shall be connected for continuity. The continuous earth bus so formed shall be connected to the main earth grid at one end only.</div><div>iii. All metallic cases of the mounted equipment shall be separately connected to the earth bus by 2.5mm² copper wires. No loops in the earth wiring shall be permitted.</div><div>iv. CT/VT neutral secondary shall only be earthed at the terminal block of the panel through links, such that the Earthing of one group may be removed without disturbing others.</div><div>v. An independent Electronic Earth System shall be provided as per contractor's standard. The electronic earth shall be connected to the substation earth mat through a dedicated riser.</div><div>vi. The earthing design shall comply with IEEE 80 and IEC 60364.</div></div>				
14.02.00	<div>Wiring</div> <div><div>i. Internal wiring to be connected to external equipment shall terminate on terminal blocks.</div></div>				
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16.02.00	<p>The FAT shall be mutually agreed upon and approved by Owner during detailed engineering.</p> <p>Operational and Pre-FAT Tests</p> <ul style="list-style-type: none"> i. The authorized quality assurance personnel of the contractor shall conduct all tests as per the requirements of this clause 15.02.00 and clause 15.03.00 and fully satisfy themselves regarding completeness of hardware, software and full compliance with specification requirements by all equipment/sub-systems and the system as a whole before sending notification for FAT to the Owner. Contractor shall maintain accurate records for all pre-FAT tests which shall be properly documented, and duly certified documents shall be furnished to Owner at least two weeks prior to FAT tests, while giving inspection call. ii. Each individual item of equipment/ sub-system/ software package furnished by the Contractor as well as the complete system as per this specification shall be inspected and tested by the Contractor in his works for full compliance with specification requirements, completeness, proper assembly, proper operation, cleanliness and state of physical condition as applicable. iii. The Contractor shall conduct a point-by-point wiring continuity check to every input and output and verify that the wiring connections agree with the documentation. iv. Contractor shall conduct all tests as per requirements of clause 15.03.00 (Factory Acceptance Tests) to fully satisfy himself regarding completeness of the system and full compliance with specification requirements for SAS as a whole as well as for individual components/ software module. This test will be done for 100% samples, even if the FAT requires tests for only some smaller percentages. v. The pre-FAT report shall be in the format of FAT procedure as approved by the Owner. It shall be accompanied by a very detailed report, in a log form, of the performance of all pre-FAT Tests. These records shall list not only the successfully completed tests, but shall detail all system, test and component failures. 			
16.03.00	<p>Notification for FAT</p> <ul style="list-style-type: none"> i. Contractor shall send notification regarding readiness for FAT and indicate the proposed date for commencement of FAT to enable the Owner to depute representatives for participating in these tests. The notification shall be sent to the Owner not less than one week prior to commencement of the FAT along with the copies of documents covering pre-FAT results as per <u>clause 16.02.00.</u> ii. The Contractor shall ensure that all hardware and software required for fully implementing the system as per requirements of this specification is available and the adequacy of hardware, software, system configuration, etc., is fully established during the pre-FAT Tests conducted by the Contractor. In case any deficiencies in hardware and/or software are noticed by the Contractor during the pre-FAT Tests, the Contractor shall make good all such deficiencies and re-conduct the required tests to fully satisfy him regarding completeness of the 			
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16.04.00	<p>system and full compliance with specification requirements before sending notification to the Owner regarding FAT Tests.</p> <p>Factory Acceptance Tests (FAT)</p> <ul style="list-style-type: none"> i. Factory Acceptance Tests (FAT) shall include all tests required to fully demonstrate to Owner's satisfaction that each equipment/sub-system/system as well as software modules furnished as per this specification as well as SAS as a whole, fully meets the functional, parametric and other requirements of this specification and Owner's approved drawings/documents under all operating regimes. The testing shall be conducted with the all the SAS components fully interconnected as per the final system configuration, including BCU, BPU and other protection relays. The Owner shall witness all FAT tests. ii. The Factory Acceptance Tests (FAT) shall include all reasonable exercises which the combination of equipment and software can be expected to perform. These tests shall be divided into, as a minimum, but not limited to the following categories: <ul style="list-style-type: none"> a) Pre power on checks b) Power on checks c) Hardware tests d) Functional tests e) Parametric tests f) Specific tests on electronic hardware g) Power failure auto-restart tests h) Testing of interlocking iii. The Contractor shall submit a detailed FAT procedure for Owner's approval during detailed engineering stage based on the above guidelines. The FAT procedure to be submitted by the Contractor shall be detailed and exhaustive enough such that Owner is satisfied that all the SAS System specification requirements and features are being tested and the system meets these requirements. The test results obtained shall be properly documented by the Contractor and furnished in the Owner approved format as decided during detailed engineering and submitted in the requisite number of copies with all annexes irrespective of the fact that Owner 's representative was present during the tests. iv. For integrated testing of the total SAS system, the Contractor shall provide an I/O generator/simulator, which will be connected, to the BCUs simulating the plant status and plant operation. This will help in generating desired rate and sequence of I/O to test various BCU and HMI functionality under worst case loading conditions. With the I/O generator/simulator, all possible interlocking conditions shall be simulated and controls tested. v. Following the tests, if in the opinion of the Owner, the system has not been adequately manufactured, programmed, tested or debugged the Contractor shall make good all deficiencies including system parametric specifications of 			
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	<p>display response time, processor duty cycle, SOE resolution, etc., and re-run the test to fully satisfy the Owner regarding full compliance with specification requirements and requisite quality standards. The Contractor shall be responsible for all travel and accommodation costs of the Owner related to re-visits and/or re-testing required.</p> <p>vi. The system shall not be shipped without approval of Owner in writing. Upon successful completion of FAT, the Owner will provide the Contractor with a written authorization for shipment of the system equipment to the project site.</p> <p>vii. Contractor shall note that no payments towards dispatch of equipment and subsequent activities shall be due and payable to the Contractor till the Contractor is able to successfully demonstrate to Owner's satisfaction that the SAS and parts thereof fully meet the FAT requirements. The tests shall include the verification of all I/O functions at all Control Levels. The interface to the control center(s), interface to the EHV SAS and interface to the DDC shall be tested with the use of a protocol simulator.</p> <p>viii. Performance test: The duty cycle time as specified in clause 3.02.00 shall be checked under the worst loading conditions.</p> <p>17.00.00 Site / Commissioning Tests</p> <p>17.01.00 Site tests shall include all tests to be carried out at site upon receipt of equipment. It shall include but not be limited to testing calibration, configurations and pre-commissioning trials start up tests, trial operation and performance and guarantee tests. The Contractor shall be responsible for all site / commissioning tests.</p> <p>17.02.00 The Contractor shall maintain all tests, calibration records in Owner approved formats, and these shall be countersigned by authorized quality assurance personnel of the Contractor supervising these works.</p> <p>17.03.00 The Contractor shall maintain master checklists to ensure that all tests and calibration for all equipment/devices furnished under these specifications are satisfactorily completed under the supervision of the authorized quality assurance personnel of the Contractor.</p> <p>17.04.00 The site / commissioning tests shall be categorized under following categories:</p> <p>i. Start-up tests</p> <p>ii. Calibration and configuration checks</p> <p>iii. Pre-commissioning tests</p> <p>iv. Trial Operation</p> <p>v. Availability Tests</p> <p>17.05.00 Point-to-point testing of all the I/O signals in the EHV network.</p> <p>17.06.00 Point-to-point testing shall include:</p> <p>i. Verification of all status indications by operating the equipment</p> <p>ii. Verification of event / alarm indications by simulating alarm conditions</p> <p>iii. Verification of all analogue indications by injection testing</p> <p>iv. Verification of all controls by operating the equipment</p>		
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17.07.00	<p>Availability Tests</p> <p>i. The Contractor shall guarantee 99.9 % availability for a continuous period of 1000 hrs. Availability guarantee test shall be conducted to assure this level of availability. If the accrued down time exceeds 0.1% of 1000 hrs, during availability test run, a new 1000 hrs test run shall start at the time when the system becomes available again. Loss of availability (unavailable system) shall be defined as the loss of the systems guaranteed accuracy and repeatability or of any system function, except however, that the loss of a function for not more than five percent of the points shall not be considered loss of availability. Loss of function for not more than 5% of the points shall be treated as partial unavailability and the corresponding outage time shall be weighted with respect to the function and the percentage of the points for which the function is unavailable. Loss of each function shall have one weighing factor and unavailability of each equipment, peripherals device or process I/O card etc. shall have another weighing factor. The guaranteed accuracy and repeatability and system parametric requirements specified in clauses on system parametric requirements shall be maintained for the entire 1000 hrs run without any manual re-calibration or any other changes made to the SAS.</p> <p>ii. Downtime shall start upon loss of a system function and shall end upon full restoration of the affected system function. A minimum of one hour's down time shall be charged for each loss of availability in determining system availability.</p> <p>iii. The Contractor shall submit the Availability Test Procedure for Owner's approval. The details regarding outage time, weighing factors for various systems functions equipment to calculate the down time shall be discussed and finalized during detailed engineering.</p> <p>iv. The availability test shall start at a date, which will occur, between the commissioning date and 5 months after commissioning. The contractor will be notified the date during PG test.</p> <p>v. The availability test shall be expressed as percentage, which shall be calculated as (100% x (test duration time – Accumulated test outage time/Test duration time).</p> <p>vi. System outage time will be accumulated over test duration and calculated as outage time x weighing factor. The contractor shall submit a list of weighing factors for all system components along with the bid and the same will be mutually finalized before contract award. Outage time shall be weighted by each function's weighing factor.</p>				
17.08.00	<p>Conditions for Availability Tests</p> <p>i. Down time shall start with the notification to contractor about any loss of function. Downtime shall be exclusive of travel time required by the Contractor, but not in excess of 8 hours.</p> <p>ii. The contractor shall furnish in his bid recommended spare parts inventory, along with unit price, to be maintained at site during availability test run. If the spare parts required for maintenance as recommended by contractor are not available with Owner for fault repair the outage time necessary for obtaining spare will not</p>				
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17.09.00	<p>be counted. If the required spare is not recommended by the Contractor and are required for repairs, then the time required to obtain the part by the Contractor shall be multiplied by weighting factor or 0.05 and counted as a accumulated outage time. The spare parts, which are used by the Contractor and not replaced by the contractor, shall accumulate outage time at the rate of time required to obtain the spare parts multiplied by the weighing factor of 0.05 if the part is required on a subsequent outage.</p> <p>iii. The contractor shall be responsible for replacing any of the Owner’s spare parts which are used in the availability run free of cost to the Owner.</p> <p>iv. Failure of peripheral output devices shall be counted as outage time if failure of the device affects any for part of the system function.</p> <p>v. Any degradation of function shall accrue outage time regardless of processor configuration.</p> <p>vi. During a period of system outage, the Owner shall use operable functions of the system provided that such use does not interfere with maintenance of the inoperable functions or hardware as determined by the Contractor.</p> <p>vii. Should the contractor determine that partial use of the system by the Owner will interfere with the contractor’s maintenance procedures, system outage time shall accumulate with a weighing factor of 1.0 since no functions are available to the Owner. This shall include offline servicing.</p> <p>ii) Outage time for each function shall stop at the time the contractor returns each of the functions in full service and relinquishes full use of the system to the Owner.</p> <p>The contractor shall prepare a detailed site / commissioning tests procedure based on the guidelines given here and submit to Owner for approval during detailed engineering stage.</p>				
	<p>System Hand-over and Final Acceptance</p> <p>i. The system will be handed-over to the Owner for commercial operation after the site / commissioning tests have been completed to the satisfaction of the Owner. A hand-over certificate will be issued by the Owner. The Contractor will still be responsible for the Availability Tests.</p> <p>ii. Final acceptance of the system by the Owner will take place after the Availability Tests have been done to the satisfaction of the Owner.</p>				
	<p>Type Test Requirements</p>				
	<p>Test reports for following type tests shall be submitted for all BCUs / BPUs / DR. Reports / Certificates of tests conducted in accredited Laboratories (accredited by the national accrediting body of the country where the lab is located) are also acceptable.</p>				
	<p>BCU/BPU</p>				
18.00.00	<p>i. Insulation Tests</p>				
	<table><tr><th>Sl.No.</th><th>Description</th><th>Standard</th></tr></table>			Sl.No.	Description
Sl.No.	Description	Standard			
18.01.00					
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CLAUSE NO.	TECHNICAL REQUIREMENTS																						
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	<p>iv. Atmospheric Environment Tests:</p> <table><tr><th>Sl.No.</th><th>Description</th><th>Standard</th></tr><tr><td>1.0</td><td>Humidity</td><td>IEC 60068-2-78 ed1.0</td></tr><tr><td>2.0</td><td>Temperature</td><td>IEC 60255-1 IEC 60068-2-1 ed6.0 for Cold IEC 60068-2-2 ed5.0 for Dry heat</td></tr></table>			Sl.No.	Description	Standard	1.0	Humidity	IEC 60068-2-78 ed1.0	2.0	Temperature	IEC 60255-1 IEC 60068-2-1 ed6.0 for Cold IEC 60068-2-2 ed5.0 for Dry heat			
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	<p>v. Mechanical Stress Tests:</p> <table><tr><th>Sl.No.</th><th>Description</th><th>Standard</th></tr><tr><td>1.0</td><td>Vibration (during Operation and Transportation)</td><td>IEC 60255-21-1 IEC 60068-2-6</td></tr><tr><td>2.0</td><td>Shock (during Operation and Transportation)</td><td>IEC 60255-21-2 IEC 60068-2-27</td></tr><tr><td>3.0</td><td>Seismic Vibration (during Operation)</td><td>IEC 60255-21-3</td></tr></table>			Sl.No.	Description	Standard	1.0	Vibration (during Operation and Transportation)	IEC 60255-21-1 IEC 60068-2-6	2.0	Shock (during Operation and Transportation)	IEC 60255-21-2 IEC 60068-2-27	3.0	Seismic Vibration (during Operation)	IEC 60255-21-3
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GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6401-001-2	SUB SECTION B-13 SAS	43 of 45											

CLAUSE NO.	TECHNICAL REQUIREMENTS											
22.00.00	<table><tr><td>i)</td><td>Desk for Switchyard control room – Modular) & Desk (Size for 01 workstation and printer) for workstations and printers covered under this package</td><td>6</td></tr><tr><td>ii)</td><td>Chairs</td><td>12</td></tr><tr><td>iii)</td><td>Filing Cupboard</td><td>5</td></tr></table>			i)	Desk for Switchyard control room – Modular) & Desk (Size for 01 workstation and printer) for workstations and printers covered under this package	6	ii)	Chairs	12	iii)	Filing Cupboard	5
	i)	Desk for Switchyard control room – Modular) & Desk (Size for 01 workstation and printer) for workstations and printers covered under this package	6									
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	iii)	Filing Cupboard	5									
ANNUAL MAINTENANCE SERVICE (AMS)												
<p>The Bidder shall provide maintenance services of complete Substation Automation System under a comprehensive Annual Maintenance Service (AMS) for a 2-year period after Warranty period.</p> <p>The AMS shall cover total maintenance of all hardware & software coming under the scope of SAS and shall include free repair/replacement of all cards/modules/peripherals/cables/components etc., correction of software problems, patches/updates for all software and anti-virus and supply of consumable items. The Bidder shall ensure 99.7% availability of the system with the AMS. For that purpose, contractor may maintain adequate no. of staff at site as per his own assessment if considered necessary to ensure availability.</p> <p>Further, Bidder may note that during the AMS he will be allowed to use Employer's mandatory spares and must replenish the same within three months' time or before completion of AMS period whichever is earlier. However, if in the opinion of the Bidder, more spares than those included in the mandatory spare list are required to meet the availability requirement, then Bidder shall stock the same.</p> <p>The Bidder shall prepare detailed list of faults corrected and parts, expendables utilized during AMS period and shall furnish the same to Employer, properly documented at the end of every six month. Further, during AMS period the details as required by Employer/ Project Manager shall be made available by Bidder's personnel.</p>												
23.00.00	Cybersecurity Audit											
<p>For checking compliance to latest Cybersecurity Guidelines/Policies issued by CEA and ISO-27001, security audit by a certified Third-Party cybersecurity OT auditor (as per CERT-In panel) is to be arranged by the Contractor during Factory Acceptance Test (FAT) of SAS package.</p> <p>This shall include vulnerability assessment of complete Substation Automation System and penetration testing of the Station LAN through the firewall from a node outside the network. The Contractor shall close all critical and high vulnerabilities within a period of one month/before dispatch of the system. Effective closure of all non-conformities shall be verified during SAT.</p>												
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6401-001-2	SUB SECTION B-13 SAS	45 of 45								

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Annexure I to Chapter 13		
	Network Configuration and Equipment Characteristics		
1.1	INTRODUCTION <p>This section describes the Fiber Optic Communication network configuration and the equipment characteristics for communication system to be installed under the project. The sub-systems addressed within this section are:</p> <div><div>(1)</div>Fiber Optic Transmission System (FOTS)</div> <div><div>(2)</div>DDF and Cabling</div> <div><div>(3)</div>Craft Terminal based Network Management System (NMS)</div> <p>The requirements described herein are applicable to and in support of network requirements. The equipment supplied shall support the existing regional network for Power system operational requirements.</p> <p>The security related requirements of the equipment shall be as per DoT (Department of Telecommunication) guidelines and all similar security requirements as amended by DoT on time-to-time basis shall be followed/complied with by the vendor.</p> <p>The manufacturer shall allow the Employer and/or its designated agencies to inspect the hardware, software, design, development, manufacturing, facility, and supply chain and subject all software to a security /threat check any time during the supplies of equipment. The contractor shall ensure that the supplied equipment’s have been got tested as per relevant contemporary Indian or International Security Standards e.g. IT and IT related elements against ISO/IEC 15408 standards, for Information Security Management System against ISO 27000 series Standards, Telecom and Telecom related elements against 3GPP security standards, 3GPP2 security standards etc. from any international agency/ labs of the standards e.g. Common Criteria Labs in case of ISO/IEC 15408 standards until 31st March 2013. The certification shall be got done from authorized and certified agency/lab in India.</p> <p>The Contractor shall also ensure that the equipment supplied has all the contemporary security related features and features related to communication security as prescribed under relevant security standards. A list of features, equipment, software etc. supplied and implemented in the project shall be given for use by the Employer.</p> <p>The contractor shall get the Employer’s equipment audited from a security point of view once a year from a network audit and certification agency as identified by DoT. The audit of the equipment shall be carried out once in a financial year till the maintenance service contract in the bid.</p> <p>In case of any deliberate attempt for a security breach at the time of procurement or at a later stage after deployment/installation of the equipment or during maintenance, liability and criminal proceedings can be initiated against the Contractor as per guidelines of DoT and any other Government department.</p>		
1.2	General Network Characteristics		
1.2.1	Description <p>The fibre optic network shall be based on the Synchronous Digital Hierarchy (SDH) having a bit rate of STM-16. The network shall consist of overhead fibre optic links with a minimum</p>		
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1.2.2	<p>bit rate of Synchronous Transport Module-16 (STM-16). The Contractor can propose a system based on higher bit rate systems, if required, to meet the link budget requirements or any other specification requirement.</p> <p>The contractor shall develop a numbering plan for the proposed voice communication system equipment.</p>		
	<p>Functional Requirement</p> <p>The primary function of the communication network is to provide a highly reliable voice and data communication system for grid operation in support of the SCADA/EMS, RTUs & PMUs and for new technological requirements of Power System Operation such as Special Protection Scheme, Grid Security Expert System, Load Management, Advanced Protection System & Substation Automation System. The communications support requirement for SCADA/EMS, RTUs, PMUs system & EPABX system is for low & high-speed data, express voice circuits and administrative voice circuits as defined in appendices. A summary of the communication system requirements is as follows:</p>		
	<p>(a) High speed E1 channel support</p> <p>(b) 64kbps & nx64kbps data channel support</p> <p>(c) Low speed (300 -1200 bps) data channel support</p> <p>(d) Voice (2 wires, 4 wires) channel support and integration with EPABX system. The details of EPABX System shall be provided during detailed engineering.</p> <p>(e) Data transport supporting Network Management channels.</p> <p>(f) The connectivity envisaged between Substation and Control Centre over TCP-IP using Ethernet interface for various services of data and voice such as for PMUs, RTUs, VOIP.</p>		
	1.2.3		
	<p>General Systems Requirements</p> <p>Required characteristics are defined and specified herein at the system level, subsystem level, and equipment level.</p>		
1.2.3.1	<p>System Synchronization</p> <p>The Contractor shall synchronize the equipment under the contract using Master clock procured under the Substation Package. The contractor shall submit the synchronisation plan as per standard ITU-T G.811. All sync equipment proposed under this contract should meet ITU-T G.811 criterion. The holdover quality of slave clock, if any, shall meet ITU-T G.812 standard requirements.</p> <p>The Contractor shall provide system wide synchronization fully distributed throughout the telecom network and connected to all equipment new & existing. The Contractor shall submit the synchronization plan for the entire network meeting the requirement of ITU-T G.803.</p> <p>The system equipment requiring “clock” shall be connected to the master clock using external clocking. For this purpose, appropriate interfaces(s) in the transmission & termination equipment being supplied and all other associated hardware shall be provided by the Contractor.</p>		
	1.2.3.2		
	<p>System Maintainability</p> <p>To facilitate performance trending, efficient diagnosis and corrective resolution, the system shall permit in-service diagnostic testing to be executed locally by Craft Terminal. Such testing shall not affect the functional operation of the system.</p>		
1.2.3.3	<p>System Upgradeability and Expandability</p> <p>Equipment supplied shall be sized (though not necessarily equipped) to support system/ subsystem expansion to full capacity as provided by specified aggregate transmission rates.</p>		
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1.2.3.4	Equipment units provisioned for equipped subunits shall be terminated at appropriate patching facilities or termination blocks. Power supplies shall be sized for maximum equipped system capacity.																						
	Equipment Availability The calculated availability of each fibre optic link (E1 to E1) shall be at least 99.999%. The calculated availability is defined as the theoretical availability determined by a statistical calculation based on the mean-time-between-failure (MTBF) and the mean-time-to-repair (MTTR) of the components and subsystems comprising the FOTS. For this analysis, an MTTR of at least 4 hours shall be assumed. The down time of the fibre optic cable shall not be considered in the aforesaid availability calculations. The calculated failure rates of the units and the calculated availability of the equipment being offered shall be provided by the Contractor during detailed engineering.																						
	1.2.3.5 Revision Levels and Modifications All hardware, firmware and software delivered as part of the communications network shall be field proven and at the most current revision level. All modifications and changes necessary to meet this requirement shall be completed prior to the start of the factory tests or under special circumstances, on written approval by the Employer, prior to the completion of SAT.																						
	1.2.3.6 Equipment Capacities Equipment supplied shall be sized and equipped with sufficient capacity and configuration to meet complete system requirement.. Each subsystem supplied shall be sized (to be equipped as specified) to support full subsystem expansion.																						
	1.2.3.7 Redundancy Requirements and Protection Schemes Equipment redundancy and Automatic Protection Schemes (APS) are specified in Table 2-1. The failure of one element shall not prevent the use of any other that has not failed.																						
<table><tr><td colspan="2">Table 2-1</td><td colspan="2"></td></tr><tr><td colspan="2">Fiber Optic transmission Equipment: SDH equipment</td><td colspan="2"></td></tr><tr><td colspan="2">Power Supply & Converters -----</td><td colspan="2">1:1 APS or distributed power supply</td></tr><tr><td colspan="2">Common Control* Cards-----</td><td colspan="2">1:1 APS</td></tr><tr><td colspan="2">* = Common control cards which are essentially required for operation of the equipment.</td><td colspan="2"></td></tr></table>				Table 2-1				Fiber Optic transmission Equipment: SDH equipment				Power Supply & Converters -----		1:1 APS or distributed power supply		Common Control* Cards-----		1:1 APS		* = Common control cards which are essentially required for operation of the equipment.			
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* = Common control cards which are essentially required for operation of the equipment.																							
The offered equipment shall support at least SNCP as per standard ITU-T G.841 . In case the equipment offered by the Bidder does not support the above-mentioned minimum protection methods, the bidder shall have to provide all additional equipment needed to provide same level of flexibility, redundancy, and functionality at no additional cost to Employer. The bidders shall provide details of protection schemes supported in the Bid document. The offered equipment shall support automatic switchover function between the redundant modules and all required modules and hardware to support the automatic switchover shall be provided by the Contractor.																							
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1.2.3.8	Lost Signal Recovery At any digital signal level, reapplication of a lost signal shall result in automatic resynchronization and full restoration to normal operation without manual intervention. All alarms incident to signal failure, shall be automatically cleared at the equipment, rack and monitoring levels and normal operation indications restored and reported if applicable.																										
1.2.3.9	Software Upgrades The Contractor shall provide antivirus software along with all the computer hardware/software which shall be upgraded periodically till the maintenance services contract in the bid. Further, to meet all the specifications requirements during implementation and maintenance, if an upgrade in the hardware/software of the supplied item is required, the same shall be done by the contractor without any additional cost to the Employer.																										
1.2.3.10	General Site Considerations All fiber optic links up to 150kms/175kms/200kms/225kms/250kms transmission line length (as applicable) shall be implemented by the Contractor without repeaters. To meet the link budget requirement, the Contractor shall provide all the necessary equipment for remote end stations as well. The contractor may provide the optical amplifier, wavelength translator, optical cards, or high capacity SDH equipment with suitable rack/sub rack to meet the maximum distance limit. The contractor will have to integrate all the new equipment with the existing NMS.																										
1.2.3.11	Proposed Optical Fibre Characteristics The link budget calculations and equipment design shall be based on the specified fibre parameters. The optical cables shall have Dual Window Single Mode (DWSM) fibre conforming to ITU-T Recommendations G.652D and the major parameters of these optical fibre(s) are defined in Table-2-2: <table><tr><td colspan="2">Table-2-2 Optical Fibre Characteristics</td></tr><tr><td>Fibre Description:</td><td>Dual-Window Single-Mode (DWSM)</td></tr><tr><td>Mode Field Diameter:</td><td>8.6 to 9.5 μm (±0.6 μm)</td></tr><tr><td>Cladding Diameter:</td><td>125.0 μm + 1 μm</td></tr><tr><td>Mode field Concentricity Error:</td><td>< 0.6 μm</td></tr></table> <table><tr><td colspan="2">Table-2-2 Optical Fibre Characteristics</td></tr><tr><td>Core-Clad concentricity error:</td><td>< 1.0 μm</td></tr><tr><td>Cladding non-circularity</td><td>< 1%</td></tr><tr><td>Cable Cut off Wavelength:</td><td>< 1260 nm</td></tr><tr><td>1550 loss performance</td><td>As per G.652D</td></tr><tr><td>Proof Test Level</td><td>0.69 Gpa</td></tr><tr><td>Attenuation coefficient</td><td>@ 1310nm < 0.35 dB/Km @ 1550nm < 0.21 dB/Km</td></tr></table>			Table-2-2 Optical Fibre Characteristics		Fibre Description:	Dual-Window Single-Mode (DWSM)	Mode Field Diameter:	8.6 to 9.5 μm (±0.6 μm)	Cladding Diameter:	125.0 μm + 1 μm	Mode field Concentricity Error:	< 0.6 μm	Table-2-2 Optical Fibre Characteristics		Core-Clad concentricity error:	< 1.0 μm	Cladding non-circularity	< 1%	Cable Cut off Wavelength:	< 1260 nm	1550 loss performance	As per G.652D	Proof Test Level	0.69 Gpa	Attenuation coefficient	@ 1310nm < 0.35 dB/Km @ 1550nm < 0.21 dB/Km
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	Attenuation variation with wavelength 1285 nm - 1330 nm 1525 nm – 1575 nm	Attenuation coefficient @1310 ± 0.05 dB Attenuation coefficient @1550 ± 0.05 dB		
	Point discontinuities	< 0.1dB		
	Chromatic Dispersion; Max.: Zero Dispersion Wavelength: Zero Dispersion Slope:	18.0 ps/(nm x km) @ 1550 nm 3.5 ps/(nm x km) @ 1288-1339nm 5.3 ps/(nm x km) @ 1271-1360nm 1300 to 1324nm 0.092 ps/(nm2xkm) maximum		
	Polarization mode dispersion coefficient	< 0.2 ps/km^1/2		
	Temperature Dependence:	Induced attenuation < 0.05 dB (-60 deg C - +85 deg C)		
	Bend performance:	@1310nm (75+2 mm dia Mandrel), 100 turns; Attenuation rise 0.05 dB @1550nm (30+1 mm dia Mandrel), 100 turns; Attenuation rise 0.10 dB @1550nm (32+0.5 mm dia Mandrel), 1 turn; Attenuation rise 0.50 dB		
	1.2.4	Fibre Optic Link Lengths The exact cable lengths shall be provided during detailed engineering.		
1.3	Fibre Optic Transmission System The Fibre Optic Transmission System (FOTS) is defined herein to include ETSI digital optical line termination equipment. The FOTS shall be based on SDH technology. Minimum aggregate bit rate shall be STM-4/STM-16 and equipped with minimum 16nos. E1 interfaces (G.703) and minimum 16 nos. Ethernet interfaces (IEEE 802.3/IEEE 802.3u) supporting layer 2 switching as tributaries. The Ethernet interfaces shall support VLAN (IEEE 802.1P/Q), spanning tree (IEEE 802.1D) quality of service. The protection scheme for Ethernet traffic should be ERPS based (Ethernet ring protection scheme) as per ITU-T G.8032. The Contractor shall provide (supply and install) connectorized jumpers (patch cords) for FODP-to-equipment and equipment-to-equipment connection. Two number spare jumpers shall be provided for each equipment connection. Fiber jumpers shall be of sufficient lengths as to provide at least 0.5m of service loop when connected for their intended purpose.			
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<p>1.3.1</p> <p>1.3.1.1</p> <p>1.3.1.2</p> <p>1.3.1.3</p> <p>1.3.1.4</p> <p>1.3.1.5</p> <p>1.3.1.6</p>	<p>SDH Equipment</p> <p>Functional Requirement For the purpose of BOQ, the SDH Equipment is considered to be divided in three parts i.e. Optical interface/SFP, Tributary interfaces (Electrical tributaries such as E1 & Ethernet 10/100 Mbps) and Base Equipment (Consisting of Common Cards, Control Cards, Optical base card, Power supply cards, sub-rack, cabinet, other hardware and accessories required for installation of equipment i.e. everything besides optical interface/SFP and tributary interfaces). If bidder is offering equipment with multifunction cards such as cross-connect or control card with optical interface/SFP or tributary interface, such type of multifunction card shall be considered as Common control card and shall be the part of base equipment. In case optical interface/SFP is embedded with control card, the adequate number of optical interface/SFPs shall be offered to meet the redundancy requirements of the specifications. Further, the main and protection channel shall be terminated on separate cards and there shall not be a single point of failure.</p> <p>The equipment shall be configurable as Terminal Multiplexer (TM) as well as ADM with software settings only.</p> <p>SDH ADM The aggregate interfaces shall be (at least) STM-16 towards at least three protected directions. At present the equipment shall be equipped with a minimum of 16 nos. E-1 electrical tributary interfaces & minimum 16 nos. Ethernet interfaces. The equipment shall provide access to full STM-16payload.</p> <p>Redundancy and Protection Two fibre rings shall be installed wherever the network permits. On linear sections of the network, protected links using 4 fibers shall be implemented.</p> <p>Service Channel Service channels shall be provided as a function of the SDH equipment and shall be equipped with Service Channel Modems that shall provide at a minimum: One voice channel (order wire) with analog interface (0.3 to 3.4 kHz) and one data channel. There shall be a facility to extend the line system order wire to any other system or exchange lines.</p> <p>Supervision and Alarms ISM (In Service Monitoring) circuitry shall be provided as a function of the SDH equipment. Local visual alarm indicators shall be provided on the equipment, as a rack summary alarm panel. Alarms shall be as per ITU-T Standards G.774, G.783 and G.784. Additionally, F2/Q2 interfaces for a local craftsperson terminal interface and remote equipment monitoring is required. The Equipment shall support collection of at least four (4) external alarms for monitoring and control of station.</p> <p>Synchronisation The equipment shall provide synchronisation as per Table 2-3. One 2MHz synchronisation output from each equipment shall be provided.</p> <p>Electrical and Optical I/O Characteristics and General Parameters Table 2-3 provides the electrical and optical characteristics as well as other general parameters for SDH equipment.</p>
<p>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO:CS-6401-001-2</p> <p>ANNEXURE TO SUB-SECTION-B-13</p> <p>PAGE 6 OF 15</p>

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	Table 2-3 Electrical and Optical I/O Characteristics and General Parameters		
	Optical Wavelength NOTE (1)	1310/1550 nm	
	Optical Source NOTE (2)	Laser	
	Optical Source Lifespan	Better than 5X105 Hours	
	Optical Fibre Type	G.652 D	
	Optical Connectors	Type FC-PC	
	Transmission Quality	Per ITU-T G.821, G.823, G.826	
	Source Primary Power	-48 Vdc	
	Equipment Specifications	Per ITU-T G.783	
	Tributary, Electrical Interface	Per ITU-T G.703, 75Ω	
	Ethernet Interface	10/100 Mbps	
	SDH Bit Rates	Per ITU-T G.703	
	Optical Interfaces	Per ITU-T G.957, G.958	
	Frame and Multiplexing Structure for SDH	Per ITU-T G.707	
	Synchronization	Per ITU-T G.813	
	Management Functions	Per ITU-T G.774, G.784	
	Protection Architectures	Per ITU-T G.841	
	Built In Testing and Alarms	Per ITU-T G.774, G.783, G.784	
	NOTE (1) Optical wavelength shall be finalised during detailed engineering. NOTE (2) Eye Safety for Laser Equipment: To avoid eye damage, when a receiver detects a line interruption, it is required that the optical power of the laser shall be reduced to safe limits on the transmitter in the opposite direction as per ITU-T G.958. NOTE (3) In case other than FC-PC connector is provided in the equipment, suitable patch cord with matching connector is to be provided to connect with FODP.		
	1.3.2.1	FODP to SDH Equipment The Contractor shall be responsible for connectivity between the FODP and the SDH equipment. The Contractor shall provide FC PC coupled patch cords. The patch-cord length between the FODP & equipment rack shall be suitably protected from rodents, abrasion, crush or mechanical damage.	
1.4	DDF and Cabling For the purposes of the specification, the contractor shall provide cabling, wiring and DDF patching facilities to the wideband telecommunications system. Equipment and material components for DDF and cabling are also part of this procurement. It shall be the Contractor's responsibility to provide all cable support required for full supplied equipment interconnection and shall be in accordance with communications industry standard practices and the requirements mentioned in the technical specifications.		
1.4.1	Digital Distribution Frame Functional Requirements		
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	<p>The Contractor shall provide DDF for Digital Signal Cross connect (DSX) Broadband-quality (better than 20 MHz) patching facilities configured "normally-thru" with Equipment, Line and Monitor Patch Jacks. DDFs shall provide the following basic functions:</p> <p>(i) "Normally thru" circuit routing (ii) Circuit rerouting via patch cord assemblies (iii) Circuit disconnect and termination</p> <p>All DDFs shall be sized and equipped to support the offered configuration of the provided equipment. Independent Transmit and Receive patch jack assemblies (line and equipment) shall provide for separate transmit and receive single-plug patching. Transmit and receive patch jack assemblies shall be located side-by-side such that dual-plug patch cord assemblies may be used to route both transmit and receive for the same circuit.</p>		
1.5	<p>Patch Cords</p> <p>The Contractor has to supply FC PC coupled Patch cords. The Patch cord return loss shall be equal to or better than 40 dB and insertion loss equal to or less than 0.5 dB.</p>		
1.6	<p>Craft terminal based /Telecommunication Management Network/Network Management System</p> <p>Each equipment on the fibre optic communication network shall include provision for connecting a portable personal computer (PC) to be known as craft terminal to support local commissioning and maintenance activities. Using this PC and local displays/controls, the operator shall be able to:</p> <p>a. Change the configuration of the station & the connected NEs. b. Perform tests c. Get detailed fault information</p> <p>The craft terminal shall be connected to the interface available in the communication equipment. Portable (laptop) computers (Craft terminals), each complete with the necessary system and application software to support the functions listed above, shall be supplied to the employer.</p>		
1.6.1	<p>Hardware Requirements - Craft Terminal</p> <p>Craft Terminal shall be a laptop. The craft terminal shall have minimum configuration of 2.4 GHz, 2 GB RAM, 256 MB Video Graphics Memory, DVD RW drive, 160 GB Hard Disk Drive, keyboard, mouse etc., LAN port, serial/USB (2.0) ports to accommodate printers, and Data/Fax modem and a battery back-up of at least 60 minutes. VDUs shall be 15" TFT active-matrix color LCD with a minimum resolution of 1024 X 768.</p>		
1.6.2	<p>General Software/Firmware Requirements</p> <p>Due to various alternative design approaches, it is neither intended nor possible to specify all software and firmware characteristics. It is the intent herein to provide design boundaries and guidelines that help to ensure a demonstrated, integrated program package that is maintainable and meets both hardware systems requirements and the customer's operational requirements.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.6.3	Operating System Software Operating system software shall be provided to control the execution of system programs, application programs, and management devices, to allocate system resources, and manage communications among the system processors. The contractor shall make no modifications to the OEM's operating system, except as provided as USER installation parameters.			
1.6.4	Applications Software All applications software shall be written in a high-level programming language unless developed using industry proven application programs and development tools provided with the system. The contractor shall make no modifications to the applications program except as provided as USER development tools.			
1.6.5	Software Utilities A utility shall be provided to convert all reports into standard PC application formats such as excel.			
1.6.6	Revisions, Upgrades, Maintainability All firmware and software delivered under this specification shall be the latest field proven version available at the time of contract approval. Installed demonstration for acceptance shall be required. All firmware provided shall support its fully equipped intended functional requirements without additional rewrite or programming. All software shall be easily user-expandable to accommodate the anticipated system growth, as defined in this specification. Reassembly, recompilation or revision upgrades of the software or components of the software shall not be necessary to accommodate full system expansion. The software provided shall be compliant with national and international industry standards.			
2.0	List of Type Tests Test reports for following type tests shall be submitted. Reports / Certificates of tests conducted in accredited Laboratories (accredited by the national accrediting body of the country where the lab is located) are also acceptable. (a) SDH Equipment with all types of cards (optical card & Tributary card)			
2.1	List of type test to be conducted on Telecom equipment The type tests for SDH Equipment with all types of cards are described below:			
2.1.1	Temperature and Humidity Tests The tests listed below are defined in IEC Publication 60068.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
	<p>(a) Low Temperature Test: Operation to Specifications</p> <p>Low temperature tests shall be conducted as defined in IEC Publication 60068-2-1, test method Ad, with the following specifications:</p> <ul style="list-style-type: none">(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for sixteen (16) hours. Its performance is checked during the test.(2) Degree of Severity: Test shall be done at 0°C(3) Acceptance Criteria: No degradation of performance during and after the test. <p>(b) Low Temperature Test: Operation without Damage</p> <p>Low temperature tests shall be conducted as defined in IEC Publication 60068-2-1, test method Ad, with the following specifications:</p> <ul style="list-style-type: none">(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 72 hours. Its performance is checked during the test and after the test as soon as the thermal equilibrium is reached at the room temperature (<i>Post-test</i>).(2) Degree of Severity: Test shall be done at -10° C(3) Acceptance Criteria: Degradation of performance is allowable during the test, however there shall be no degradation of performance in the <i>post-test</i>. <p>(c) Dry Heat Test: Operation to Specifications</p> <p>Dry heat test shall be done as defined in IEC Publication 60068-2-2, test method Bd, with the following specifications:</p> <ul style="list-style-type: none">(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 96 hours. Its performance is checked during the test.(2) Degree of Severity: As per table 3-1: operation to specification range.(3) Acceptance Criteria: No degradation of performance during and after the test. <p>(d) Dry Heat Test: Operation without Damage</p> <p>Dry heat tests shall be done as defined in IEC Publication 60068-2-2, test method Bd, with the following specifications:</p> <ul style="list-style-type: none">(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 96 hours. Its performance is checked during the test and after the test as soon as the thermal equilibrium is reached at the room temperature (<i>Post-test</i>).(2) Degree of Severity: Test shall be done at 55°C.(3) Acceptance Criteria: Degradation of performance is allowable during the test, however there shall be no degradation of performance in the <i>post-test</i>. <p>(e) Damp Heat Test</p> <p>Damp heat testing reveals aging with respect to the humidity level and applies basically to electronic equipment. This test shall be done as defined in IEC Publication 60068-2-78 with the following specifications:</p> <ul style="list-style-type: none">(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 10 days. Its performance is checked during the test.(2) Degree of Severity: Test shall be done at (40 ± 2) °C & (93 ± 3) % RH.(2) Acceptance Criteria: The equipment shall meet the specified requirement and there shall not be any degradation in BER.				
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CLAUSE NO.	TECHNICAL REQUIREMENTS																																																																													
2.1.2	<p>(f) Temperature Variation Test</p> <p>Temperature variation testing shall be as per IEC Publication 60068-2-14 (Gradual Variations, Method Nb). The equipment shall be powered on, and various parameters shall be monitored continuously during the test period.</p> <p>(1) Number of cycles required is five (5)</p> <p>(2) The degree of severity: temperature TL:0°C, TH: As per table 3-1 (Operation to specification range)</p> <p>(3) Cycle duration for each temperature is three (3) hours.</p> <p>(4) Ramp: 1 oC/minute.</p> <p>(5) Acceptance Criteria: The equipment shall meet the specified requirement and there shall not be any degradation in BER.</p>																																																																													
	<p>Power Supply and EMI/EMC tests</p> <p>The test procedure and acceptance criteria shall be as defined in IEC 60870-2-1.</p> <p>(a) Immunity Tests</p> <p>The list of Immunity tests is specified below in Table 4-4:</p>																																																																													
	<table><tr><th colspan="7">Table 4-4: Recommended Immunity Tests</th></tr><tr><th>S. No.</th><th>Immunity Test</th><th>AC Power Supply</th><th>DC Power Supply</th><th>Control & Signal</th><th>Telecom Line</th><th>Parameters</th></tr><tr><td>1.</td><td>Voltage Fluctuations</td><td>Yes</td><td>Yes</td><td>N/A</td><td>N/A</td><td>Table 11 of IEC 60870-2-1: 1995 Level: 1</td></tr><tr><td>2.</td><td>Voltage dips and Interruptions</td><td>Yes</td><td>Yes</td><td>N/A</td><td>N/A</td><td></td></tr><tr><td>3.</td><td>1.2/50 - 8/20 μs surges</td><td>Yes</td><td>Yes</td><td>N/A</td><td>N/A</td><td>Table 12 of IEC 60870-2-1: 1995 Level: 4</td></tr><tr><td>4.</td><td>Fast transient bursts</td><td>Yes</td><td>Yes</td><td>Yes</td><td>N/A</td><td></td></tr><tr><td>5.</td><td>Damped oscillatory waves</td><td>Yes</td><td>Yes</td><td>Yes</td><td>Yes</td><td></td></tr><tr><td>6.</td><td>10/700 μs surges</td><td>N/A</td><td>N/A</td><td>N/A</td><td>Yes</td><td></td></tr><tr><td>7.</td><td>Electrostatic Discharge</td><td colspan="4">Yes</td><td>Table 12 of IEC 60870-2-1: 1995 Level: 4</td></tr><tr><td>8.</td><td>Power frequency magnetic field</td><td colspan="4">Yes</td><td>Table 14 of IEC 60870-2-1: 1995 Level: 4</td></tr><tr><td>9.</td><td>Damped oscillatory magnetic field</td><td colspan="4">Yes</td><td></td></tr></table>	Table 4-4: Recommended Immunity Tests							S. No.	Immunity Test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Parameters	1.	Voltage Fluctuations	Yes	Yes	N/A	N/A	Table 11 of IEC 60870-2-1: 1995 Level: 1	2.	Voltage dips and Interruptions	Yes	Yes	N/A	N/A		3.	1.2/50 - 8/20 μs surges	Yes	Yes	N/A	N/A	Table 12 of IEC 60870-2-1: 1995 Level: 4	4.	Fast transient bursts	Yes	Yes	Yes	N/A		5.	Damped oscillatory waves	Yes	Yes	Yes	Yes		6.	10/700 μs surges	N/A	N/A	N/A	Yes		7.	Electrostatic Discharge	Yes				Table 12 of IEC 60870-2-1: 1995 Level: 4	8.	Power frequency magnetic field	Yes				Table 14 of IEC 60870-2-1: 1995 Level: 4	9.	Damped oscillatory magnetic field	Yes				
	Table 4-4: Recommended Immunity Tests																																																																													
	S. No.	Immunity Test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Parameters																																																																							
1.	Voltage Fluctuations	Yes	Yes	N/A	N/A	Table 11 of IEC 60870-2-1: 1995 Level: 1																																																																								
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CLAUSE NO.	TECHNICAL REQUIREMENTS						
2.1.3	Table 4-4: Recommended Immunity Tests						
	S. No.	Immunity Test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Parameters
	10	Radiated electromagnetic field	Yes				Table 15 of IEC 60870-2-1: 1995 Level: 4
	11	Power Frequency voltage on control and signal lines	N/A	N/A	Yes	Yes	IEC 61000-4-16: 2002-07 Level:4
	12	DC voltage on control and signal lines	N/A	N/A	Yes	N/A	IEC 61000-4-16:2002-07 Level:4
	(b) Emission Tests						
	The list of Emission tests is specified below in Table 4-5						
	Table 4-5: Recommended Emission Tests						
	S. No.	Immunity Test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Parameters
	1.	LF disturbance voltages CCITT recommendation P.53	N/A	Yes	N/A	N/A	Table 17 of IEC 60870-2-1: 1995 Class: B
2.	RF disturbance voltages CISPR 22	Yes	Yes	N/A	N/A		
3.	RF disturbance currents CISPR 22	N/A	N/A	N/A	Yes		
4.	RF radiated fields CISPR 22	Yes					
(c) Insulation Withstand Voltages							
As per section 6 of IEC 870-2-1. Recommended class: VW1 of Table 18.							
Mechanical Tests							
(a) Mechanical Vibration Test							
The procedure for this test is described in IEC Publication 60068-2-6. The testing procedure shall be carried out in sequence 8.1 + 8.2.1 + 8.1 as described in document 60068-2-6.							
For the vibration response investigation (clause 8.1 of 60068-2-6), the test shall be carried out over a sweep cycle under the same conditions as for the endurance test (described later), but the vibration amplitude and the sweep rate may be decreased below these conditions so that the determination of the response characteristics can be obtained.							
The endurance test conditions are selected according to the vibration withstand requirements.							
Transportation tests shall be performed with the equipment packed according to the Contractor's specifications.							
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CLAUSE NO.	TECHNICAL REQUIREMENTS
	<p>(b) Shock Test The procedure of this test is defined in IEC Publication 60068-2-27 (each test) with a semi-sinusoidal shape (clause 3.1.1.2). The recommended severity shall be A = 294 m/s², D = 18 ms. Three shocks per axis per direction shall be applied to the equipment packed according to the Contractor's specifications.</p> <p>Or Free Fall Test</p> <p>This test could be performed as an alternative to the shock or Bump test. The procedure is defined in IEC publication 60068-2-32. The equipment shall be packed according to the Contractor's specifications. The drop height shall be defined in accordance with IEC 68-2-32. The surface of the packing case which comes into contact with the ground is the surface on which the packing case normally rests; if the packing does not have any features (inscription, special shape, etc.) identifying this surface, the test is carried out successively on all the surfaces of the packing.</p> <p>Or Bump Test</p> <p>This test could be performed as an alternative to Shock test or Free Fall test. The procedure is defined in IEC 60068-2-29.</p> <p>Hands-on training shall be provided to O&M personnel at site.</p> <p>Optical Fibre & Approach Cable Parameters</p> <p>1. Required Optical Fibre Characteristics</p> <p>The optical fibre to be provided should have following characteristics:</p> <p>1.1 Physical Characteristic</p> <p>Dual-Window Single mode (DWSM), G.652D optical fibres shall be provided in the fibre optic cables. DWSM optical fibres shall meet the requirements defined in Table 1-1(a):</p> <p>1.1.1 Attenuation</p> <p>The attenuation coefficient for wavelengths between 1525 nm and 1575 nm shall not exceed the attenuation coefficient at 1550 nm by more than 0.05 dB/km. The attenuation coefficient between 1285 nm and 1330 nm shall not exceed the attenuation coefficient at 1310 nm by more than 0.05 dB/km. The attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities more than 0.10 dB. The fibre attenuation characteristics specified in table 1-1 (a) shall be "guaranteed" fibre attenuation of any & every fibre reel.</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
	Table 1-1(a) DWSM Optical Fibre Characteristics				
	Fibre Description:		Dual-Window Single-Mode		
	Mode Field Diameter @ 1310nm:		8.6 to 9.5 μm (± 0.6μm)		
	Cladding Diameter:		125.0 μm ± 1 μm		
	Mode field concentricity error		≤ 0.6μm		
	Cladding non-circularity		≤ 1%		
	Cable Cut-off Wavelength λ _{cc}		≤ 1260 nm		
	1550 nm loss performance		As per G.652 D		
	Proof Test Level		≥ 0.69 Gpa		
	Attenuation Coefficient:		@ 1310 nm ≤ 0.35 dB / km @ 1550 nm ≤ 0.21 dB / km		
	Chromatic Dispersion; Maximum:		18 ps/ (nm x km) @ 1550 nm 3.5 ps/ (nm x km) 1288-1339nm 5.3 ps/ (nm x km) 1271-1360nm 1300 to 1324nm		
	Zero Dispersion Wavelength:		0.092 ps/(nm²xkm) maximum		
	Zero Dispersion Slope:				
	Polarization mode dispersion coefficient		≤ 0.2 ps/km ^½		
	Temperature Dependence:		Induced attenuation ≤ 0.05 dB (-60°C to +85°C)		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	Bend Performance:		<div>@ 1310 nm (75±2 mm dia Mandrel), 100 turns; Attenuation Rise ≤ 0.05 dB/km</div> <div>@ 1550 nm (75±2 mm dia Mandrel), 100 turns. Attenuation Rise ≤ 0.10 dB/km</div> <div>@ 1550 nm (32±0.5 mm dia Mandrel, 1 turn. Attenuation Rise ≤ 0.50 dB/km</div>
	<div><div>2</div><div>Fibre Optic Approach Cables</div><div>A fibre optic approach cable is defined as the Armoured underground fibre optic cable required to connect Overhead Fibre Optic Cable (OPGW) between the final in line splice enclosure on the gantry / tower forming the termination of the fibre cable on the power line and the Fibre Optic Distribution Panel (FODP) installed within the building.</div><div><div>2.1.</div><div>Basic Construction</div><div>The cable shall be suitable for direct burial, laying in trenches & PVC/Hume ducts, laying under false flooring and on indoor or outdoor cable raceways.</div></div><div><div>2.2</div><div>Jacket Construction & Material</div><div>The Approach Cable shall be a UV resistant, rodent proof, armoured cable with metallic type of armouring. The outer cable jacket for approach cable shall consist of carbon black polyethylene resin to prevent damage from exposure to ultra-violet light, weathering, and high levels of pollution. The jacket shall conform to ASTM D1248 for density.</div></div><div><div>2.3</div><div>Optical, Electrical and Mechanical Requirements</div><div>Approach cable shall contain fibres with identical optical/ physical characteristics as those in the OPGW cables. The cable core shall comprise of tensile strength member(s), fibre support/bedding structure, core wrap/bedding, and an overall impervious jacket.</div></div></div>		
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SUB-SECTION-B – 14

NOT USED

SUB-SECTION-B – 15

ELECTRICAL HOIST, CRANE AND ELEVATOR

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	<div>ELECTRICAL HOIST, CRANE AND ELEVATOR</div>			
1.00.00	<div>CODES AND STANDARDS</div>			
1.01.00	<div>All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the standards/ codes as applicable.</div>			
2.00.00	<div><div>Electric motor:</div><div>The driving motors shall conform to IEC 60034 and suitable for the Variable Voltage Variable Frequency (VVVF) application. All motors shall be squirrel cage induction type, suitable for operation at 415V (+/- 10% variation) , 3 phase, 3 wire, 50HZ (+3% to -5% variation) supply. Motors shall be provided with thermal class 155(F) or better insulation.</div></div>			
3.00.00	<div><div>CAR ELECTRICAL ACCESSORIES</div><div>The following accessories shall be provided:</div><div><div>a. LED light fittings for illumination level of 100 lux on car floor.</div><div>b. Portable light and alarm bell with battery and charger ventilation fan with control.</div><div>c. Car control station with position indicator inside the car and at landing platforms (both visual and audio).</div><div>d. Emergency stop switch.</div><div>e. 5/15A, 3 pin plug socket with switch on top of lift car.</div><div>f. Hand free speaker telephone set connected to plant network.</div><div>g. AUTOMATIC RESCUE DEVICE (ARD)- (BATTERY DRIVE) :</div><div>Contractor to provide a modern Advanced electronic drive system of “RESCUING Passenger Trapped in an ELEVATOR”.</div><div>h. EMERGENCY SAFETY DEVICES:</div><div>The lift shall be provided with safety Device attached to the lift car frame and placed beneath the car. The safety device shall be capable of stopping and sustaining the lift car up at governor tripping speed with full rated load in car.</div></div></div>			
4.00.00	<div><div>OPERATIONAL REQUIRMENTS:</div><div>a. Contractor shall provide car operating panel with luminous buttons, car position indication in car (both visual and audio) combined with direction arrows, overload warning indicator, battery operated alarm bell and emergency light and fan & hands free speaker telephone set with suitable battery, charger & controls.</div></div>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<div>b. Contractor shall provide emergency indicator to indicate the location of elevator in case of elevator being stuck up between the floors through automatic flashers (both audio & visual).</div> <div>c. Contractor shall provide electronic door detector (Infra-red curtain type).</div> <div>d. Digital hall position indicator at all floors, tell lights at all floors shall also be provided by the Contractor.</div> <div>e. For facilitating the movement of visually & hearing-impaired persons, hall lantern and car arrival chimes shall be provided</div> <div>f. All fixtures shall be in stainless steel face plates.</div> <div>g. Push buttons shall be fixed in the car for holding the doors open for any length of the time required.</div> <div>h. All other safety/protection/operation interlocks as required by IS:14665 (latest edition).</div>			
4.00.00	POWER SUPPLY: Each elevator shall be provided with a separate three phase, three wire 415V feeder of adequate rating.			
5.00.00	Controls: The controls shall be Variable Voltage and Variable frequency type and shall provide smooth and constant acceleration and retardation under all conditions of operation. Suitable control panel shall be provided in the machine room.			
6.00.00	Cables and wiring: All the cables except trailing cables shall be as per IS:1554-1 or IS-7098-I. The PVC outer sheath of these cables shall be flame retardant, low smoke (FRLS) type with the following FRLS properties. <div>a) Oxygen index of min. 29 (as per IS:10810 Part-58)</div> <div>b) Acid gas emission of max. 20% (as per IEC-754-I).</div> <div>c) Smoke density rating shall not be more than 60% (as per ASTM-D-2843).</div> The circular trailing cables shall be either in accordance with IS 4289 Part-I (Elastomer insulated) or IS-4289 Part-II (PVC insulated). The flat type of trailing cables if offered shall be in accordance with IEC-60227-6.			
7.00.00	Earthing: All wiring / cabling between the equipment's in the lift machine room and that between the machine room and equipment's in the lift well and at the landings shall be wired in HDPE conduits/ galvanized steel conduits to be supplied by the contractor. Alternatively armored cables may be used. The elevator, EOT and crane structures and all Electrical equipment, including metal conduits shall be effectively earthed with the earth conductors provided in the machine room as per IS: 3043.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>	
8.00.00	EOT/ Hoist and Crane Motors: Three phase Squirrel Cage Induction motors to be operated from VFD system shall be suitable for speed range and torque without exceeding temperature rise limits as specified elsewhere in this specification. VFD shall be used to drive three (3) phase squirrel cage inverter duty Induction motor with VPI insulation (Resin poor) suitable for VFD application. These motors shall be provided with insulated bearing on at least one side for motor frame size above 250 frame. However, contractor's proven practice with respect to use of insulated bearing in VFD driven motor may be accepted subject to Employer's approval. Motors shall conform to latest revision of IS 15999, IS 3177 and motor subsection of this specification.			
8.01.00	Controls: <div>a) Speed control of EOT crane shall be through Variable Voltage Variable Frequency System (VVVF) with minimum 6 (six) pulse design.</div> <div>b) Necessary input & output devices to be provided to reduce harmonics, as per IEEE519, at supply side of the drive at the switchgear.</div> <div>c) All necessary protections e.g., Input Phase Loss, Earth Fault, Over Voltage, Output Short Circuit, Load Loss, Input Transient Protection, overload etc to be provided.</div> <div>d) VVVF system shall be capable of generating suitable starting torque (up to 400% typical) with / without encoder, however starting current shall not exceed 150% at rated torque.</div> <div>e) VVVF system shall be capable to withstand up to 50 deg C ambient temp without derating.</div> <div>f) Provision for controlling the motion from operator cabin (in case of Turbine Hall EOT crane) as well as remote control shall be available.</div> <div>g) Squirrel cage Induction motor with VPI insulation shall be provided With VVVF system.</div> <div>h) Mechanical locking arrangement shall be provided by bidder for power supply change over switch for EOT</div> <div>i) VFD controller for Hoist shall be positioned by bidder at operating floor</div> <div>j) EPB for GAS ENGINE HALL EOT CRANE shall be provided by bidder at operating floor</div> <div>k) Master controller - Desk type having following features.<div>I. Five speed control points in each direction of hoist motion.</div><div>II. Four speed control points in each direction of bridge and trolley motion.</div><div>III.Release of operator's hand from the controls shall stop motion and set brakes automatically.</div></div> <div>l) Protective Panel: Shall be Provided with isolating switch, power contactor control and indication to switch ON/OFF power to starter panels, control and lighting transformer.</div> <div>m) Starter Panel:<div>I. Separate VVVF system panels to be provided for CT, LT and hoist motion (main and auxiliary drives).</div><div>II. Contactors shall be of AC 4 duty for reversing application and AC 3 duty for non-reversing application</div><div>III. Switches shall be AC 23 for motor application and AC 22 for other application.</div><div>IV. Fuses: HRC & SEMICONDUCTOR FUSES for VFD Input Side.</div><div>V. Overload relay shall be of Temperature compensated, bimetallic with single phasing preventor.</div></div>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO.: CS-6401-001-2	SUB-SECTION-B-15 ELECTRICAL HOIST, CRANE AND ELEVATOR	Page 3 of 5


CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
8.02.00	<p>n) Panel shall be fabricated out of 1.6 mm thick rolled sheet steel. IP 52 degree of protection. Paint shade shall be RAL 9002 for front & rear and RAL 5012 for side covers. Space heaters to be provided.</p> <p>Radio remote Control of EOT Crane:</p> <p>a) The equipment should have facility to control EOT crane by radio frequency based wireless remote unit. The equipment should be supplied with transmitter unit, receiver unit, encoder unit, decoder unit, interface panel, coupling system, battery unit and any other control gear if required.</p> <p>b) The equipment should be based upon the microprocessor based digital technology with almost nil hard wiring.</p> <p>c) The remote unit should communicate up to the distance of approximately 100 meters.</p> <p>d) The system has to integrate with the control system of crane, which operates at 110 V AC, Single phase.</p> <p>e) The remote unit should have transmitter which can be mounted on shoulder by suitable belt. Main controls can be of single joystick movement or double joystick movement type stepped control with spring return. The Micro control should be toggle switch type or push control type.</p> <p>f) Frequency allotment for radio remote unit from Govt. of India, Dept. of Telecommunication or any other agency shall be the responsibility of supplier.</p> <p>g) The transmitter and receiver unit should have its own frequency and address code with each system having its own security code so that one particular set becomes unique and there is no interference from any other remote unit device. A microprocessor should check all security codes. The processor should have its own watchdog circuit. The receiver FM band should be sufficiently narrow to allow only passing of desired frequency and valid command. Any error should shut down the system immediately.</p> <p>h) The remote unit should have safety key to prevent any unauthorized operation. All the crane operations should stop at once the communication breakdown occurs.</p> <p>i) On local unit (receiver side), the system should be provided with one selector switch so that EOT crane can be operated either from Operator cabin or radio remote unit.</p> <p>j) In case tandem operation is envisaged, a suitable selector switch shall be provided in the cabin for selection of Tandem/normal operation.</p> <p>k) The receiver unit along with I/O interface unit should be able to bear the vibrations and shocks encountered in normal usage of EOT crane.</p> <p>l) The system should have very fast response time.</p>			
8.03.00	<p>Power Supply:</p> <p>(a) <u>Incoming numbers:</u></p>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO.: CS-6401-001-2		SUB-SECTION-B-15 ELECTRICAL HOIST, CRANE AND ELEVATOR
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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	<div>I. <u>Engine hall EOT crane</u>: Contractor shall provide two (2) numbers 415 volts, 3 phase, 3 wire supply at operating floor near A-row column at centre of bay length with a changeover switch in enclosure.</div> <div>(b) <u>Down shop Lead (DSL)</u>:<div>I. DSL Shall conform to IS: 282 and shall be sized to Cater to all cranes working simultaneously with 40% cyclic duration factor for load. II. Limit voltage drop at motor terminals within 2% at extreme positions. III. DSL shall be sized with a margin of 10% overload requirement. IV. Protective cover over DSL to be provided. V. Two (2) no. isolating switches in enclosure shall be provided at extreme ends of operating floor for disconnecting supply to DSL while maintaining the crane. DSL shall be located on 'A' -row side for Turbine Hall EOT crane.</div></div> <div>(c) <u>Transformers</u> Shall be of Dry type, with insulation class B or better. Following transformers shall be provided.<div><div>(i)</div><div>Control Transformers</div><div>:</div><div>2x100%, 415V / 110V</div></div><div><div>(ii)</div><div>Lighting Transformers</div><div>:</div><div>One 415V/240V</div></div><div><div>(iii)</div><div>Hand lamp</div><div>:</div><div>One 415V/24V</div></div></div>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO.: CS-6401-001-2	SUB-SECTION-B-15 ELECTRICAL HOIST, CRANE AND ELEVATOR	Page 5 of 5

SUB-SECTION-B – 16

BATTERY CHARGER

CLAUSE NO.	<div style="text-align: center;">TECHNICAL REQUIREMENTS</div> <div style="text-align: right;">  </div>		
1.00.00	BATTERY CHARGER CODES AND STANDARDS		
	ANSI-C 37.90a	Guide for surge withstand capability tests	
	IS:5	Colours for ready mix paints.	
	IS : 694	PVC Insulated Cable for working voltages upto and including 1100 V.	
	IS : 1248	Specification for Direct acting indicating analogue electrical measuring instruments.	
	IS:13947 Part-1	Degree of protection provided by enclosures for low voltage switch gear and control gear.	
	IS : 13947	Specification for low voltage switch gear and control gear	
	IS : 3231	Electrical relays for power system protection.	
	IS : 3842	Application guide for Electrical relays for AC System	
	IS : 3895	Mono-crystalline semi-conductor Rectifier Cells and Stacks	
	IS : 4540	Mono crystalline semi-conductor Rectifier assemblies and equipment.	
	IS:6005	Code of practice for phosphating of Iron and Steel.	
	IS:6619	Safety Code for Semi-conductor Rectifier Equipment.	
	IS:11171/ IS:2026	Rectifier Transformer	
	IS:6875	Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto 1000 V AC or 1200 V DC.	
	IS : 9000	Basic environmental testing procedures for electronic and electrical items.	
	IS:13703	Low voltage fuses for voltages not exceeding 1000 V AC or 1500 V DC.	
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC NO: CS-6401-001-2	<div style="text-align: center;">SUB-SECTION B-16 BATTERY CHARGER</div> <div style="text-align: center;">PAGE 1 OF 5</div>

CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.00.00	EEUA-45D	Performance requirements for electrical Alarm Annunciation System		
		Indian Electricity Rules		
		Indian Electricity Act.		
	Technical Parameters			
	1.	Mode of Charging	Float cum Boost Charger (Automatic and Manual Mode)	
	2.	Charger Ambient Temp	50 deg C	
	3.	Voltage Rating	110V	
	4.	Trickle Charging	1.4-1.42V per cell(Ni-Cd) 2.25V per cell(Lead-Acid)	
	5.	Boost Charging Mode	1.53-1.7V per cell(Ni-Cd) 2.3-2.7 V per cell(Lead-Acid)	
	6.	Automatic Voltage regulator (rickle Mode)	± 1% at 415 ± 10% and 0-100% Load, Automatic Controlled feedback-Closed Loop	
	a.	Load Limiter current setting Range(Trickle Mode)	80%-100%	
	b.	% Stabilization of the output DC voltage	1% for ±10% input supply variation and 0-100% DC load	
	c.	Voltage Range and Stabilizing time for momentary load changes from 20%-100% and Vice versa	+/- 6 % and less than 2 secs	
	d.	Stabilizing time	Less than 15 secs	
7.	Current setting range in Boost Charging Mode	50-100% of rated output current		
8.	Voltage limit setting range in Boost Charging Mode	Boost charging limit		
9.	Rectifier Type	Full wave bridge Type		
10.	Ripple Content	1% Peak-Peak at 0-100% of DC Load		
11.	Rectifier Transformer	Dry and Air Cooled(AN) type Class-F Insulation with temp rise limited to Class-B at 50deg C Ambient		
12.	Charger Enclosure	IP42		
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC NO: CS-6401-001-2	SUB-SECTION B-16 BATTERY CHARGER	PAGE 2 OF 5


CLAUSE NO.	<div style="text-align: right;">  </div> TECHNICAL REQUIREMENTS		
3.00.00	<p>EQUIPMENT DESCRIPTION</p> <p>(a.) The Battery Chargers as well as their automatic regulators shall be of static type. Battery chargers shall be capable of continuous operation at the respective rated load in Trickle mode i.e. Trickle charging the associated DC lead-acid Batteries while supplying the D.C. loads.</p> <p>(b.) All Battery Chargers shall have provision to receive two input supplies along with suitable automatic changeover between the sources. Battery Chargers shall have a selector switch for selecting the battery charging mode i.e. Trickle or Boost charging and automatic/manual mode.</p> <p>(c.) The chargers shall be capable of limiting the voltage or current in case DC load current exceeds the load limiter setting of the Charger. The load limiter characteristic shall be such that any sustained overload or short circuit in DC system shall neither damage the Charger nor shall it cause blowing of any of the charger fuses. The DC System shall be ungrounded and float with respect to the ground potential when healthy. An earth fault relay shall be provided by the Employer in the DC distribution board for remote annunciation.</p> <p>(d.) Digital indicating instruments with built in communication port for remote data transfer shall be provided for all chargers. Ammeters & voltmeters shall have 4-20mA analog output for current and voltage respectively.</p> <p>(e.) Blocking diode shall be provided in the output circuit of each Charger to prevent current flow from the D.C. Battery into the Charger.</p> <p>(f.) Digital Outputs shall be configured for connection to the DC health monitoring system for real-time charger status updation.</p> <p>(g.) For all Power Components (contactors, MCCBs, fuses, relays, metering instruments etc) and constructional details (sheet thickness, paint shade, gland plate thickness etc) of charger enclosure and internal wiring details, refer relevant clauses in LT switchgear specifications (as applicable).</p> <p>(h.) Live busbars, parts etc shall not be accessible while the charger is in energized condition. Suitable safety interlocks to be ensured.</p>		
3.1.00	<p>Rectifier Assembly</p> <p>The rectifier cells shall be provided with their own heat dissipation arrangement along with forced air cooling for above 400A rating chargers and fan shall be temperature controlled with 100% standby redundancy. The rectifier shall utilize diodes/thyristors and heat sinks</p>		
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC NO: CS-6401-001-2	SUB-SECTION B-16 BATTERY CHARGER	PAGE 3 OF 5


CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>												
3.2.00	<p>rated to carry 200% of the load current continuously and the temperature of the heat sink shall not be permitted to exceed 85°C absolute duly considering the maximum charger panel inside temperature.</p> <p>Annunciation System</p> <p>Visual indications through indicating lamps/LEDs or annunciation fascia shall be provided in all Chargers for A.C. supply failure, Rectifier fuse failure, Surge circuit fuse failure, Filter fuse failure, Load limiter operated, Charger trip, Battery on Boost .</p> <p>Potential free NO contacts of all above these conditions signals shall be provided for following remote alarms in the Employer's Unit Control Board:</p> <div><div>(a)</div><div>Battery on Boost</div></div> <div><div>(b)</div><div>Charger trouble (this being a group alarm initiated by any of the faults other than 'Battery on Boost')</div></div>															
2.00.00	<p>TESTS</p> <p>For conductance/report submission/validity of type tests, refer Sub Section-II B, Section-VI, Part A of technical specifications.</p>															
2.01.01	<p>-LIST OF TYPE TESTS</p> <div><div>1.</div><div>The contractor shall furnish the following type tests reports for each rating of the equipment to be supplied under this contract.</div><table><tr><td>a)</td><td>Complete physical examination</td></tr><tr><td>b)</td><td>Temperature rise test at full load. (For chargers of up to 400A rating, Temperature rise test report for rectifier assembly at 200% of full load shall also be submitted.)</td></tr><tr><td>c)</td><td>Insulation resistance test.</td></tr><tr><td>d)</td><td>High voltage (power frequency) test on power and control circuits except low voltage electronic circuits.</td></tr><tr><td>e)</td><td>Automatic voltage regulator operation test at specified A.C. supply variations at no load, half load and full load.</td></tr><tr><td>f)</td><td>Load limiter operation test</td></tr></table></div>				a)	Complete physical examination	b)	Temperature rise test at full load. (For chargers of up to 400A rating, Temperature rise test report for rectifier assembly at 200% of full load shall also be submitted.)	c)	Insulation resistance test.	d)	High voltage (power frequency) test on power and control circuits except low voltage electronic circuits.	e)	Automatic voltage regulator operation test at specified A.C. supply variations at no load, half load and full load.	f)	Load limiter operation test
a)	Complete physical examination															
b)	Temperature rise test at full load. (For chargers of up to 400A rating, Temperature rise test report for rectifier assembly at 200% of full load shall also be submitted.)															
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f)	Load limiter operation test															
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC NO: CS-6401-001-2	SUB-SECTION B-16 BATTERY CHARGER	PAGE 4 OF 5												


CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
3.00.00		<div>g) Efficiency and power factor measurement.</div>		
		<div>h) Surge withstand capability test at the following points of the Charger:</div> <div><div>i) Across each A.C. input phase</div><div>ii) Across AC input line to ground.</div><div>iii) Across D.C. output terminals.</div><div>iv) Across each D.C. output terminal to ground</div></div> <div>The Charger shall not exhibit any component damage and there shall be no change in performance as per (g) and (h).</div>		
		<div>i) Environmental Tests</div> <div>Steady state performance tests (f) and (g) shall be carried out before and after each of the following tests.</div> <div><div>i) Soak Test</div><div>ii) Degree of protection test.</div></div>		
		<div>2. Dynamic response test and Temperature rise test at full load shall be carried out on each charger before dispatch at manufacturer's works.</div>		
3.01.01	<div>COMMISSIONING TESTS</div> <div>Bidder shall submit commissioning test procedure including details of all commissioning checks before commissioning the system at site.</div>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-B BID DOC NO: CS-6401-001-2		SUB-SECTION B-16 BATTERY CHARGER
				PAGE 5 OF 5


SUB-SECTION-B – 17


SWITCHYARD ELECTRICAL


Clause No.	TECHNICAL REQUIREMENTS			
	CHAPTER: SWITCHYARD ELECTRICAL			
1.00.00	SCOPE AND GENERAL INFORMATION			
1.01.00	The Voltage level for the Switchyard shall be as per Single Line Diagram. In addition to the detailed scope and other requirements specified in Part-A, the intent of the specifications for various electrical equipments shall also cover the following scope:			
1.01.01	Contractor shall be responsible for design and engineering of overall system/station, and all elements, systems, sub-systems, facilities, equipments, material, etc. The Contractor shall submit design calculations, drawings, codes, codes of practices, construction drawings, etc. for Employer's approval.			
1.01.02	The basic design shall include, but not limited to, the following:			
	<div>a) Development of general arrangement.</div> <div>b) Development of detailed layout (plan & section/elevation) drawings.</div> <div>c) Development of single line diagram with parameters of equipment and details of protection.</div> <div>d) Protection and control philosophy and selection of protection, control and annunciation schemes.</div> <div>e) Development of interlocking schemes.</div> <div>f) Development of switchyard structure loading details.</div> <div>g) Development of earthing system.</div> <div>h) Development of direct stroke lightning protection system.</div> <div>i) Insulation coordination of the EHV equipment.</div> <div>j) Calculation of static and dynamic force load, and selection of spacer spans and equipment terminal loading.</div> <div>k) Development of clearance diagrams.</div> <div>l) Lighting design, Lux level calculation and conduit wiring diagram.</div> <div>m) Development of power & control cable laying and termination schedules.</div> <div>n) Relay setting calculations.</div> <div>o) Development of erection key diagram with bill of material.</div> <div>p) Foundation design and construction drawings.</div> <div>q) Development of cable trench layout and sections and construction drawings.</div>			
1.01.03	Contractor shall furnish detailed drawings for the various equipments covered in their scope. design calculations and construction drawings for all civil works, schematics, schedules, panel wiring diagrams, general arrangement drawings, schedules, interconnection schemes, cable schedules, interconnection schedules. etc for employer's approval. Contractor shall also furnish the recommended relay settings to be adopted			
1.01.04	Exposed live parts shall be placed high enough above ground to meet the requirements of Indian Electricity Rules and other statutory codes. All responsibilities regarding co-ordination with Electrical Inspection Agencies and			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI ,PART B BID DOC NO: CS-6401-001-2		B-17: SWITCHYARD
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Clause No.	TECHNICAL REQUIREMENTS		
	obtaining clearance certificate from them rests with the Contractor. The necessary fees for such clearances shall be borne by the Owner.		
1.01.05	All equipment shall be supplied with suitable terminal connectors. The terminal connector shall be well coordinated with the rating/type/size of conductor and equipment to be connected. The type of terminal clamps would be finalised by the Contractor in consultation with Employer based on layout requirement. The terminal pads shall be capable of taking the required conductor span under normal, short circuit and meteorological conditions, without effecting the performance of the equipment.		
1.01.06	NOT USED		
1.01.07	NOT USED		
1.01.08	<p>The minimum sizing criteria of the control room and GIS building shall be as given below:</p> <p>i)The GIS buildings shall be adequately designed so as have a passage of minimum 2.0 m on either side and adequate overhead clearance for the movement of equipments without any obstruction, from the top of the GIS equipment to EOT Crane. The GIS switchyards shall have a Separate suitable Control Room Building with provision of Switchgear room, Battery room, charger room, office, cable vault, SAS room, Lab room, CRP Panel room, conference room, toilet etc.. The GIS & control room building is to be designed keeping future provision for extension if any as shown in the Single line diagram. GIS buildings shall have adequate provision (at least 4.0mt) for maintenance bay shall be provided one side of GIS building considering the future provision for GIS extension.</p> <p>ii)Maintenance room (as a part of GIS building) shall be constructed for carrying out repair works / small part assembly, storage of material, test equipment and tools and tackles to be stored separately from GIS hall in this room.</p> <p>iii) GIS building shall have with provision of Toilet room etc..</p>		
1.01.09	The EOT crane to be provided inside the GIS buildings and shall be suitable to move heaviest part for maintenance. The minimum capacity of EOT crane shall be, 5T for 132kV GIS buildings.		
1.01.10	The Contractor shall cooperate in all respects and exchange the necessary technical data/ drawings with other agencies and Employer's other Contractors under intimation to Employer to ensure proper coordination and completion of work in time.		
1.01.11	NOT USED		
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI ,PART B BID DOC NO: CS-6401-001-2	B-17: SWITCHYARD
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Clause No.	TECHNICAL REQUIREMENTS			
1.01.12	NOT USED			
1.01.13	Post insulators shall be provided at line entry and near transformers and other jumpers so as to avoid mechanical forces on the LA's and Bushings etc.			
1.01.14	Necessary fire wall shall be provided between single phases of transformers. The fire wall height shall be 600mm above transformer bushing.			
1.01. 15	The pit size of transformers shall be designed for minimum 1000mm beyond the physical dimension of the reactor/transformer.			
1.01. 16	NOT USED			
1.01.17	The switchyard shall be provided with peripheral roads and roads for maintenance/approach for GIS equipment's, Cables, Transformers ,Tie & service Transformers, major AIS equipment's etc for maintenance purpose. The specification for Roads (RCC / B.T) some where else specified in the Civil specification.			
1.01.18	NOT USED			
1.01.19	Voltage drop for sizing of power cables shall not be more than 6%.			
1.01.20	The illumination level for AIS shall be 20 lux in general and minimum 50lux on equipment boxes. No lighting fixture shall be mounted on gantries, they shall be mounted on Structured Lightning Cum Lighting Masts or Structured Lighting Masts / towers only . For Approach / work roads , Lighting pole to be used . Specification of lighting is provided elsewhere in the specification. Detailed specification covered in Section -VI, Part-B, B-11(Lighting).			
1.01.21	Contractor shall provide panel mounted automatic start / stop type centrifugal self priming pump for sump pit to drain the water in approximately one (1) hour. The contractor shall also provide suitable pedestal/ foundation for this pump. The pump shall be complete with all necessary fittings such as NRV, inlet & outlet pipes of suitable length and dia. The out door cable trenches shall be connected to common sump pit with necessary slope shall be maintained. In side GIS building , Switchyard MCC room , control room etc for cable trenches , panel mounted automatic start / stop type centrifugal self-priming pump shall be provided to drain the water in approximately one (1) hour.			
1.01.22	NOT USED			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI ,PART B BID DOC NO: CS-6401-001-2	B-17: SWITCHYARD	PAGE 3 of 78


Clause No.	TECHNICAL REQUIREMENTS		
1.01.23	75mm thick base layer of M5 grade PCC shall be provided over the prepared sub grade in the entire area of the Switchyard inside the fence excluding foundations, roads, drains, cable trenches as per detailed engineering drawing. In switchyard area earth resistance measurement points shall be marked in the layout where the PCC shall not be provided. For easy drainage of water, adequate slope is to be provided from the ridge to the nearest drain. A final layer of minimum 75mm thickness of stone aggregate of 40mm nominal size shall be spread uniformly over PCC layer. In Switchyard before laying of PCC layer, the subgrade shall be properly compacted, and the top layer of the soil shall be treated for anti-weed considering the type of weeds found in the vicinity.		
1.01.24	Adequate AC & Ventilation of Control room building and Ventilation of GIS Building is to be provided by the contractor. Specification of AC & Ventilation is specified elsewhere. Specification of AC & Ventilation is specified elsewhere in the specification (Part-B Mechanical) .		
1.01.25	The cable trenches from control room to switchyard shall be designed to cater as required for bays indicated in SLD. The contractor shall construct the common sections suitably of appropriate sizes upto common points so that the same can be extended in future.		
1.01.26	one no(1no) suitable industrial socket and suitable power cable for oil filtration equipment for Transformers shall be provided.		
1.01.27	The scope also include cable trenches , cable trays & supports, accessories , Roads , drains & its interconnection to storm water drain , fencing with gate required for present scope of bays.		
1.01.28	Contractor shall make earth resistivity measurements at site (based on four electrode method) and design the earthing grid as per IEEE: 80 (Latest edition) and Gravel filling of switchyard . Earthing of all switchyard equipment's and its connection to earthing grid. Also connection of switchyard earthing grid with main plant earthing grid is in bidders scope . Earth pit as per IS-3043 as required.		
1.01.29	Supply & laying of power, control cables , Screen cable, Fibre optic cable and cabling between Contractor supplied equipment and Owner supplied equipment required. etc , from owner feeders , panels and from present scope of panels to existing panels to complete the system is in the scope of Bidder.		
1.01.30	Lighting, earthing , lightning protection , cabling including all civil works etc of complete switchyard of - However any items though not specifically mentioned but which are required to make the switchyard complete in all respects for its safe, efficient, reliable and trouble free operation shall be supplied and erected by the Contractor, unless they are specifically excluded in the text of exclusions given in the specification		
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI ,PART B BID DOC NO: CS-6401-001-2	B-17: SWITCHYARD PAGE 4 of 78

Clause No.	TECHNICAL REQUIREMENTS																					
1.02.00	CLEARANCES : The minimum clearances for 132kV AIS shall be as given below: <table><tr><th>Sl.no</th><th>Description</th><th>132KV</th></tr><tr><td>1</td><td>Phase to earth clearance</td><td>1300mm</td></tr><tr><td>2</td><td>Phase to phase clearance</td><td>1300mm</td></tr><tr><td>3</td><td>Section clearance</td><td>4000mm</td></tr><tr><td>4</td><td>Ground Clearance</td><td>4800mm</td></tr><tr><td>5</td><td>Height of Insulator bottom from Ground</td><td>Min.2550r</td></tr></table> The Contractor shall supply the structures suitable to meet the above clearances. The average limit of 10kV per meter and 500 micro tesla for electric and magnetic field respectively are to be met at a height of 1.8 meter from ground level. The Contractor shall furnish calculations.				Sl.no	Description	132KV	1	Phase to earth clearance	1300mm	2	Phase to phase clearance	1300mm	3	Section clearance	4000mm	4	Ground Clearance	4800mm	5	Height of Insulator bottom from Ground	Min.2550r
Sl.no	Description	132KV																				
1	Phase to earth clearance	1300mm																				
2	Phase to phase clearance	1300mm																				
3	Section clearance	4000mm																				
4	Ground Clearance	4800mm																				
5	Height of Insulator bottom from Ground	Min.2550r																				
1.03.00	EARTHING : For earthing 50x6 mm GS flat shall be used in all cabinets, MOM boxes, panels and balance all other earthing such as all equipments, towers, cable trenches etc shall be through 75x12mm GS Flat. The Switchyard earthing criteria is given in Annexure-II of this specification.																					
1.04.00	Not used																					
1.05.00	EQUIPMENT CONNECTOR RATING :The connectors and clamps shall be rated same as the connected equipment's																					
1.06.00	CIVIL DESIGN :The civil design criteria is given in Civil Chapter of Technical specification																					
1.07.00	CONTROL PHILOSOPHY :The switchyard control philosophy and protection system is described in chapter B-13 Substation Automation System of section-VI Part-B.																					
1.08.00	SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING SUPPLIED: The system is being designed to limit the power frequency over voltage of 1.4 p.u. and the switching surge over voltage to 1.9 p.u. All the equipment/materials covered																					
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Clause No.	TECHNICAL REQUIREMENTS																																																															
	in this specification shall perform all its function satisfactorily without undue strain, restrike etc. under such over voltage conditions.																																																															
1.09.00	SITE SUPERVISION OF EQUIPMENTS: The contractor shall ensure that, erection, testing and commissioning of, GIS, Circuit Breaker, Isolator, Instrument Transformer, Surge Arrestor, Substation Automation System & Protective relays is carried out, under the supervision of manufacturer of respective equipment.																																																															
1.10.00	Insulation Co-Ordination and Selection of Surge Arrestor:																																																															
1.10.01	The contractor shall be fully responsible for complete insulation co-ordination of switchyard. Contractor shall ensure that adequate protective margin is available. If surge arrestors at some more locations other than those indicated in the tender drawings are required to be provided, the same shall be deemed to be included in the offer.																																																															
1.11.00	SYSTEM PARAMETERS:																																																															
1.11.01	FOR GIS: <table border="1"><thead><tr><th>Sl.no</th><th>Description</th><th>Unit</th><th>132KV</th></tr></thead><tbody><tr><td>1</td><td>i)Highest System voltage)</td><td>kV rms</td><td>145</td></tr><tr><td></td><td>ii)Rated / Nominal system voltage</td><td>kVrms</td><td>132</td></tr><tr><td>2</td><td>Phase</td><td>No</td><td>3</td></tr><tr><td>3</td><td>Rated Frequency</td><td>Hz</td><td>50</td></tr><tr><td>4</td><td>Ambient Temperature</td><td>Deg,C</td><td>50</td></tr><tr><td>5</td><td>Specific Creepage Distance (Very Heavy)</td><td>mm/kV</td><td>31</td></tr><tr><td>6</td><td>Rated Fault current and duration</td><td>kA</td><td>40 kA,1sec</td></tr><tr><td>7</td><td>Min.Corona Extinction Voltage</td><td>kV rms</td><td>105</td></tr><tr><td>8</td><td>Min.Radio Interference Voltage(RIV) for frequency between 0.5 &2.0 Mhzμ</td><td>μ-volt</td><td>500(at 92kV rms)</td></tr><tr><td>9</td><td>Seismic accelaration</td><td>g</td><td>0.3</td></tr><tr><td>10</td><td>System neutral earthing</td><td></td><td>Effectively earthed</td></tr><tr><td>11</td><td>Auxiliary AC .supply(3 ph , 4wire, 50Hz)</td><td>V</td><td>415+-10%</td></tr><tr><td>12</td><td>Auxiliary DC .supply(2wire, grounded)</td><td>V</td><td>220+-10%</td></tr><tr><td>13)</td><td>Lightning Full wave impulse withstand voltage</td><td>kVp</td><td>±650</td></tr></tbody></table>				Sl.no	Description	Unit	132KV	1	i)Highest System voltage)	kV rms	145		ii)Rated / Nominal system voltage	kVrms	132	2	Phase	No	3	3	Rated Frequency	Hz	50	4	Ambient Temperature	Deg,C	50	5	Specific Creepage Distance (Very Heavy)	mm/kV	31	6	Rated Fault current and duration	kA	40 kA,1sec	7	Min.Corona Extinction Voltage	kV rms	105	8	Min.Radio Interference Voltage(RIV) for frequency between 0.5 &2.0 Mhzμ	μ-volt	500(at 92kV rms)	9	Seismic accelaration	g	0.3	10	System neutral earthing		Effectively earthed	11	Auxiliary AC .supply(3 ph , 4wire, 50Hz)	V	415+-10%	12	Auxiliary DC .supply(2wire, grounded)	V	220+-10%	13)	Lightning Full wave impulse withstand voltage	kVp	±650
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		1.2/50micro sec(ph to earth & between phases)				
	14)	Switching impulse voltage (250/2500µsec- Dry & wet (ph to earth)	kVp		NA	
	15	Power frequency withstand (for 1 min. rms.) to earth & between phases-Dry & wet	kV rms		wet-275	
	16	Rated dynamic with stand current	kAp		78.5	
	17	PD Level for GIS			<5pico coulomb	
	18	Min.Eelctromechnaicl strength of Insulators	KN		120	
	19	Main Busbar rating	A		As per SLD	
	20	GIS & AIS Equipment ratings	A		As per SLD	
	<p>Note: Bidder to consider above parameters for all the equipment's of GIS . For other Parameters bidder to refer respective chapter.</p>					
	1.12.00	TYPE TEST REQUIREMENTS:				
1.12.01	TYPE TEST REQUIREMENTS:					
	a)	All equipments to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification. The validity period of reports shall be as per CEA Guidelines for the validity period of Type test(s) conducted on Major Electrical Equipment in power Transmission-May2020 & with latest amendments from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client.				
	b)	However if contractor is not able to submit report of the type test(s) conducted as per CEA Guidelines for the validity period of Type test(s) conducted on Major Electrical equipment in power Transmission-May2020 & with latest amendments from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.				
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Clause No.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>																			
1.12.03	c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.																				
	Common requirements (For GIS):																				
	a) The Employer will have the right of getting any test of reasonable nature carried out on any component or completely assembled equipment at Contractor's premises or at site or in any other place in addition to the aforesaid type and routine tests, to satisfy that the materials/equipment comply with the specification.																				
	b) Failure of any equipment to meet the specified requirements of tests carried out at works or at site shall be sufficient cause for rejection of the equipment. Rejection of any equipment will not be held as a valid reason for delay in the completion of the works as per schedule. Contractor shall be responsible for removing all deficiencies, and supplying the equipment that meet the requirement.																				
	c) All equipments with their terminal connectors, control cabinets, main protective relays, energy meters etc as well as insulators, insulator strings with hardwares, clamps and connectors, marshalling boxes etc shall be subjected to routine and acceptance tests in accordance with the requirements stipulated under respective equipment sections. Charges for the same shall be deemed to be included in the equipment price.																				
	The following type tests (as applicable) are proposed to be conducted on a complete single pole assembly of one typical GIS switchgear bay module as per IEC 62271-203. The one Typical GIS switchgear bay module consists of equipment like Circuit breakers, Current transformers, Disconnectors / isolator, earth switches etc. of each type / rating.																				
	The offered GIS equipments shall confirm to the type tests as per IEC 62271-203. The list of the type tests shall be as follows:																				
	The components forming parts of the GIS which are covered by other standards shall comply with and shall be type tested according to those standards.																				
	<table><tr><th>Sl.No</th><th>List of Type tests as per IEC.</th></tr><tr><td>i)</td><td>Lightning impulse voltage dry tests.</td></tr><tr><td>ii)</td><td>Switching impulse voltage dry tests</td></tr><tr><td>iii)</td><td>Power frequency voltage dry tests.</td></tr><tr><td>iv)</td><td>Partial discharge tests</td></tr><tr><td>v)</td><td>Radio Interference Voltage test (as applicable)</td></tr><tr><td>vi)</td><td>Test to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.</td></tr><tr><td>vii)</td><td>Test to prove the ability of the main circuit and earthing circuit to carry the rated peak and the rated short time withstand current.</td></tr><tr><td>viii)</td><td>Test to verify the making and breaking capacity of the included switching</td></tr></table>	Sl.No	List of Type tests as per IEC.	i)	Lightning impulse voltage dry tests.	ii)	Switching impulse voltage dry tests	iii)	Power frequency voltage dry tests.	iv)	Partial discharge tests	v)	Radio Interference Voltage test (as applicable)	vi)	Test to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.	vii)	Test to prove the ability of the main circuit and earthing circuit to carry the rated peak and the rated short time withstand current.	viii)	Test to verify the making and breaking capacity of the included switching		
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Clause No.	TECHNICAL REQUIREMENTS		
		devices.	
	ix)	Test for satisfactory operation of the included switching devices	
	x)	Test to prove the strength of enclosures	
	xi)	Gas tightness test	
	xii)	Electromagnetic capability test (if applicable)	
	xiii)	Test on partitions	
	xiv)	Internal arc tests.	
	xv)	Mechanical operation tests.	
	xvi)	Test to prove the satisfactory operation at limit temperature	
	xvii)	Verification of degree of protection of auxiliary and control circuits	
	xviii)	Test to prove performance under thermal cycling and gas tightness test on gas barrier insulators	
	xix)	Capacitive Current switching test	
	c)	For surge arrestor and Bus VT following type tests are proposed to be conducted as per relevant IEC.	
		<u>Surge Arrestor (As per IEC 60099-4):</u>	
		a)Insulation with stand test on housing	b)Residual voltage test
		c)Long duratrion current impulse with stand test	d)pressure relief test (if applicable)
		e)operating duty test	f) Partial discharge test
		g) leakage test	
		<u>BUS VT (As per IEC 60044-2):</u>	
	a) Temparature rise test	b)Lightning impulse test	
	c) switching impulse test	d) Determination of errors	
	e) short circuit with stand capability	f)chopped lightning impulse test	
1.12.04	NOT USED		
1.13.00	CORONA AND RIV TESTS AND SEISMIC WITHSTAND TEST:		
	The corona and RIV tests shall confirm to the requirements as per Annexure A to this chapter. The seismic withstand test shall conform to requirements as per Annexure B to this section.		
	Annexure – A		
	CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST :		
1.0	General:		

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Clause No.	TECHNICAL REQUIREMENTS		
2.0	<p>Unless otherwise stipulated, all equipment together with its associated connectors where applicable shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and measurement of radio interference voltage (RIV).</p> <p>Test Levels :</p> <p>The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.</p>		
3.0	<p>Test Methods for RIV :</p>		
3.1	<p>RIV tests shall be made according to measuring circuit as per International Special – committee on Radio Interference (CISPR) Publication 16 -1 (1993) Part – I. The measuring circuit shall preferably be tuned to frequency with 10 % of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The result shall be in microvolts.</p>		
3.2	<p>Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107 – 1964 except otherwise noted herein.</p>		
3.3	<p>In measurement of RIV temporary additional external corona shielding may be provided. In measurement of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.</p>		
3.4	<p>Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% for the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage is listed in the detailed specification together with maximum permissible RIV level in microvolts.</p>		
3.5	<p>The metering instruments shall be as per CISPR recommendations or equivalent device so long as it has been used by other testing authorities.</p>		
3.6	<p>The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to the voltage read by the noise meter.</p>		
2.00.00	<p>REQUIREMENTS FOR GAS INSULATED SWITCHYARD:</p>		
2.01.00	<p>GENERAL:</p>		
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Clause No.	TECHNICAL REQUIREMENTS		
2.01.01	The GIS shall comply to IEC – 62271-203. The general requirements and special requirements for Gas Insulated Switchgear (GIS) are given in this chapter. GIS shall also meet other requirements specified under switchyard for various equipments as applicable. Materials and components not specifically stated in this specification but are necessary for the satisfactory operation of the equipment shall be deemed to be included unless specifically excluded and shall be supplied at no extra cost.		
2.01.02	The GIS shall be modular in structure and shall be housed indoor. The modules shall be single phase / Three phase encapsulated and provided with hooks for handling by EOT cranes to be provided in the building. The modular design shall be capable of extension on either side without any major dismantling.		
2.01.03	The GIS equipment's shall be housed in separate GIS building of overall height and width determined by the layout arrangement. The bus bars shall be rated for the duty specified and current rating shall be as per tender Single line Diagram (SLD). All the SF6 gas insulated circuit breakers, disconnectors, grounding switches and bus bars shall be of single-phase isolated type.		
2.01.04	The bus bars shall be rated for the duty specified and current rating shall be derived considering maximum possibilities.		
2.02.00	TECHNICAL REQUIREMENTS:		
2.02.01	The requirements for all switchyard equipments are given in subsequent sections.		
2.02.02	The VT's for GIS shall be installed within the GIS enclosure and shall be SF6 gas insulated or cast resin type. The secondary terminals shall be brought out in a dust proof enclosure suitably.		
2.02.03	The Surge arrestors for main buses shall be of GIS type only.		
2.02.04	The earthing of the GIS shall be carried out considering the safety requirements as per relevant standards. All parts to which access is required for maintenance work shall have provision for earthing. In addition after opening of enclosure it shall be possible to have continuity of earth for the duration of work. The continuity of earthing shall be ensured considering electrical and thermal stresses caused by current they may have to carry.		
2.02.05	Each section & phase of the GIS enclosure shall be monitored for leakage of SF6 gas and suitable indication shall be provided in the control room.		
2.02.06	All components of the same rating and construction shall be interchangeable.		
2.02.07	Each breaker module of the GIS shall have a local control cabinet suitably located and shall be ground mounted meeting the requirements specified elsewhere for cabinets. Suitable interlocking arrangements shall be provided for the entire GIS.		
2.02.08	All the SF6 gas insulated circuit breakers, disconnectors, grounding switches and		
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Clause No.	TECHNICAL REQUIREMENTS			
2.02.09	bus bars shall be of single phase/Three Phase isolated type .			
	Protective Finish -Preferable			
	All the exterior surfaces shall be cleaned and painted before leaving the factory with one coat of approved primer and two coats of water resistant approved paint on the equipment. The under-side of all painted surfaces bearing upon the concrete foundation shall be given two coats of approved primer. Extra paint for retouching at site shall be made available by the Contractor.			
	2.02.10 Fire Retardancy			
a)	All components shall be fire retardant and shall be tested in accordance with IEC 695.			
2.03.00	DESIGN AND SAFETY REQUIREMENT:			
2.03.01	The GIS assembly shall be as per switching arrangement indicated under single line diagram and consist of separate modular compartments e.g. Circuit Breaker compartment, Bus bar compartment filled SF6 gas and separated gas tight partitions so as to minimize risk to human life, allow ease of maintenance and limit the effects of gas leaks failures & internal arcs etc. These compartments shall be such that maintenance on one feeder may be performed without de-energizing the adjacent feeders. These compartments shall be designed to minimize the risk of damage to adjacent sections and protection of personnel in the event of a failure occurring within the compartments. Rupture diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting pressures developing within the enclosures under worst operating conditions. The compartments of GIS assemblies shall be supplied filled with nitrogen/ air or dry SF6 gas at a positive pressure and hermetically sealed to protect the dielectric system during transportation.			
2.03.02	The workmanship shall be of the highest quality and shall conform to the latest modern practices for the manufacture of high technology machinery and electrical switchgear.			
2.03.03	The switchgear, which shall be of modular design. The conductors and the live parts shall be mounted on insulators. These insulators shall be designed to have high structural strength and electrical dielectric properties and shall be shaped so as to provide uniform field distribution and to minimize the effects of particle deposition either from migration of foreign particles within the enclosures or from the by-products of SF6 breakdown under arcing conditions.			
2.03.04	Gas barrier insulators and support insulators shall have the same basis of design. The support insulators shall have holes on both sides for proper flow of gas.			
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Clause No.	TECHNICAL REQUIREMENTS			
2.03.05	Gas barrier insulators shall be provided so as to divide the GIS into separate compartments. They shall be suitably located in order to minimize disturbance in case of leakage or dismantling. They shall be designed to withstand 1.5 times full rated pressure on one side while vacuum is exerted on the other side. They shall be designed to withstand any internal fault thereby keeping an internal arc inside the faulty compartment. Due to safety requirement for working on the pressurized equipment, whenever the pressure of the adjacent gas compartment is reduced, it should be ensured by the contractor that adjacent compartment would remain in service with reduced pressure. The gas tight barriers shall be clearly marked on the outside of the enclosures.			
2.03.06	The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through for a period of 300ms at rated short time withstand current. The material shall be such that it has no effect of environment as well as from the by-products of SF6 breakdown under arcing condition.			
2.03.07	Sufficient inspection windows/access openings shall be provided at the switchgear to ensure that each switchgear component can be inspected / monitored during installation and future maintenance. Each section shall have plug-in or easily removable connection pieces to allow for easy replacement of any component with the minimum of disturbance to the remainder of the equipment.			
2.03.08	The material used for manufacturing the switchgear equipment shall be of the type, composition and have physical properties best suited to their particular purposes and in accordance with the latest engineering practices. All the conductors shall be fabricated of aluminum/ copper tubes of cross sectional area suitable to meet the normal and short circuit current rating requirements. The finish of the conductors shall be smooth so as to prevent any electrical discharge. The conductor ends shall be silver plated and fitted into finger contacts or tulip contacts. The contacts shall be of sliding type to allow the conductors to expand or contract axially due to temperature variation without imposing any mechanical stress on supporting insulators.			
2.03.09	Each pressure filled enclosure shall be designed and fabricated to comply with the requirements of the applicable pressure vessel codes and based on the design temperature and design pressures as defined in IEC -62271-203 .			
2.03.10	The maximum SF6 gas leakage shall not exceed half percent (0.5%) per year for the whole equipments and for any individual gas compartment separately.			
2.03.11	Each gas-filled compartment shall be equipped with static filters, density switches, filling valve and safety diaphragm. The filters shall be capable of absorbing any water vapour which may penetrate into the enclosures as well as the by-products of SF6 during interruption. Each gas compartment shall be fitted with separate non-return valve connectors for evacuating & filling the gas and checking the gas pressure etc.			
2.03.12	The switchgear line-up when installed and operating under the ambient conditions			
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Clause No.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>		
	<p>shall perform satisfactorily and safely under all normal and fault conditions. Even repeated operations up to the permissible servicing intervals under 100% rated & fault conditions shall not diminish the performance or significantly shorten the useful life of the switchgear. Any fault caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear.</p>			
2.03.13	NOT USED			
2.03.14	The thermal rating of all current carrying parts shall be minimum for one sec. for the rated symmetrical short-circuits current.			
2.03.15	<p>The Switchgear shall be of the free standing, self-supporting with easy accessibility to all the parts during installation & maintenance with all high-voltage equipment installed inside gas-insulated metallic and earthed enclosures, suitably sub-divided into individual arc and gas-proof compartments at least for:</p> <ul style="list-style-type: none">a) Bus barsb) Intermediate compartmentc) Circuit breakersd) Bus / Line disconnectionse) Gas insulated bus duct sectionsf) Voltage Transformersg) Surge Arrestors <p>The bus enclosure should be sectionalized in a manner that maintenance work can be carried out by isolating and evacuating the small effected section and not the entire bus.</p> <p>The design of double bus scheme shall be such that the common point of the two bus bars along with the earth switch shall be designed and housed in a separate compartments so as to avoid complete shutdown of the system in case of maintenance required in any bus disconnecter. Further maintenance on one bus disconnecter should be possible when the feeder is live through other disconnecter.</p>			
2.03.16	The arrangement of the individual switchgear bays shall be such so as to achieve optimum space-saving, neat and logical arrangement and adequate accessibility to all external components.			
2.03.17	It is required that the three phases of each switchgear bay be arranged side by side. The arrangement of the equipment offered must provide adequate access for operation, testing and maintenance.			
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Clause No.	TECHNICAL REQUIREMENTS		
2.03.18	The arrangement of gas section or compartments shall be such as to facilitate extension of any make on either end without any drilling, cutting or welding on existing equipments. The GIS shall be designed such that a future requirement as per single line diagram can be extended with-out any necessity to move or dislocate the existing switchgear bays. It shall be kept in view that very little shutdown time is needed for adding future requirement.		
2.03.19	All the elements shall be accessible without removing support structures for routine inspections and possible repairs. The removal of individual enclosure part or entire breaker bays shall be possible without disturbing the enclosures of neighboring bays. It should be impossible to unwillingly touch live parts of the switchgear or to perform operations that lead to arcing faults without the use of tools or brute force.		
2.03.20	All interlocks that prevent potentially dangerous mal operations shall be constructed such that they can not be operated easily, i.e. the operator must use tools or brute force to over-ride them.		
2.03.21	The actual position of circuit breakers, disconnectors and grounding switches must be positively displayed by mechanical indicators visible from the operating position.		
2.03.22	In general the contours of energized metal parts of the GIS and any other accessory shall be such, so as to eliminate areas or points of high electrostatic flux concentrations. The surfaces shall be smooth with no projection or irregularities which may cause visible discharges. There shall be no radio interference from the energized switchgear at rated voltage.		
2.03.24	The fabricated metal enclosures shall be of Aluminum alloy and have high resistance to corrosion, low electrical losses and negligible magnetic losses. All jointed surfaces shall be machined and all castings shall be spot faced for all bolt heads or nuts and washers. All screws, bolts, studs and nuts shall conform to metric system.		
2.03.25	The breaker enclosure shall have provision for easy withdrawal of the interrupter assemblies/complete CB pole.		
2.03.26	The enclosures of the same phase shall be electrically interconnected and at proper points they shall be connected to the other phases thus entailing a return current almost equal to the current circulating in the conductors.		
2.03.27	The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electrodynamics stresses even under short circuit conditions.		
2.03.28	The elbows, bends, cross and T-sections of interconnections shall include the		
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	insulators bearing the conductor when the direction changes take place in order to ensure that live parts remain perfectly centered and the electrical field is not increased at such points.		
2.03.29	The switchgear shall have provision for connection with ground mat risers. This provision shall consist of grounding pads to be connected to the ground mat riser in the vicinity of the equipment. The connection between the grounding pads of switchgear and ground mat risers shall be provided by the contractor. The contractor shall furnish the design details & drawings for ground mat for GIS.		
2.03.30	The ladders and walkways shall be provided wherever necessary for access to the equipment. The layout of Switchgear such that each equipment shall be easily accessible for monitoring, maintenance, and testing purpose. The fixed type walkways shall be provided for access to the equipment for maintenance and testing purpose. In addition to this hydraulic portable ladder shall also be provided by the contractor		
2.03.31	Wherever required, the heaters shall be provided for the equipment in order to ensure the proper functioning of the switchgear at specified ambient temperatures. The heaters shall be rated for 240V AC supply and shall be complete with thermostat, control switches and fuses, connected as balanced 3-phase, 4-wire load. The distribution of AC / DC power supply to LCC, Switchgear equipment's such that isolation of AC / DC supply to One particular Bay equipment's will not effect the other bay equipments.		
2.03.32	Arrangement shall be provided to visually observe the contact position of disconnecting switches and earth switches. Viewing window shall be provided to visually observe the contact position for all phases of disconnecting switches and earth switches. Also clearly identifiable local, positively driven mechanical position indicator, Open / Close Indication for all phases of disconnecting and earth switches shall be provided		
2.03.33	The enclosure & support structure shall be designed that a mechanic 1780mm in height and 80 Kg in weight shall be able to climb on the equipment for maintenance.		
2.03.34	The sealing provided between flanges of two modules / enclosures shall be such that long term tightness is achieved.		
2.03.35	Alarm circuit shall not respond to faults for momentary conditions. The following indications in addition to those required elsewhere in the specifications shall be provided in the alarm & indication circuits in Bay Module Control Cabinets:		
l)	Gas Insulating System:		
a)	Loss of gas density		
b)	Loss of heater power (if required)		
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c)	Any other alarm necessary to indicate deterioration of the gas insulating system			
II)	Operating System:			
a)	Low operating pressure.			
b)	Loss of Heater Power.			
c)	Loss of operating power.			
d)	Loss of control			
e)	Pole-disordance			
	In addition, all the above alarms shall also be hooked up to the Substation Automation system.			
2.03.36	Each gas compartment barrier shall be easily identifiable from the outside of the switchgear.			
2.03.37	Maximum weight of gas in gas tight section of GIS duct shall not exceed 250 kg for 132kV)			
2.03.38	The equipment shall be suitable for operation under the ambient conditions prevailing at project site. The prevailing conditions shall be taken into account by the Contractor in the design of the equipment.			
2.03.39	The supplier shall submit guarantee that all offered SF6 GIS equipment has a Min.service life of 10,000 normal operations. The maintenance free period for any of its external components shall not be less than 5 years intervals. Internal components including refilling of gas shall not be less than 10 years. The supplier shall submit the O&M manuals of all GIS equipment, trouble shooting, recommended spares parts etc. The supplier shall propose the recommended period for schedule maintenance.			
2.03.40	<p>Online Partial Discharge Monitoring system for GAS insulated switchgear and Busduct shall be provided to monitor the entire GIS installation as per the Specification mentioned at Annexure-C:</p> <p>Annexure-C: ONLINE PD MONITORING SYSTEM FOR GAS INSULATED SWITCHGEAR:</p> <p>GIS equipment shall be designed to minimize partial discharge or other electrical discharge. A state-of-the art Partial Discharge Monitoring system shall be provided to monitor the entire GIS installation.</p>			
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	<p>i)An on-line continuous Partial Discharge Monitoring (PDM) system shall be designed to provide an automatic facility for the simultaneous collection of PD data at multiple points on the GIS & its associated GIB ducts and Voltage Transformers adopting UHF technique.</p> <p>ii)On-line continuous Partial Discharge Monitoring (PDM) system shall be capable for measuring PD in charged GIS environment as EHV which shall have bandwidth in order of 100 MHz–2GHz with possibility to select a wide range of intermediate bandwidths for best measurement results. The principle of operation shall be based on UHF principle of detection.</p> <p>iii)The scope shall cover Engineering, supply, installation, testing and commissioning of partial discharge continuous monitoring system, with all necessary auxiliaries and accessories to make a complete system as per technical specification, including site demonstration of successful operation. The PDM system shall be provided with all its hardware and software, with readily interfacing to the UHF PD couplers installed in the GIS of present bays and future bays as shown in SLD plus 20% additional as extra. Details of this shall be submitted during engineering stage for approval.</p> <p>The number of UHF PD coupler for future bays shall be decided based on GIS layout finalized under present scope (considering present GIS equipment with future provision).</p> <p>iv)The PD Monitoring PC Work Station shall be in the control room of the GIS substation. Workstation PCs shall be pre-loaded with all necessary Hardware & Software. The PCs shall have each Combo drive & Retrievable disk drive (1 TB), Ethernet port 100Mbps, colour printer. The workstation PC shall be powered by suitable dedicated UPS. PDM system shall have built in self-checking facility.</p> <p>Design of on-line PDM System:</p> <p>1.)The sensitivity of the offered system shall be in accordance with CIGRE Document No. 654 that will be verified as part of site sensitivity tests.</p> <p>2.) UHF attenuation data of GIS shall be submitted for the switching devices, spacers, bends etc.</p> <p>3.) The signal attenuation level of co-axial cable per meter length and justification for the length of cable connection between the couplers and detector units shall be furnished.</p> <p>4.)The overall sensitivity of PD detection system shall consider the spacing between couplers and the associated cabling, filters, amplifiers, etc.</p>		
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Clause No.	TECHNICAL REQUIREMENTS			
	<p>5.) The PD sensors shall be identified / coordinated with the corresponding detector unit etc. with proper identification labelling and indicated in the substation PDM SLD.</p> <p>6) Supply requirement (AC & DC) to be specified for the complete monitoring system.</p> <p>7.) Power supply to PDM PC shall have protection against surges, overload and short circuit. A dedicated on-line UPS system shall also be provided as a backup during supply interruption, to ensure trouble-free & reliable running of the PDM System for a minimum of 15 minutes duration.</p> <p>8.) PDM System shall be provided with a user security for accessing the system with a log-on and password entry procedure. The user levels shall be defined as a Master User and other users for the modification of system, update, and entry of parameters or manual operation. System shall be able to generate 3D point on wave pattern whenever any PD activity detected by the system. System shall be able to give online 3D point on wave pattern, online PRPD (phase resolved PD) and online short time trend etc. System shall be able to generate the all the logs related to system fault, system access, PD event, and any changes in system setting etc.</p> <p>9.)The selected mode of propagation of PD signal (electromagnetic wave) inside GIS for the design of sensors shall be furnished.</p> <p>The applicable standards to meet IEC & IEEE requirements for electromagnetic compatibility shall be specified. The offered system should have been tested for the same for working in a 132kV & above substation environment. The necessary documentation must be submitted in this regard.</p> <p>10)Calibration:</p> <p>i) The UHF Couplers must be first calibrated as per CIGRE procedure TF 15/330305 as part of factory acceptance tests to guarantee detection sensitivity of 5pC or better. The GIS of same design shall be used as test specimen during the coupler calibration. The pulse injection level determined through above factory calibration tests shall only be used as reference for site sensitivity checks during commissioning of PDM system. The data sheet/frequency response characteristics shall be submitted for reference.</p> <p>11) The system shall generate alarms if suspected partial discharge activity is noticed or the system itself is in failure, thereby eliminating the necessity of periodic system access by the user and one such alarm shall be connected to Substation automation system (SAS). The alarms shall be configured coupler wise.</p> <p>12) Filtering Facility: The filtering facility must be provided to distinguish real PD from internal/external noise such as switching operations, self-test signal, radio, communication signal etc.</p>			
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	<p>13) Diagnostic Software: To interpret various types of PD defects, intelligent diagnostics software (expert system) shall be built- in as part of the PDM software capability. This is mainly to reduce the dependence on PD specialist. The bidder shall also make available typical point-on-wave patterns as library pictures to train the user.</p> <p>14)Special tools and critical spare parts for trouble free operation of the system are also to be supplied along with the PDM system. Pulse generator for UHF sensor sensitivity test shall also be supplied as a standard accessory.</p>		
2.03.41	ADEQUATE NUMBER OF GAS LEAK DETECTORS SHALL BE INSTALLED AT VARIOUS LOCATIONS AT THE BASE OF THE GIS STRUCTURE TO DETECT PRESENCE OF GAS WHICH MAY BE HARMFUL FOR HUMAN. THE DETECTOR SHALL SEND ALARM SIGNAL LOCALLY AS WELL AS AT REMOTE STATIONS		
2.04.00	<p>MANDATORY MAINTENANCE EQUIPMENTS:</p> <p>The maintenance equipment necessary for the operation and maintenance of GIS shall be supplied. In addition to this maintenance equipment specified at Annexure-D of this section shall also be supplied and covered in the contractor's scope.</p>		
2.05.00	<p>MANDATORY MONITORING EQUIPMENTS:</p> <p>The monitoring equipment necessary for the operation and maintenance of GIS shall be supplied. A list of such equipments is enclosed at Annexure-E of this section.</p>		
2.06.00	<p>BELLOWS OR COMPENSATING UNITS:</p> <p>Adequate provision shall be made to allow for the thermal expansion of the conductors and of differential thermal expansion between the conductors and the enclosures. The metallic bellows (preferably of stainless steel) of following types or other suitable arrangement shall be provided wherever necessary:</p> <ul style="list-style-type: none">i) To enable sections of the switchgear to be removed and reinserted without interfering with adjacent parts.ii) To accommodate changes in length of bus bars due to temperature variations.iii) To accommodate large linear expansions and angle tolerances.iv) For taking up manufacturing, site assembly & foundation tolerances.v) for absorbing vibrations caused by the transformers when connected to SF6 switchgear by oil / SF6 bushings.		
2.07.00	<p>INDICATION AND VERIFICATION OF SWITCH POSITIONS:</p>		
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	<p>currents. The power losses in the system shall be kept to a minimum. The induced voltages on the enclosures shall not be allowed to exceed reasonable limits of safety for operating personnel.</p> <p>2.10.02 The bus end connections shall be made with multi-contact connectors to allow for axial thermal expansion of the bus. The enclosure connections shall be flanged and shall be fitted with gaskets or O-ring seals to provide an effective gastight joint between sections.</p> <p>2.10.03 Main bus bars shall be designed to have future extension bay if any as indicated in the single line diagram. The bus conductor end connectors and enclosure flanges shall be designed accordingly.</p> <p>2.10.04 All necessary indoor and outdoor galvanised steel supporting structures for the proper erection, leveling and alignment of the bus bars shall be provided by the Contractor.</p> <p>2.10.05 The SF6 GIS bus-bars shall have continuous current rating as shown in the single line diagram or as required for the system.</p> <p>2.10.06 The system employed shall be of the electrically continuous enclosure type, allowing free circulation of induced currents in the enclosures. The enclosures shall be cylindrical in shape and designed for maximum shielding to minimize electromagnetic forces caused by short circuit currents.</p> <p>2.10.07 Wherever necessary, to absorb expansion / contraction, relative movement between the various items of equipment and the earthquake forces, bellows or other means shall be provided. The contractor must submit details of the means deployed along with the offer.</p> <p>2.10.08 Each gas compartment barrier shall be easily identifiable from the outside of the switchgear. The means of identification used shall be a black band, approx. 10mm wide, permanently affixed to the barrier insulator on the outer surface of the enclosure at the location of the barrier insulator. In case of leakage of the gas from any compartment, indication of respective compartments should be provided on the annunciator</p> <p>2.11.00 BAY MODULE CONTROL CABINETS:</p> <p>2.11.01 Each switchgear bay module shall be suitable for local control and remote control. The contractor shall supply the main control cabinet of the floor standing type along with GIS equipments. The cabinet shall have double, full height, hinged, gasketed, lockable doors. One door shall have a safety glass window through which the various switchgear controls can be viewed without opening the doors.</p> <p>2.11.02 The cabinet will be utilized for the switchgear bay local control module and as the terminating center for all power supply, control annunciation and supervisory</p>		
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	wiring interfacing with Employer's systems.			
2.11.03	The following equipments shall be mounted on the cabinet door:			
	<ul style="list-style-type: none">- Remote/local control transfer switch for the circuit breakers and disconnecter switches.- Normal operation/maintenance control transfer switch for disconnecter of remote electrical controls.- Mimic diagram of the switchgear bay complete with semaphore indicators for the switchgear component position indication and local control switches for open / close or close-trip control of the circuit breaker, isolators and grounding switches.			
2.11.04	The following equipments shall be mounted internally in the cabinet:			
	<ul style="list-style-type: none">- All bay switchgear interlocking wiring and auxiliary relays.- AC and DC power supply circuit breakers.- All necessary incoming and outgoing terminal blocks.- Space heaters- All instruments and devices required for supervision & control of GIS			
2.11.05	The annunciator system shall have sufficient modules and illuminated windows for providing annunciation for low / high gas pressure / density, alarms & trips for circuit breaker operating mechanism and all other abnormal conditions.			
2.11.06	Each annunciator panel shall be complete with an audible warning horn, acknowledge/reset for horn silence and lamp test push buttons. Apart from annunciator system in LCC, alarm contacts for remote alarm indication shall have to be wired separately in LCC terminal block.			
2.11.07	The control cabinets shall be suitable for bottom entry of cables.			
2.12.00	SUPPORTING STRUCTURES:			
2.12.01	The Contractor shall design, fabricate and supply the equipment supporting framework including all rails, transverse & longitudinal beams and supporting members with all necessary hardware & embedded parts. General structural designs and structural details shall be subject to the approval of the Employer.			
2.12.02	The floor of the switchgear building will be designed to support all the loads			
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	<p>imposed by the equipment supporting framework. The Contractor shall make provision in his designs to minimize transfer of forces resulting from thermal expansion or switchgear operation to the walls & floors of the switchgear building. To facilitate the design of floor of switchgear, the Contractor shall supply the details of static and dynamic loads to be supported by the slab along with the offer.</p>		
2.12.03	Non-corrosive metal or cadmium plated steel shall be used for bolts and nuts throughout the work when either or both are subjected to frequent adjustment or removal.		
2.12.04	All steel structure members shall be hot dip galvanised.		
2.12.05	All supporting structures shall be designed in such a way so as to allow dismantling for the addition of further switchgear components or maintenance of existing equipment without requiring temporary supports.		
2.12.06	The supporting arrangements for the GIS duct outside the building shall have adequate provision for thermal expansion/seismic forces etc.		
2.13.00	MONITORING:		
2.13.01	<p>The gas density in each gas compartment shall be monitored by electrically isolated & independently adjustable temperature compensated density switches. The factory set density switches shall also be acceptable. The relative merits, however for such switches in place of adjustable density switches shall be indicated in the offer. Two level density switches shall be provided for each GIS bus compartment to initiate remote devices of level-I alarm and level-II tripping. The setting of level-I alarm and level – II tripping shall be such that the dielectric strengths of SF6 gas are maintained. The necessary indication shall be provided at the circuit breaker control cabinet identifying the gas compartment from which a level-I alarm is initiated. Two level density switches shall be provided for each circuit breaker compartment to initiate the following:</p> <p>i) Level-I- Remote alarm and prevent closing of the breaker in case it is open.</p> <p>ii) Level-II- Initiation of Zone trip, Contact shall be in accordance with the requirement.</p>		
2.13.02	Gas pressure monitoring devices shall be fitted with test valves such that field testing of the monitoring device can be performed without draining the main gas system.		
2.13.03	Each gas section shall be fitted with a suitable valve for routine gas sampling.		
2.13.04	The Contractor shall satisfy the Employer regarding accuracy limits of gas		
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2.13.05	monitoring devices.			
	The equipment shall have provision to monitor the following parameters periodically to check anomalies and/or wear & tear of equipment.			
	i)	Operation of mechanical components:		
	The parameters to be monitored are:			
	<ul style="list-style-type: none">- Fluid pressure(oil) or hydraulic mechanism power reserve- The displacement speed of the moving parts- The travel of moving parts- Friction of moving parts			
ii)	Wear of circuit breakers interrupting chamber:			
	The parameters to be monitored are:			
	<ul style="list-style-type: none">- Determination of contact closing position- Accumulated effect of interrupted currents- Decomposition products content in SF6 Gas			
iii)	Insulation failure:			
	The parameters to be monitored are:			
	<ul style="list-style-type: none">- SF6 gas density monitoring of all the compartments- High frequency current detection for partial discharge detection- Sonic detection			
iv)	Safety bursting disc for each SF6 gas compartment.			
2.14.00	HIGH VOLTAGE TRANSIENTS:			
	High voltage transients from switching operations and internal faults are coupled to the external enclosure of the GIS. Since the effects of these transients on people are not known, the operating personnel are required to avoid contact with the enclosure during switching operations. The contractor is therefore required to establish that the reduced transient levels are within acceptable level.			
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2.15.00	BURN THROUGH PREVENTION: The Contractor shall furnish the details regarding the design features of their equipment which are intended to prevent burn through when an internal arc occurs.			
2.16.00	HEATERS: All the heaters shall be suitable for connection to a 240V AC, single phase, 50 Hz supply. The heater in the mechanism housing shall be connected inside the housing to this supply and shall be thermostatically controlled. The leads to the tank heaters shall be enclosed in a conduit. All the thermostats and the temperature indicating devices shall be calibrated in metric units.			
2.17.00(A)	SERVICE LIFE: SF6 circuit breakers, disconnecting switches and grounding switches will be subjected to frequent and occasionally repetitive, no load / full load operations and switching off short circuit currents , capacitive and inductive currents within their ratings. The Contractor shall propose the recommended period for scheduled maintenance.			
2.17.00 (B)	SEISMIC DESIGN CRITERIA: a) The equipment shall be designed for operation in seismic zone for earthquake resistance. The seismic loads are due to the horizontal and vertical acceleration which may be assumed to act on concurrently. Seismic Qualification requirements shall be as per IEC 62271-207 for the design of equipment. The equipment along with its parts shall be strong enough and sufficiently well connected to resist total operating stresses resulting from the forces in normal operation, but in case of abnormal condition shall also resist with forces superimposed due to earthquakes. The copies of type test reports for similar rated equipment, if tested earlier, should be furnished. If the equipment has not been type tested earlier, Test Report/Analysis Report should be furnished. b) To prevent the movement of GIS sub-assemblies i.e. various bay modules during the earthquake, suitable devices shall be provided for fixing the sub-assemblies to the foundation. The contractor shall supply necessary bolts for embedding in the concrete foundation. The fixing of GIS sub-assemblies to the foundation shall be designed to withstand the seismic events. It will also be ensured that the special devices as well as bolts shall not be over stressed. The details of the devices used and the calculations for establishing the adequacy shall be furnished by the supplier and shall be subject to the employer’s approval.			
2.18.00	INSPECTION AND TESTING:			
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2.18.01	All the equipment, apparatus, materials and supplies provided by the contractor under the contract shall be subjected to tests in the shop and at the field in the presence of employer for conformity with the requirements of the specifications. be as specified for the particular item or shall be in conformity with the applicable recognized standards for making such test. The details of the test procedures and test equipment to be used should be intimated to the Employer well in advance i.e. no less than 30 days before these tests are conducted. Unless otherwise specified, the contractor shall perform all shop and field tests.			
2.18.02	The Contractor shall submit a detailed quality assurance plan with 30 days after the commencement date intimating the testing program to the Employer for testing may proceed with minimum delay. The performances tests shall start, proceed, stop and be resumed in accordance with the approved schedule.			
2.18.03	The Contractor shall, at its own expense, promptly make good all defects evident by testing or made apparent in any other ways. After defects in the equipment have been rectified, the equipment is proved to be in satisfactory operation.			
2.18.04	Within 30 days of completion of each and every specified test, including commissioning tests, the Contractor shall submit six signed copies of the test reports to the Employer.			
2.18.05	The test reports shall indicate the tests performed, the result obtained, instruments used, names of personnel carrying out the tests and provisions for signature of witnesses. They shall also show the number and date. The format of these reports shall be submitted along with testing procedure for the employer's approval well in advance.			
2.18.06	<p>The test report shall include, but not necessarily be limited to the following:</p> <ul style="list-style-type: none">- A description of the test equipment with diagram showing arrangement of the test instruments and devices.- Sample computations, wherever necessary or desirable to show the test values employed in the equations.- Curves showing relation of tested quantities- Data in tabulated form <p>The comparison of the test results with the guaranteed requirements of the specification and explanation of deviations, if any.</p>			
2.19.00	Shop test:			
2.19.01	All major part of equipment, is essentially those necessitating subdivision of parts are transport and subsequent and reassembly at site, shall be matched,			
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	<p>assembled in the factory and carefully marked before dismantling. The dowel holes shall be provided with dowels to assist reassembly. The accuracy of fitting has to be assured at site at all stages of assembly.</p>																														
2.19.02	Each transport section of switchgear shall be shop tested.																														
2.19.03	<p>Switchgear components forming part of GIS namely circuit breakers, disconnectors, grounding switches, current transformers, Voltage transformers, surge arrestors & SF6 interface bushing, the routine tests of which have been covered under other relevant IEC standards and which do not form the part of tests specified below shall have these tests performed before being assembled into the switchgear. However, for electronic modules, equipment and individual components burn-in tests, temperature & voltage stress tests shall also be performed. Routine tests shall be conducted by automatic processes, wherever practicable particularly during testing of wiring. An example of the other tests referred to above would be as follows:</p> <p>a) Verification of terminal markings and accuracy & composite error tests for current and potential transformers.</p> <p>b) Routine and standard acceptance tests for surge arrestors specified in IEC60099-4 relevant to metal oxide type arrestors without gaps.</p> <p>c) Routine tests (on transport section):</p> <table><tr><th>Sl.No</th><th>Routine tests (On transport section)</th></tr><tr><td>i)</td><td>Dry Power frequency voltage withstand tests on the main circuit.</td></tr><tr><td>ii)</td><td>Dielectric tests on auxiliary and control circuit</td></tr><tr><td>iii)</td><td>Tests to verify the resistance of the main circuit</td></tr><tr><td>iv)</td><td>Partial discharge tests</td></tr><tr><td>v)</td><td>Pressure test on enclosures</td></tr><tr><td>vi)</td><td>Gas tightness test.</td></tr><tr><td>vii)</td><td>Mechanical operation tests.</td></tr><tr><td>viii)</td><td>Tests of auxiliary, electrical, and hydraulic devices</td></tr><tr><td>ix)</td><td>Checking of wiring</td></tr><tr><td>x)</td><td>Power frequency voltage dry tests</td></tr><tr><td>xi)</td><td>Voltage tests on auxiliary and control circuits</td></tr><tr><td>xii)</td><td>Fluid leakage tests (where applicable).</td></tr><tr><td>xiii)</td><td>other tests as per OEM recommendations , practice</td></tr></table> <p>The applicable standards for the above tests shall be IEC 62271-203, IEC 62271-100 and IEC 62271-1.</p>	Sl.No	Routine tests (On transport section)	i)	Dry Power frequency voltage withstand tests on the main circuit.	ii)	Dielectric tests on auxiliary and control circuit	iii)	Tests to verify the resistance of the main circuit	iv)	Partial discharge tests	v)	Pressure test on enclosures	vi)	Gas tightness test.	vii)	Mechanical operation tests.	viii)	Tests of auxiliary, electrical, and hydraulic devices	ix)	Checking of wiring	x)	Power frequency voltage dry tests	xi)	Voltage tests on auxiliary and control circuits	xii)	Fluid leakage tests (where applicable).	xiii)	other tests as per OEM recommendations , practice		
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	In addition, corrosion protection tests at random on all equipment shall be performed.			
2.20.00	Type Tests:			
	For Type Test requirement, Please refer clause No.1.12.00.			
2.21.00	Performance Tests:			
	Performance tests will be required to prove that equipment meets the requirements of the specifications and the guarantees. All the tests shall be conducted by the contractor subject to Employer's approval. The contractor shall supply all labour, consumables, materials, equipment, meters, gauges etc. necessary for the performance of all the tests and recording the results of the tests. The contractor shall assume full responsibility for the operation and safety of the equipment during all tests. The reports of all the tests shall be prepared by the contractor and incorporated in the final test report. The performance tests shall comprise of:			
	<div>a) Field stage tests, to be carried out during erection, to demonstrate that the equipment or any component or subassembly has been properly erected and functions correctly.</div> <div>b) Commissioning tests, precedent to the acceptance of work, in respect of the equipment or any section of the equipment, to demonstrate proper operation.</div>			
2.22.00	Field Stage Tests:			
	From time to time at various stages of erection, tests of sub-assemblies of the equipment shall be carried out as instructed by the Employer. The contractor shall make records of all measurements and shall make corrections or adjustments as required. A record of all stage tests shall be embodied in a report. These tests shall include, but not be limited to the following:			
	<div>(a) Continuous testing of the properties of SF6 gas through the entire filling period.</div> <div>(b) Test to check the continuity of wiring and correct operation of electrical systems.</div> <div>(c) Testing of all current carrying & ground connections to all conductors and terminal pads, to determine that the surfaces & all the bolted connections are tightly secured with lock washers; testing of all the flexible connections to ensure that sufficient slack is available for expansion.</div> <div>(d) Individual inspection of pressure relief devices, pressure gauges, moisture</div>			
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2.23.00	<p>detectors and all other auxiliary devices to examine their condition.</p> <p>(e) Checking of cabling between apparatus by the contractor, prior to acceptance tests. Written evidence shall be produced on these tests. Random checks shall be made in the presence of the Engineer.</p> <p>(f) Measurement of the insulation resistance of the various measuring and control circuits, including cables, instruments and apparatus wherever practical and feasible.</p> <p>(g) Operation checks of operating mechanism, all control, signaling, measuring, metering, recording and interlocking equipment to confirm complete conformity with designed data.</p> <p>Prior to commencement of these tests, the contractor shall submit a detailed programme to Employer's for approval. Detailed records, including all the details of tests performed and the results obtained shall be prepared by the contractor and furnished to the Employer.</p>			
	<p>Commissioning Tests:</p> <p>On completion of the erection and installation, following commissioning tests shall be performed as per IEC 62271-203, CIGRE working Group 23.03, 1975-Electra No.42, 7-29:</p> <p>(a) One minute power frequency withstand tests for the main circuits. As per IEC 62271-203 high voltage tests at site with lightning impulse and switching impulse voltages are also acceptable as alternative. The Contractor may carry out either of the above tests but relative merits of particular type of test over the other tests to be carried out by the contractor should be indicated in the offer.</p> <p>(b) Partial discharge measurement tests.</p> <p>(c) Voltage tests for the main circuits</p> <p>(d) Voltage tests for the auxiliary and control circuits.</p> <p>(e) Tests to verify the resistance of the main circuits.</p> <p>(f) Operation tests for various components.</p> <p>(g) Gas leakage tests.</p> <p>(h) Calibration/checking of SF6 gas pressure/density switches.</p>			
	<p>Measurement of moisture.</p>			
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<p>2.24.00</p> <p>2.25.00</p> <p>2.26.00</p>	<p>After erection, a test shall be made to prove the absence of the dangerous voltages in the enclosure and other metal parts such as pipes and framework. If the tests prove the existence of any fault or faults in the equipment, or any failure to meet the requirements of the specifications the Employer may direct Contractor to rectify the defects or repair, reconstruct or replace faulty work and Contractor shall without delay, carry out the instructions of the Employer in this respect.</p> <p>Except as otherwise provided hereunder, responsibility for apparatus & test equipment and the control thereof shall be exercised by contractor subject to the over riding control of the Employer.</p> <p>Commissioning tests shall be as per the IEC standard and shall not be restricted to the tests stated above. The Contractor shall also recommend any additional commissioning tests.</p>																					
	<p>Final Acceptance Tests:</p> <p>After commissioning tests have been satisfactorily completed, the contractor shall carry out tests as per relevant standards.</p>																					
	<p>Test Reports:</p> <p>The contractor shall record all the relevant facts and the quantities on the basis of which a final test report shall be prepared. Such reports will be prepared in a form approved by the Employer and reproduced at the expense of the contractor in six copies for submission to the Employer.</p>																					
	<p>TRAINING: GIS manufacturer Shall Provide Training to the Employer's Personnel as per the Details Given Below:</p> <table border="1"> <thead> <tr> <th>SI No.</th><th>Description of Training</th><th>Training Duration (Days)</th><th>Place of Training</th><th>Number of Trainees from Employer</th><th>Boarding & Lodging</th></tr> </thead> <tbody> <tr> <td>1</td><td>GIS</td><td></td><td></td><td></td><td></td></tr> <tr> <td>a)</td><td><i>GIS equipments including system description, Basic Design and engineering, Quality Assurance concepts, Erection and operational aspects for the offered equipments.</i></td><td>5 days</td><td>Manufacturers works</td><td>8</td><td>To be provided by Bidder</td></tr> </tbody> </table>					SI No.	Description of Training	Training Duration (Days)	Place of Training	Number of Trainees from Employer	Boarding & Lodging	1	GIS					a)	<i>GIS equipments including system description, Basic Design and engineering, Quality Assurance concepts, Erection and operational aspects for the offered equipments.</i>	5 days	Manufacturers works	8
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	SI No.	Description of Training	Training Duration (Days)	Place of Training	Number of Trainees from Employer	Boarding & Lodging
	b)	<i>Operation, Maintenance, Site Testing and Trouble shooting for GIS.</i>	5 days	Site	6	-
1.0	<div>Annexure-D</div> <div>SPECIFICATION OF MANDATORY MAINTENANCE EQUIPMENT:</div> <div>SF6 Gas Handling Plants:-</div> <div>a) SF6 gas filling and evacuating equipment (Portable), Qty:1no</div> <div>The capacity of this plant shall be such that it shall not take appreciable time for filling or evacuating of largest compartment. The required vacuum for complete evacuation shall be attained with the help of this plant.</div> <div>b) SF6 gas filtering, drying, storage and recycling plant- Qty:1no</div> <div>i)The plant shall be complete with accessories and fittings so that SF6 gas from the breaker can be directly filled in the plant storage reservoir.</div> <div>ii) In case purging of the equipment before filling with SF6 gas is desirable, then the required equipment for dry gases etc. shall be furnished as a part of the plant.</div> <div>iii)For heavy items within the plant, the lifting hooks shall be provided for lifting and moving with the overhead cranes.</div> <div>iv)The capacity of the plant shall be such as to handle and store the maximum quantity of gas that could be removed from atleast one phase of complete one bay.</div> <div>v))This shall include all the necessary devices for measurement of purity, moisture content, decomposition products etc. of SF6 gas mixing with air/oil/moisture during above process should be proved to be Nil during testing. The capacity of the plant shall be such as to handle and store min 300 litres of SF6 gas or Sf 6 Gas quantity of largest compartment.</div> <div>Note:</div>					
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<div>2.0</div> <div>3.0</div> <div>4.0</div>	<div> <p>i) These SF6 gas handling plants shall be complete with all the necessary pipes, couplings flexible tubes and valves for coupling to the equipment.</p> <p>ii) The design and construction of the plant, valves, couplings, and connections shall be such that leakage of SF6 gas shall be minimum. Similarly valves, couplings and pipe work shall be so arranged that accidental loss of gas to the atmosphere shall be minimum.</p> <p>SF6 gas analyzer : Qty:1no</p> <p>The SF6 gas analyser should be portable type and instrument should have following features:</p> <ul style="list-style-type: none"> a. Sensitivity of the equipment shall not be affected by any atmospheric conditions like dust, humidity, heat, wind etc. b. Equipment should be equipped with pumped back facilities so that no SF6 gas is wasted. c. Equipment shall be supplied with suitable regulator which can be used to connect SF6 cylinder if required. d. Following acidic/impurities products should be detected as per IEC 60480 and IEC 60376 <ul style="list-style-type: none"> i) SF6 purity – Range: 0-100 % ii) Dew point - Range: -60 to +20 deg C iii) SO2 - Range: 0-150 ppm iv) CF4 – Range: 0-60% vol v) HF - Range: 0-25 µl/l e. Instrument should work on AC source as well as on rechargeable battery f. Input pressure: upto 10 bar g. It should be housed in a robust IP67 case with wheels <p>SF6 Gas leak detector – Qty:1no</p> <p>The SF6 gas leak detector shall meet the following requirements:</p> <ul style="list-style-type: none"> a) The detector shall be free from induced voltage effects. b) The sensing probe shall be such that it can reach all the points on the GIS where leakage is to be sensed. c) The accuracy of the equipment shall be at least 10 ppm. <p>Operational analyser with DCRM kit- Qty:1no</p> <p>The operational analyser shall meet the following requirements:</p> <ul style="list-style-type: none"> a) Operational analyser shall be one complete system, which once installed </div>
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	<p>outdoor use. The meter shall be provided with dew point hygrometer with digital indication to display the dew point temperature in degree C. or PPM. It should be capable of measuring the corresponding pressure at which dew point is being measured.</p> <p>The measurement and use of the instrument must be simple, direct without the use of any other material/chemical like dry ice/acetone etc. It should be battery operated with rechargeable batteries.</p> <p>ii) The equipments should have the following parameters</p> <p>a. Measuring range: Up to -100 degree C Dew Point</p> <p>b. Accuracy: + 2 degree C.</p> <p>c. Display: 4 digit LCD, inch. High</p>		
2.0	PORTABLE PD MONITORING SYSTEM FOR GAS INSULATED SWITCHGEAR, Qty:1no		
	<p>i) The equipment shall be used for detecting different types of defects in Gas Insulated Stations (GIS) such as Particles, Loose shields and Partial Discharges as well as for detection of Partial discharges in other types of equipment such as Cable Joints, CTs and PTs.</p> <p>ii) It shall be capable for measuring PD in charged GIS environment as EHV which shall have bandwidth in order of 10 KHz – 500 KHz with possibility to select a wide range of intermediate bandwidths for best measurement results. The principal of operation and the method of measurement shall be non-intrusive. The instrument is able to detect partial discharges in cable joints, terminations, CTs and VTs etc., with the hot sticks.</p> <p>iii) Detection and measurement of PD and bouncing particles shall be displayed on built in large LCD display and the measurement shall be stored in the instrument and further downloadable to a PC for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc.</p> <p>iv) The equipments should have the following parameters:</p> <p>a) Measurement shall be possible in noisy environment.</p> <p>b) Stable reading shall be possible in presence of vibrations within complex GIS assemblies, which can produce signals similar to PD.</p> <p>c) Environment should have necessary synchronizing circuits to obtain PD correlation with power cycle and power frequency.</p>		
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	<p>d) The equipment shall be battery operated with built-in battery charger. It shall also be suitable for 230V AVC/50 Hz input.</p> <p>e) Measurement shall be possible in the charged switchyard in the presence of EMI/EMC. Supplier should have supplied similar detector for GIS application to other utilities. Performance certificate and the list of users shall be supplied along with the offer.</p> <p>f) Instrument shall be supplied with standard accessories i.e. connecting cables (duly screened) to sensors, Lap-top PC, diagnostic software, carrying case, rechargeable battery pack with charger suitable for 230V AC, 50 Hz supply connecting cables (duly screened) to view in storage. Contractor shall provide adequate number of sensors in the offered GIS for detection of Partial discharge, the number and location of these sensor shall be subject to approval of the employer.</p> <p>g) The function of software shall cover the following :</p> <ul style="list-style-type: none">- Data recording, storage and retrival in computer- Data base analysis- Template analysis for easy location of fault inside the GIS- Evaluation of PD measurement i.e., Amplitude, Phase Synchronisation etc.- Evaluation of bouncing/loose particles with flight time and estimation on size of particle.- Report generation <p>h) To prove the suitability of working in charged switchyard condition, practical demonstration shall be conducted before acceptance.</p> <p>i) Supplier shall have “Adequate after sales service” facility in India.</p> <p>j) Necessary training may be accorded to personnel to make use of the kit for locating PD sources inside the GIS.</p> <p>k) Instrument shall be robust and conform to relevant standard.</p> <p>l) Adequate number of UHF sensors shall be provided in the offered GIS for detection of Partial discharge as per IEC 60270 through Partial Discharge (PD) monitoring system and the number and location of these sensors shall be subject to approval of the employer. Pulse generator for UHF sensor sensitivity test shall also be supplied as a standard accessory.</p>			
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4.0)	<p>Portable Leakage current analyzer (for Gapless Surge Arrester), Qty: 1no</p> <p>All above maintenance equipment's shall be demonstrated at site during handover.</p>		
3.00.00	<p>CIRCUIT BREAKER:</p>		
3.01.00	<p>GENERAL :</p> <p>Circuit Breakers shall be metal enclosed SF6 gas insulated, single phase /three phase encapsulated for GIS and outdoor type Sf6 gas insulated for AIS, both comprising three identical single pole units, complete in all respects with all fittings and wiring. The circuit breakers and accessories shall conform to relevant standard IEC-62271-100.</p>		
3.02.00	<p>DUTY REQUIREMENTS:</p>		
3.02.01	<p>Circuit breaker shall be restrike free under all duty conditions and shall be capable of performing their duties without opening resistor. The circuit breaker shall meet the duty requirement of any type of fault or fault location and shall be suitable for line charging and dropping when used effectively grounded or ungrounded systems and perform make and break operations as per the stipulated duty cycles satisfactorily. The circuit breaker shall meet the requirements of Capacitive Class : C2, Mechanical Endurance : M2 , Electrical Endurance class :E2 type of duty as per IEC.</p>		
3.02.02	<p>The Bidder may note that total break time of the breaker shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage, pneumatic/hydraulic pressure and arc extinguishing medium pressure, etc. While furnishing the proof of the total break time of complete circuit breaker, the Bidder may specifically bring out the effect of non-simultaneity between same pole and poles and show how it is covered in the guaranteed total break time.</p>		
3.03.00	<p>CONSTRUCTIONAL FEATURES:</p>		
3.03.01	<p>All the three poles of the breaker shall be linked together either electrically/pneumatically or electro hydraulically.</p>		
3.03.02	<p>Circuit breakers shall be provided with two (2) independent trip coils, suitable for trip circuit supervision. The trip circuit supervision relay would also be provided. Necessary terminals shall be provided in the central control cabinet of the circuit breaker.</p>		
3.04.00	<p>SULPHUR HEXAFLORIDE (SF6) GAS CIRCUIT BREAKER:</p>		
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Clause No.	<div> TECHNICAL REQUIREMENTS </div> <div> </div>
3.04.01	Circuit breakers shall be single pressure type.
3.04.02	Each pole shall form an enclosure filled with SF6 gas independent of two other poles. Common monitoring of SF6 gas can be provided for the three poles of circuit breaker having a common drive. The interconnecting pipes in this case shall be such that the SF6 gas from one pole could be removed for maintenance purposes.
3.04.03	Sufficient SF6 gas shall be supplied to fill all the circuit breakers installed plus an additional 20% of the quantity as spare.
3.05.00	OPERATING MECHANISM:
3.05.01	Circuit breaker shall be operated by pneumatic mechanism or electrically spring charged mechanism or electro-hydraulic mechanism or a combination of these. It shall be gang operated in case of 3-phase reclosing operation as applicable.
3.05.02	The pneumatically operated mechanism shall offer unit compressor with each circuit breaker with the breaker local air receivers having a capacity for two 'CO' operations of the breaker at the lowest pressure for reclose duty without refilling.
3.05.03	The Spring operated mechanism shall be complete with motor, opening spring & closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit. As long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty. After failure of power supply to the motor, one close-open operation shall be possible with the energy contained in the operating mechanism. Motor ratings shall be such that it requires not more than 30 seconds for fully charging the closing spring.
3.05.04	The hydraulic mechanism shall be suitable for at least two close open operations after failure of ac supply to the motor starting at pressure equal to lowest pressure of auto-reclose duty. All hydraulic joints shall have no oil leakage under the site conditions and joints shall be tested at factory against oil leakage at a minimum of 1.5 times maximum working pressure.
3.06.00	FITTINGS AND ACCESSORIES:
3.06.01	The insulators and terminal connectors shall conform to requirements stipulated elsewhere. All routine tests shall be conducted on the insulators as per relevant IEC.
3.06.02	UNIT COMPRESSED AIR SYSTEM:
a)	The unit compressed air system for each breaker shall be provided with compressed air piping, piping accessories, control and non-return valves, filters, coolers of adequate capacity, pressure reducing valves(if any), isolating valves, drain ports, etc. The air compressor shall be driven by automatically controlled motor. It shall be of air cooled type complete with preferably oil-less cylinder
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3.07.00	lubrication. The compressors or pumps shall be mounted within the operating mechanism housing or a separate weather-proof and dust-proof housing. Each compressor shall be equipped with a time totaliser.			
	b)	The compressor size shall be such that it is capable of performing following operations satisfactorily :		
		i) Total running time of compressor not exceeding 45 minutes per day, considering 2% leakage and 2 CO-operations.		
		ii) Air charging time not exceeding 20 minutes after one CO operation of the breaker.		
	c)	Air Receivers:		
		i) The capacity of receivers shall be sufficient for two (2) CO operations of the breaker.		
		ii) Air receiver shall be designed in accordance with the latest edition of the ASME Code for Pressure Vessel - Section VIII of BS:5179. A corrosion allowance of 3.0 mm shall be provided for shell and dished ends. Receivers shall be hot dip galvanized.		
	d)	Controls and Control Equipment:		
		i) The compressor control shall be of automatic start stop type initiated by pressure switches on the receiver. Supplementary manual control shall also be provided.		
		ii) All control equipment shall be housed in a totally enclosed cabinet. Pressure gauges and other indicating devices, control switches shall be mounted on the control cabinet.		
	iii) Facility to annunciate failure of power supply to the compressor control shall also be provided.			
e)	Compressed Air Piping, Valves and Fittings:			
	i) The flow capacity of all valves shall be at least 20% greater than the compressor capacity.			
	ii) The high pressure system shall be such that after one 0 - 0.3 Sec - CO operation, the breaker shall be capable of performing one CO operation within 3 minutes.			
	iii) All compressed air piping shall be bright annealed, seamless phosphorous Deoxidized Non-Arsenical Copper alloy or stainless steel pipe (C-106 of BS: 2871).			
	TESTS:			
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3.07.01	Type test: a) GIS circuit breaker shall be type tested in accordance with the requirement stipulated under clause no :1.12.00.																													
3.07.02	Routine Tests: Routine tests as per IEC on the complete breaker/ pole along with its own operating mechanism and pole column shall be performed on all circuit breakers.																													
3.07.03	SITE TESTS: All routine tests except power frequency voltage dry withstand test on breaker shall be repeated on the completely assembled breaker at site.																													
3.08.00	PARAMETERS:																													
3.08.01	General: <table border="1"><thead><tr><th>Sl.no</th><th>Description</th><th></th></tr></thead><tbody><tr><td>a)</td><td>Type of Circuit breaker</td><td>SF6 insulated</td></tr><tr><td>b)</td><td>No. of poles</td><td>Three(3poles)</td></tr><tr><td>c)</td><td>Rated operating duty cycle</td><td>O - 0.3 sec. - CO - 3min. – CO</td></tr><tr><td>d)</td><td>Total closing time</td><td>Not > than 150ms</td></tr><tr><td>e)</td><td>Reclosing</td><td>1ph & 3ph high speed auto reclosing</td></tr><tr><td>f)</td><td>Trip and closing coil voltage</td><td>220V DC</td></tr><tr><td>g)</td><td>Auxiliary contacts</td><td>As required plus10NO & 10NC contacts per breaker as spare.</td></tr><tr><td>h)</td><td>Type of operating mechanism</td><td>Pneumatic/spring/hydraulic/or a combination of these</td></tr></tbody></table>			Sl.no	Description		a)	Type of Circuit breaker	SF6 insulated	b)	No. of poles	Three(3poles)	c)	Rated operating duty cycle	O - 0.3 sec. - CO - 3min. – CO	d)	Total closing time	Not > than 150ms	e)	Reclosing	1ph & 3ph high speed auto reclosing	f)	Trip and closing coil voltage	220V DC	g)	Auxiliary contacts	As required plus10NO & 10NC contacts per breaker as spare.	h)	Type of operating mechanism	Pneumatic/spring/hydraulic/or a combination of these
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3.08.02	132 kV Class Circuit Breakers (GIS): a) Rated voltage :145 kV, rms. b) Rated continuous current at an ambient temperature of 50° C :As per SLD c) Symmetrical interrupting : 40 kA, rms.																													
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	<p>Capability</p> <p>d) Rated short circuit making current : 80 kAp</p> <p>e) Short time current carrying :40 kA, rms. Capacity for one second</p> <p>f) Out of phase breaking current : 7.8 kA, rms. Capacity</p> <p>g) i) Rated line charging breaking current : 50A capacity(rms) ii) Rated cable charging breaking current : 160A capacity(rms)</p> <p>h) Rated small inductive current 0.5 to 10 A Switching capability with over-voltage less than 2.3 p.u.</p> <p>i) Interrupting capability of Transformer up to 500 MVA steady and transient magnetising current</p> <p>j) First pole to clear factor 1.3</p> <p>k) Rated breaktime As per IEC</p> <p>l) Total breaktime As per IEC</p>	
4.00.00	DISCONNECTOR:	
4.01.00	GENERAL:	
4.01.01	The isolators and accessories shall conform in general to relevant IEC 62271-102 (or equivalent Indian Standard) except to the extent explicitly modified in specification.	
4.01.02	Earth switches shall be provided on isolators as marked on SLD.	
4.01.03	The isolators and earth switches shall be A. C / D.C. motor operated.	
4.01.04	Complete disconnecter with all the necessary items for successful operation shall be supplied.	
4.02.00	DUTY REQUIREMENTS:	
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4.02.01	Isolators and earth switches shall be capable of withstanding the dynamic and thermal effects of the maximum possible short circuit current of the Isolators and earth switches shall be capable of withstanding the dynamic system in their closed position. They shall be constructed such that they do not open under influence of short circuit current, wind pressure and other mechanical loads together. The earth switches wherever provided shall be constructional interlocked so that the earth switches can be operated only when the isolator is open and vice-versa.		
4.02.02	In addition to the constructional interlock, isolator and earth switches shall have provision to prevent their electrical and manual operation unless the associated and other interlocking conditions are met. All these interlocks shall be of fail safe type. Suitable individual interlocking coil arrangements shall be provided. The interlocking coil shall be suitable for continuous operation from DC supply and within a variation range as stipulated in relevant section. The interlock coil shall be provided with adequate contacts for facilitating permissive logic for 'DC' control scheme of the isolator as well as for AC/DC circuit of the motor to prevent opening or closing of isolators when the interlocking coil is not energised.		
4.02.03	The earthing switches shall be capable of discharging trapped charges of the associated lines. Isolator and earth switches shall be able to bear on the terminals the total forces including wind loading and electrodynamic forces on the attached conductor without impairing reliability or current carrying capacity.		
4.02.04	The earth switches wherever provided shall be constructional interlocked so that the earth switches can be operated only when the isolator is open and vice-versa. Mechanical Endurance : M2 type of duty as per IEC.		
4.02.05	The isolator shall be capable for making / breaking normal currents when no significant change in voltage occurs across the terminals of each pole of the isolator on account of making / breaking operation.		
4.03.00	CONSTRUCTIONAL FEATURES (For GIS):		
	a) The three pole/ Single pole group operated disconnectors shall be operated by electric motor suitable for use on 220 V DC ungrounded system/415V AC system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current & short circuit.		
	b) Disconnectors shall be designed as per relevant IEC. These shall be suitable to make and break the capacitive charging currents during their opening and closing. They shall also be able to make & break loop current which appears during transfer between bus bars. The contact shielding shall also be designed to prevent restrikes and high local stresses caused by the transient recovery voltages when these currents are interrupted.		
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Clause No.	TECHNICAL REQUIREMENTS		
c)	The disconnecting switches shall be arranged in such a way that all the three phases operate simultaneously. All the parts of the operating mechanism shall be able to withstand starting torque of the motor mechanism without damage until the motor overload protection operates.		
d)	It shall be possible to operate the disconnecting switches manually by cranks or hand wheels. The contacts shall be both mechanically and electrically disconnected during the manual operation.		
e)	The operating mechanisms shall be complete with all necessary linkages, clamps, couplings, operating rods, support brackets and grounding devices. All the bearings shall be permanently lubricated or shall be of such a type that no lubrication or maintenance is required.		
f)	The opening and closing of the disconnectors shall be achieved by either local or remote control. The local operation shall be by means of a two-position control switch located in the bay module control cabinet.		
g)	Remote control of the disconnectors from the BCU in Relay room & power house control room shall be made through remote / local transfer switch.		
h)	The disconnector operations shall be interlocked electrically with the associated circuit breakers in such a way that the disconnector control is inoperative if the circuit breaker is closed.		
i)	Each disconnector shall be supplied with auxiliary switch having eight normally open and eight normally closed contacts for use by others over and above those required for disconnector operation purposes. The auxiliary switch contacts are to be continuously adjustable such that, when required, they can be adjusted to make contact before the main switch contacts. Additionally MBB contact as required shall also be provided.		
j)	The signaling of the closed position of the disconnector shall not take place unless it is certain that the movable contacts will reach a position in which the rated normal current, peak withstand current and short-time withstand current can be carried safely.		
k)	The signaling of the open position of the disconnector shall not take place unless the movable contacts have reached such a position that the clearance between the contacts is at least 80 percent of the rated isolating distance.		
l)	All auxiliary switches and auxiliary circuits shall be capable of carrying a current of at least 10 A DC continuously.		
m)	The auxiliary switches shall be capable of breaking at least 2 A in a 220-V DC circuit with a time constant of not less than 20 milliseconds.		
n)	The disconnectors and safety grounding switches shall have a mechanical key (padlocking key) and electrical interlocks to prevent closing of the grounding		
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Clause No.	TECHNICAL REQUIREMENTS												
	<p>switches when disconnector switches are in the closed position and to prevent closing of the disconnectors when the grounding switch is in the closed position.</p> <p>o) The local control of the disconnector and high-speed grounding switches from the bay module control panel should be achieved from the individual control switches with the remote/local transfer switch set to local.</p> <p>p) All electrical sequence interlocks will apply in both remote and local control modes.</p> <p>q) Each disconnector shall have a clearly identifiable local, positively driven mechanical position indicator, together with position indicator on the bay module control cabinet and provisions for taking the signals to the power house control room. The details of the inscriptions & colouring for the indicator are given as under:</p> <table><tr><td>Sign</td><td>Back ground</td><td>Colour</td></tr><tr><td>Open position</td><td>Open</td><td>Green</td></tr><tr><td>Closed position</td><td>Closed</td><td>Red</td></tr></table> <p>r) All the disconnector and earth switches shall be provided with inspection window so that the travel of the switch contacts in both open and close positions can be verified by visual inspection.</p> <p>s) The disconnecting switches shall be provided with rating plates and shall be accessible for inspection.</p> <p>t) The disconnecting switches shall be capable of being padlocked in both the open and closed positions with the operating motor automatically disengaged. The padlocking device shall be suitable for a standard size lock with a 10mm shank. The padlock must be visible and directly lock the final output shaft of the operating mechanism. Integrally mounted lock when provided shall be equipped with a unique key for such three phase group. Master key is not permitted.</p>				Sign	Back ground	Colour	Open position	Open	Green	Closed position	Closed	Red
Sign	Back ground	Colour											
Open position	Open	Green											
Closed position	Closed	Red											
4.04.00	SAFETY GROUNDING SWITCHES:												
	<p>a) Three-pole/ Single pole, group operated, safety grounding switches shall be operated by electric motor for use on 220V DC ungrounded system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.</p> <p>b) In order to provide test facilities for CTs, transformers, cables etc., certain ground switches may require to be electrically insulated from the enclosures and have easily removable ground connections.</p> <p>c) Each safety grounding switch shall be electrically interlocked with its associated disconnector and circuit breaker such that it can only be closed if both the circuit</p>												
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI ,PART B BID DOC NO: CS-6401-001-2		B-17: SWITCHYARD									
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Clause No.	TECHNICAL REQUIREMENTS											
	<p>breaker and disconnector are in open position. Safety grounding switch shall however be mechanically key interlocked with its associated disconnector.</p> <p>d) Each safety grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the bay module control cabinet and provision for taking the signal to Power House Control Room.</p> <p>e) The details of the inscription and colouring for the indicator are given as under:</p> <table><tr><td>Sign</td><td>Background</td><td>Colour</td></tr><tr><td>Open position</td><td>Open</td><td>Green</td></tr><tr><td>Closed position</td><td>Closed</td><td>Red</td></tr></table> <p>f) Interlocks shall be provided so that manual operation of the switches or insertion of the manual operating device will disable the electrical control circuits.</p> <p>g) Each ground switch shall be fitted with auxiliary switches having six normally open and six normally closed contacts for use by others over and above those required for local interlocking and position indication purposes.</p> <p>h) Provision shall be made for padlocking the ground switches in either the open or closed position.</p> <p>i) All portions of the grounding switch and operating mechanism required for grounding shall be connected together utilizing flexible copper conductors having a minimum cross-sectional area of 50 mm².</p> <p>j) The main grounding connections on each grounding switch shall be rated to carry the full short circuit rating of the switch for 1 s and shall be equipped with a silver-plated terminal connector suitable for steel strap of adequate rating for connection to the grounding grid.</p> <p>k) The safety grounding switches shall conform to the requirements of IEC 62271-102</p> <p>l) Mechanical position indication shall be provided locally at each switch along with remote indication at each bay module control cabinet & in the power house control room.</p>	Sign	Background	Colour	Open position	Open	Green	Closed position	Closed	Red		
Sign	Background	Colour										
Open position	Open	Green										
Closed position	Closed	Red										
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI ,PART B BID DOC NO: CS-6401-001-2	B-17: SWITCHYARD	PAGE 45 of 78								


Clause No.	TECHNICAL REQUIREMENTS			
4.05.00	HIGH SPEED GROUNDING SWITCHES:			
	a)	Grounding switches located at the beginning of the Feeder bay modules shall be of the high-speed and will be used to discharge the respective charging currents, in addition to their safety grounding function. These grounding switches shall also be capable of interrupting the inductive currents and to withstand the associated TRV.		
	b)	Single phase switches shall be provided with individual/group operated mechanism operating mechanism for each phase suitable for operation from a 220V DC ungrounded supply.		
	c)	The switches shall be fitted with a stored energy closing system to provide fault making capability.		
	d)	The short circuit making current rating of each ground switch shall be at least equal to its peak withstand current rating of 125KA. The switches shall have inductive / capacitive current switching capability as per IEC-62271-102.		
	e)	Each high speed make proof grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the bay module control cabinet and provision for taking the signal to Power House Control Room.		
	f)	The details of the inscription & coloring for the indicator shall be as under:		
		Sign	Background	Colour
		Open position	Open	Green
		Closed position	Closed	Red
	g)	High-speed ground switch operation should be possible locally from the bay module control cabinet, or remotely from the relay room & power house control room in conjunction with opening of the associated disconnector.		
	h)	These high-speed grounding switches shall be electrically interlocked with their associated circuit breakers and disconnectors so that the grounding switches can not be closed if the circuit breakers and disconnectors are closed.		
	i)	Interlocks shall be provided so that the insertion of the manual operating devices will disable the electrical control circuits.		
j)	Each high speed ground switch shall be fitted with auxiliary switches having six normally open(NO) and six normally closed (NC) auxiliary contacts for use by others, over and above those required for local interlocking and position indication. All contacts shall be wired to terminal blocks in the local bay control cabinet. Provision shall be made for padlocking the grounding switches in either the open or closed position.			
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Clause No.	TECHNICAL REQUIREMENTS		
	<p>k) All portion of the grounding switches and operating mechanism required for connection to ground shall be connected together utilizing flexible copper conductor having minimum cross-sectional area of 50 sq mm.</p> <p>l) The main grounding connection on each grounding switch shall be rated to carry the peak withstand current rating of the switch for 1 sec and shall be equipped with a silver-plated terminal connector suitable for steel strap of adequate design for connection to the grounding grid.</p> <p>m) The high speed grounding switches shall conform to the requirements of IEC-62271-102.</p>		
4.06.00	CONSTRUCTIONAL FEATURES (For AIS):		
	<p>a) The isolators shall be provided with high pressure current carrying contacts on the hinge/ jaw ends and all contact surfaces shall be silver plated. The thickness of silver plating wherever provided should not be less than 25 microns.</p> <p>b) The isolator shall be provided with a galvanised steel base provided with holes and designed for mounting on a lattice/pipe support structure. The base shall be rigid and self supporting. The position of movable contact system (main blades) of each of the isolator and earthing switch shall be indicated by a mechanical indicator at the lower end of the vertical rod of shaft for the isolator and earthing switch. The indicator shall be of metal and shall be visible from operating level.</p> <p>c) All metal parts shall be of non-rusting and non-corroding metal. Current carrying parts shall be from high conductivity electrolytic copper/aluminium. Bolts, screws and pins shall be provided with lock washers. Keys or equivalent locking facilities, if provided on current carrying parts, shall be made of copper silicon alloy or equivalent. The live parts shall be designed to eliminate sharp joints, edges and other corona producing surfaces.</p> <p>d) The isolators shall be so constructed that the switch blade will not fall to the closed position if the operating shaft gets disconnected. Isolators and earthing switches including their operating parts shall be such that they cannot be dislodged from their open or closed positions by gravity, wind pressure, vibrations shocks or accidental touching of the connecting rods of the operating mechanism. The switch shall be designed such that no lubrication of any part is required except at very infrequent intervals.</p> <p>e) The insulator of the isolator shall conform to the requirements stipulated elsewhere and shall have a min. cantilever strength of 800 kg for 132kV isolator.</p>		
4.07.00	EARTHING SWITCHES (For AIS):		
	<p>Where earthing switches are specified these shall include the complete operating mechanism and auxiliary contacts. The earthing switches shall form an integral part of the isolator and shall be mounted on the base frame of the isolator. Earthing switches shall be suitable for local operation only. The earthing switches shall be</p>		
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Clause No.	TECHNICAL REQUIREMENTS		
	constructional interlocked with the isolator so that the earthing switches can be operated only when isolator is open and vice versa.		
4.08.00	OPERATING MECHANISM AND CONTROL (For AIS)		
4.08.01	The Contractor shall offer, motor operated switches having padlock arrangement for both 'ON' and 'OFF' positions.		
4.08.02	Limit switches for control shall be fitted on the isolator/ earth switch shaft, within the cabinet to sense the open and close positions of the isolators and earth switches.		
4.08.03	It shall not be possible, after final adjustment has been made for any part of the mechanism to be displaced at any point in the travel sufficient enough to allow improper functioning of the isolator when the isolator is opened or closed at any speed.		
4.08.04	Control cabinet/operating mech. box shall conform to requirements stipulated under auxiliary part and IS:5039/IS 8623/IEC 60439 as applicable.		
4.09.00	OPERATION (For AIS):		
4.09.01	Isolator shall be electrically/mechanically gang operated for main blades and earth switches. The operation of the three poles shall be well synchronised and interlocked.		
4.09.02	The design shall be such as to provide maximum reliability under all service conditions. All operating linkages carrying mechanical loads shall be designed for negligible deflection. The length of inter insulator and interpole operating rods shall be capable of adjustments.		
4.09.03	The design of linkages and gears be such so as to allow one man to operate the handle with ease for isolator and earth switch.		
4.10.00	TESTS :		
4.10.01	The GIS disconnecter shall be type tested in accordance with the requirement stipulated under clause no :1.12.00		
4.10.02	In continuation to the requirements stipulated under clause no.1.12.00 the isolator along with operating mechanism (AIS) shall conform to the type tests and shall be subjected to routine tests and acceptance tests in accordance with IEC 62271-102. Minimum 50 nos. mechanical operations will be carried out on 1 (one) isolator of each type assembled completely with all accessories as acceptance test. During final testing of isolator sequential closing/ opening of earth switch shall also be checked only after isolator is fully open/close.		
4.10.03	The insulator (AIS) shall conform to all the type tests as per IEC 60168. In addition to all type, routine and acceptance tests, as per IEC-60168, the following additional routine/ acceptance tests shall also be carried out:		
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Clause No.	TECHNICAL REQUIREMENTS		
4.11.00 4.11.01	a)	Bending load test in four directions at 50% min. bending load guaranteed in all insulators.	
	b)	Bending load test in four directions at 100% min. bending load guaranteed on sample insulators in a lot.	
	c)	Torsional test on sample insulator of a lot.	
	PARAMETERS:		
	General:(GIS)		
	Sl.no	Description	
	a)	Type of isolator	Metal enclosed,SF6 insulated
	b)	No. of poles	Three(3poles)
	c)	Rated operating time	Not > than 12sec
	d)	Control voltage	220VDC
e)	Auxiliary contacts on isolator	Min.8NO & 8NC contacts per pole/isolator .	
f	Auxiliary contacts on earth/ safety/grounding/high speed switch	Min.6NO & 6NC contacts per pole/isolator .	
g)	Operating mechanism of isolator and earth switch	AC/DC/universal motr	
General (AIS) :			
	Description	Parameter	
a)	Type of isolator	Out door type , 50Hz	
b)	No. of poles	Three(3poles)	
c)	Rated operating time	Not > than 12sec	
d)	Control voltage	220VDC	
e)	Auxiliary contacts on isolator	Min.8NO & 8NC contacts per pole/isolator .	
f	Auxiliary contacts on earth/ safety/grounding/high speed switch	Min.6NO & 6NC contacts per pole/isolator .	
g)	Operating mechanism of isolator and earth switch	AC/DC/universal motor	
h)	Minimum creepage distance	31mm/Kv	
i)	Rated ambient temperature	50 degree Celsius	
j)	Support structure height	Adequate so that lowest part of support insulator of equipment is	
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Clause No.	<div> <div>TECHNICAL REQUIREMENTS</div> <div>एनटीपीसी NTPC</div> </div>		
			minimum 2550 mm from plinth level
	k	Temperature rise	As per Table III of IEC 60694 for an ambient of 50 deg. C
4.11.02	NOT USED		
4.11.03	132 kV Class Isolators (GIS): <ol style="list-style-type: none"> Rated voltage :145 kV rms Rated continuous current As per SLD Rated short time withstand current of isolator and earthswitch 40 kA rms for One (1) second Rated dynamic short circuit withstand current of isolator and earthswitch :104 kAp 		
4.11.04	NOT USED		
4.11.05	132kV Class Isolators (AIS) : <ol style="list-style-type: none"> Rated voltage :132 kV rms Rated continuous current As per SLD Rated short time withstand current of isolator and earthswitch 40 kA rms for One (1) second Rated dynamic short circuit withstand current of isolator and earthswitch :104 kAp Operating time : <12sec minimum Phae to phase spacing : 3000mm 		
5.00.00	INSTRUMENT TRANSFORMER:		
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Clause No.	TECHNICAL REQUIREMENTS																								
5.01.00	CODES AND STANDARDS: Current transformers IEC 61869-1&2, BS: 3938, IS: 2705, IS:16277 Voltage transformers IEC 61869-1&5, IEC 60358, IS: 3156 Insulating oil IS: 335, IEC:60296																								
5.02.00	GENERAL REQUIREMENTS (FOR GIS): a) The current transformers and accessories shall conform to IEC-61869-2 and other relevant standards except to the extent explicitly mentioned in the specification. b) The instrument transformers i.e. current and voltage transformers shall be single phase transformer units. c) Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block. d) The particulars of the various cores are given here for tender purpose and may change within reasonable limits as per the requirements of protection relays. The contractor is required to submit the VA burden calculations and obtain approval from the Employer before proceeding with design of the cores. The other characteristics of CTs shall be as given below:																								
5.03.00	PARAMETERS AND CONSTRUCTION DETAILS (GIS):																								
5.03.01	GENERAL FOR CURRENT TRANSFORMER (GIS) <table><tr><th>Sl.No</th><th>Description</th><th>Rating</th></tr><tr><td>a)</td><td>One minute power frequency Withstand voltage between Secondary terminal and Earth is :</td><td>5kV</td></tr><tr><td>b)</td><td>Partial discharge level</td><td>Max.5pico Coulombs</td></tr><tr><td>c)</td><td>Type of insulation</td><td>Class A</td></tr><tr><td>d)</td><td>Number of cores</td><td>Details are given in Table-I below</td></tr><tr><td>e)</td><td>Number of terminals in box</td><td>All terminals of control circuits wired in marshalling box plus 20 terminals as spare.</td></tr><tr><td>f)</td><td>Rated extended primary current</td><td>120% of rated primary current</td></tr></table>				Sl.No	Description	Rating	a)	One minute power frequency Withstand voltage between Secondary terminal and Earth is :	5kV	b)	Partial discharge level	Max.5pico Coulombs	c)	Type of insulation	Class A	d)	Number of cores	Details are given in Table-I below	e)	Number of terminals in box	All terminals of control circuits wired in marshalling box plus 20 terminals as spare.	f)	Rated extended primary current	120% of rated primary current
Sl.No	Description	Rating																							
a)	One minute power frequency Withstand voltage between Secondary terminal and Earth is :	5kV																							
b)	Partial discharge level	Max.5pico Coulombs																							
c)	Type of insulation	Class A																							
d)	Number of cores	Details are given in Table-I below																							
e)	Number of terminals in box	All terminals of control circuits wired in marshalling box plus 20 terminals as spare.																							
f)	Rated extended primary current	120% of rated primary current																							
5.03.02(a)	NOT USED																								
5.03.02(b)	NOT USED																								
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Clause No.	TECHNICAL REQUIREMENTS		
5.03.02(c)	NOT USED		
5.03.02 (d)	132 kV Current Transformers (GIS):		
	(a)	Rated dynamic current	104 kA (peak)
	(b)	Rated short time thermal current	40 kA for 1 sec.
5.03.03	Construction Details:		
a)	The current transformers incorporated into the GIS will be used for protective relaying and metering. The secondary windings shall be air/gas insulated. All the current transformers shall have effective electromagnetic shields to protect against high frequency transients.		
b)	Each current transformer shall be equipped with a marshalling box with terminals for the secondary circuits, which are connected to the local control cubicle. The star / delta configuration and the inter connection to the line protection panels will be done at the CT terminal block located in the local control cubicle.		
c)	Rating and Diagram Plates shall be as specified in the IEC specification incorporating the year of manufacture. The rated extended current rating voltage and rated thermal current shall also be marked on the name plate. The diagram plate shall show the terminal markings and relative physical arrangement of the current transformer cores with respect to the primary terminals(P1 & P2)		
d)	The position of each primary terminal in the current transformer SF ₆ gas section shall be clearly marked by two plates fixed to the enclosure at each end of the current transformer.		
e)	Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.		
f)	The current transformers shall be suitable for high speed auto reclosing.		
g)	Electro magnetic shields to be provided against high frequency transients typically 1-30 MHz.		
h)	The wiring between each CT and bay module control cabinet shall be included in the scope of supply.		
i)	Provision shall be made for primary current injection testing of current transformers.		
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Clause No.	TECHNICAL REQUIREMENTS		
5.04.00	BUS VOLTAGE TRANSFORMERS (GIS):		
5.04.01	General :		
a)	The voltage transformers and accessories shall conform to IEC and other relevant standards except to the extent explicitly mentioned in the specification.		
b)	Voltage transformers shall be of the electro magnetic type with SF ₆ gas insulation. The earth end of high voltage winding and the ends of secondary winding shall be brought out in the terminal box.		
c)	The rating and diagram plate shall be provided complying with the requirement of IEC specification incorporating the year of manufacture and including turn's ratio, voltage ratio, burden, connection diagram etc.		
d)	The beginning and end of each secondary winding shall be wired to suitable terminals accommodated in a terminal box mounted directly on the voltage transformer section of SF6 switchgear.		
e)	All terminals shall be stamped or otherwise marked to correspond with the marking on the diagram plate. Provision shall be made for earthing of the secondary windings inside the terminal box.		
f)	The transformer shall be able to sustain full line voltage without saturation of transformer.		
g)	Core details are given in Table-II.		
5.04.03	Constructional Details:		
a)	The voltage transformers shall be located in a separate bay module on the bus and will be connected phase-to ground and shall be used for protection, metering and synchronizing		
b)	The voltage transformers shall be of induction type, nonresistant and shall be contained in their own- SF6 compartment, separated from other parts of installation. The voltage transformers shall be effectively shielded against high frequency electromagnetic transients. The voltage transformers shall have three secondary windings.		
	The voltage transformer secondaries shall be wired by Contractor to their associated bay control cabinets		
5.05.00 -5.09.00	NOT USED		
5.10.00	TESTS:		
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Clause No.

TECHNICAL REQUIREMENTS



a) GIS Instrument transformer shall be type tested in accordance with the requirement stipulated under clause no 1.12.00.

Sl.No	Description
i)	Radio Interference and Corona test
ii)	Thermal withstand test i.e. application of rated voltage and rated current simultaneously by synthetic circuit (For CT only) Seismic withstand test along with structure (for 765kV only)
iv)	Thermal co-efficient test i.e. measurement of Tan-Delta as function of temperature (at ambient and between 80 deg. C and 90 deg. C) and voltage (at 0.3, 0.7, 1.0 and 1.1 Um).(for CT only)
v)	Multiple chopped impulse test on Primary winding.
vi)	In addition to routine tests as per IEC/IS, measurement of partial discharge in continuation with power frequency withstand test required for 132 kV current transformer. ISF (Instrument Security Factor) test will be done as part of Routine acceptance test

TABLE-I

Clause No.

TECHNICAL REQUIREMENTS




CORE DETAILS OF 132V CTs

CT No.	Current Ratio (A)	Application	Output Burden (VA)	Accuracy Class as per IEC	Min Knee Point Voltage (Vk)	Max CT Sec Winding Res. (Ohm)	Max Exciting Current in mA at Vk
1	1200/ 600/1	Busbar Diff. Protection	-	PS	1200 / 600	6 /3	30 on 1200/1 TAP 60 on 600/1 TAP
2	1200/ 600/1	Busbar Diff. Protection	-	PS	1200 / 600	6 /3	30 on 1200/1 TAP 60 on 600/1 TAP
3	1200/ 600/ 300/1	Metering and synchronization (ISF<5)	20/20/20/20	0.2S, ISF<5	-	-	-
4	1200/ 600/ 300/1	Trans. back up/ Line protection	-	PS	1200 / 600/ 300	6 /3 /1.5	30 on 1200/1 TAP 60 on 600/1 TAP 120 on 300/1 TAP
5	1200/ 600/ 300/1	Trans. Back up/ Line protection	-	PS	1200 / 600/ 300	6 /3 /1.5	30 on 1200/1 TAP 60 on 600/1 TAP 120 on 300/1 TAP


Physical arrangement of CTs shall be as per Protection SLD.


The rated extended primary current of the CTs shall be 120 % continuous of 1200 A. All relaying CTs shall be accuracy class PS as per IS:2705


Note : The Knee point Voltage(Vk) & Max CT sec winding Resistance , Exciting current values mentioned are min / max values are of Typical values. These values will be finalized during detailed engg stages per the requirement of Numerical relays based on protection philosophy adopted. The supporting calculation for burden to be furnished during detail engineering.


Clause No.	TECHNICAL REQUIREMENTS				
	TABLE – II				
	CORE DETAILS OF VT, 132KV (GIS)				
	Primary Voltage : 132/ √3 for Primary I,II,III				
	Application	Rated Voltage (V)	Secondary	Accuracy	Output Burden – Maximum (*)
	Protection	110/√3		3P	50 VA
	Protection	110/√3		3P	50 VA
	Metering	110/√3		0.2	50 VA
	The accuracy of 0.2 on secondary III should be maintained through the entire burden range up to total simultaneous burden 150 VA on all the three windings without any adjustments during operation.				
	* The rated burden of cores shall be closer to the maximum burden requirement of metering and protection system for better sensitivity and accuracy .The supporting calculation for burden to be furnished during detail engineering.				
	Note: The rated extended primary current of the CTs shall be 120% continuous of rated current.				
6.00.00	SURGE ARRESTOR:				
6.01.00	GENERAL:				
6.01.01	The surge arrestors shall conform in general to IEC-60099-4 and IS: 3070/IS:15086(Part-4) except to the extent modified in the specification.				
6.01.02	Arrestors shall be hermetically sealed units, self supporting construction, suitable for mounting on lattice/tubular type support structures.				
6.02.00	DUTY REQUIREMENTS:				
6.02.01	The Surge Arresters (SAs) shall be capable of discharging over-voltages occurring due to switching of unloaded transformers, reactors and long lines.				
6.02.02	The reference current of SAs shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.				
6.02.03	The SAs shall be capable of withstanding meteorological and short circuit forces under site conditions.				
6.03.00	CONSTRUCTIONAL FEATURES (FOR AIS):				
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Clause No.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>		
6.03.01	Each Surge Arrester (SA) shall be hermetically sealed single phase unit.			
6.03.02	The non linear blocks shall be sintered metal oxide material. The SA construction shall be robust with excellent mechanical and electrical properties.			
6.03.03	SAs shall have pressure relief devices and arc diverting ports suitable for preventing shattering of porcelain housing and to provide path for flow of rated fault currents in the event of SA failure.			
6.03.04	The SA shall not fail due to porcelain contamination.			
6.03.05	Seals shall be effectively maintained even when SA discharges rated lightning current.			
6.03.06	Outer insulator of Surge arrester shall be of Polymer type. The SA shall not fail due to polymer contamination. Polymer housing shall be so coordinated that external flashover will not occur due to application of any impulse or switching surge voltage up to maximum design value for SA. The cantilever strength of the complete assembled surge arrester shall be as per the actual calculation which ever is higher shall be provided .			
6.03.07	The end fittings shall be non-magnetic and of corrosion proof material. The metal flanges shall be fixed with the porcelain by cement or other materials so as to withstand the forces experienced in normal operation and provide continuous sealing for entry of moisture for a period of minimum 20 years. The sealing arrangement of the Surge Arrester stacks shall be done incorporating grooved flanges with O-rings/elliptical cross section gasket of Neoprene or Butyl rubber.			
6.04.00	CONSTRUCTIONAL FEATURES FOR GAS INSULATED SURGE ARRESTOR:			
	a) It will be SF6 gas insulated, metal enclosed surge arrester of the gapless non linear zinc oxide, heavy duty, station type.			
	b) The arrester enclosure shall be vertically or horizontally mounted to suit the layout of the switchgear and shall be fitted with a discharge counter located in an easily accessible position.			
	c) The main grounding connection from the surge arrester to the earth shall be provided by the Contractor. The size of the connecting conductor shall be such that all the energy is dissipated to the ground without getting overheated.			
6.05.00	FITTINGS AND ACCESSORIES FOR AIS:			
6.05.01	Each SA shall be complete with insulating base for mounting on structure.			
6.05.02	SAs shall be provided with grading and/or corona rings as required.			
6.05.03	i)Self contained discharge counters, suitably enclosed for outdoor use (IP:55 degree of protection) and requiring no auxiliary or battery supply shall be fitted with each SA			
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Clause No.	TECHNICAL REQUIREMENTS			
	<p>alongwith necessary connections to SA and earth. Suitable leakage current meters shall also be supplied in the same enclosure. The reading of milliammeter and counter shall be visible through an inspection glass panel to a man standing on ground. A pressure relief vent/suitable provision shall be made to prevent pressure build up.</p> <p>ii)The surge counter shall be provided with a potential free contact which shall close whenever a surge is recorded by the surge monitor. Necessary arrangement shall be provided for extending the contact information to substation Automation system.</p> <p>iii) Insulated copper conductor of adequate size and length shall be used for connecting discharge counter terminal and lightning arrester earth terminal. Insulation level of the conductor shall not be less than 5 kV.</p> <p>Suitably sized bypass copper shunts shall be provided for bypassing the discharge counter for removal / maintenance of the counter.</p> <p>iv) (Note: Optional) : Surge monitor comprising a digital type counter, leakage current detector shall be provided for each arrester and the same shall be mounted at eye level height to facilitate easy reading of the counter and leakage current detectors. Necessary arrangement shall be provided for extending the reading of surge counter, leakage current indication in the SAS.</p>			
6.06.00	PARAMETERS:			
6.06.01	General :			
	a)	System neutral earthing	Effectively earthed	
	b)	Installation	Outdoor	
	c)	i) Nominal discharge current	i)10 kA of 8/20 microsec. Wave (132kV)	
		ii) Discharge current at which insulation coord. is done	i)10kA of 8/20 micro wave wave(132kV)	
	d)	Rated frequency	50 Hz	
	e)	Current for pressure relief test	40 kArms (132kV),	
	f)	Prospective symmetrical fault current	40 kArms for 1 second (132kV)	
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Clause No.	<div> <div> TECHNICAL REQUIREMENTS </div> <div>  </div> </div>
	<div> <div>g)</div> <div>Low current long duration test value (2000 micro sec.)</div> <div>As per IEC</div> </div> <div> <div>h)</div> <div> <div>i)Pressure relief class</div> <div>: As per IEC</div> </div> <div> <div>ii)Long Duration discharge class</div> <div>: Class #3 or 4</div> </div> </div> <div> <div>i)</div> <div>Partial discharge at 1.05 MCOV (Continuous operating voltage)</div> <div>Not more than 50 p.C.</div> </div> <div> <div>j)</div> <div>Siesmic acceleration</div> <div>0.3 g horizontal</div> </div> <div> <div>k)</div> <div>Reference ambient temp.</div> <div>50 deg. C</div> </div> <div> <div>l)</div> <div>Minimum total creepage distance (mm)</div> <div>5075 for 132kV</div> </div> <div> <div>(The arrester voltage / rating shall be as per the study of insulation co-ordination of system)</div> </div>


Clause No.	TECHNICAL REQUIREMENTS																	
	i) Long duration discharge class (2 successive shots)	3																
	j) Current for Pressure relief test	31.5kArms																
	k) High current short duration test value (4/10 micro sec.)	100 kAp																
	l) One minute power frequency withstand voltage of arrestor housing (dry and wet)	275 kV (rms)																
	m) Impulse withstand voltage of arrestor housing with 1.2/50 micro sec. Wave	650 kV (Peak)																
	n) Radio interference voltage at 92kV	Not more than 1000 micro volt																
	o) Partial discharge at 1.05 MCOV (continuous operating voltage)	Not more than 50 p.c.																
	<p>The surge arrestors are provided to protect the following equipment whose insulation levels are indicated in the Table# 4 given below. The contractor shall carry out the insulation coordination studies for deciding the location of the surge arrestors.</p>																	
	<p>Table #4 :</p> <table><tr><th>Sl.no</th><th>Equipment to be Protected</th><th>Lightning impulse(kVp)</th></tr><tr><td>)</td><td>Power Transformer</td><td>± 650</td></tr><tr><td>)</td><td>Instrument Transformer</td><td>± 650</td></tr><tr><td>)</td><td>CB/isolator (Ph to ground)</td><td>± 1650</td></tr><tr><td></td><td>Across open contacts</td><td>± 750</td></tr></table>			Sl.no	Equipment to be Protected	Lightning impulse(kVp))	Power Transformer	± 650)	Instrument Transformer	± 650)	CB/isolator (Ph to ground)	± 1650		Across open contacts	± 750
	Sl.no	Equipment to be Protected	Lightning impulse(kVp)															
)	Power Transformer	± 650																
)	Instrument Transformer	± 650																
)	CB/isolator (Ph to ground)	± 1650																
	Across open contacts	± 750																
6.07.00	TESTS																	
6.07.01	Surge arrestor (GIS) shall be type tested in accordance with clause no. 1.12.00																	
6.07.02	Surge arrestors (AIS) shall confirm to all type tests (as applicable) as per IEC 60099-4 and shall be subjected to routine and acceptance tests in accordance with IEC-60099-4. The resistive current drawn by the arrestor for at rated voltage shall be indicated in the routine test report.																	
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Clause No.	TECHNICAL REQUIREMENTS			
7.00.00	POST INSULATOR:			
7.01.00	GENERAL:			
	The post insulators shall conform in general to latest IS: 2544 and IEC – 60815, 60168.			
7.02.00	CONSTRUCTIONAL FEATURES:			
7.02.01	Post type insulators shall consist of a porcelain / Polymer part permanently secured in a metal base to be mounted on the supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand any shocks to which they may be subjected to by the operation of the associated equipment. Only solid core insulators shall be accepted. Height of post insulator shall be preferably as given under parameters of this part.			
7.02.02	The other requirements of insulator as given under auxiliary requirements shall also be applicable.			
7.03.00	TESTS:			
7.03.01	In accordance with the stipulations elsewhere the post insulators shall conform to type tests and acceptance, sample and routine tests as per IS: 2544, IEC-60168 shall be carried out.			
7.03.02	In addition to acceptance/sample/routine tests as per IS: 2544, IEC-60168, the following tests shall also be carried out.			
	Sl.No	Description		
	a)	Ultrasonic tests on all cut shells as routine check		
	b)	Visual examination and magna flux test on all flanges prior to fixing		
	c)	Check for uniformity of thickness and weight of zinc coating as a sample test from each lot of flanges prior to fixing.		
	d)	Bending load test shall be carried out at 50% minimum failing load in four directions as a routine test.		
	e)	Bending load in four directions at 100% minimum bending load guaranteed on samples as per clause-2.3 of IEC. Subsequently this post insulator shall not be used.		
	f)	Tests for deflection measurement at 20, 50, 70% of specified minimum failing load on sample.		
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Clause No.	TECHNICAL REQUIREMENTS																										
7.03.03	The post insulator shall conform to following type tests as applicable according to voltage class: a) Switching Impulse withstand test (dry & wet) b) Lightning Impulse withstand test (dry) c) Power frequency withstand test (dry & wet) d) Measurement of RIV e) Corona extinction voltage test f) Test for deflection under load. g) Test for mechanical strength,																										
7.04.00	PARAMETERS:																										
7.04.01.	NOT USED																										
7.04.02.	132 kV class Bus Post Insulators(AS APPLICABLE):																										
	<table><tr><th>Sl.no</th><th>Description</th><th></th></tr><tr><td>a)</td><td>Type</td><td>Solid core</td></tr><tr><td>b)</td><td>Dry and wet one min.power frequency voltage</td><td>275kV rms</td></tr><tr><td>c)</td><td>Dry impulse withstand positive and negative(kVp)</td><td>650</td></tr><tr><td>d)</td><td>Wet switching surge withstand (kVp)</td><td>NA</td></tr><tr><td>e)</td><td>Total min.cantilever strength(kg)</td><td>800</td></tr><tr><td>f)</td><td>Min. torsional moment(kg- m)</td><td>500</td></tr><tr><td>g)</td><td>Total height of insulator(mm)</td><td>1500</td></tr></table>	Sl.no	Description		a)	Type	Solid core	b)	Dry and wet one min.power frequency voltage	275kV rms	c)	Dry impulse withstand positive and negative(kVp)	650	d)	Wet switching surge withstand (kVp)	NA	e)	Total min.cantilever strength(kg)	800	f)	Min. torsional moment(kg- m)	500	g)	Total height of insulator(mm)	1500		
Sl.no	Description																										
a)	Type	Solid core																									
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f)	Min. torsional moment(kg- m)	500																									
g)	Total height of insulator(mm)	1500																									
8.00.00	NOT USED																										
9.01.00-9.09.00	08.00 NOT USED																										
	CABINETS, BOXES, BAY MARSHALLING BOX , KIOSKS, PANELS, ETC.																										
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI ,PART B BID DOC NO: CS-6401-001-2	B-17: SWITCHYARD																								
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Clause No.	TECHNICAL REQUIREMENTS			
9.09.01	All types of control cabinets, junction boxes, marshaling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC: 60439 as applicable.			
9.09.02	They shall be of Stainless steel or Aluminium. The thickness of Stainless steel shall be minimum 1 mm. The thickness of aluminium shall be minimum 3 mm and shall provide rigidity. Top of the boxes shall be sloped towards the rear of the box.			
9.10.00	BAY MARSHALLING BOX:			
9.10.01	Bay Marshaling Box located at a convenient location to receive and distribute cables shall be provided as required. It shall meet all the requirements as specified for cabinets/boxes.			
9.10.02	It shall have three separate distinct compartments for following purposes: - To receive two incoming 415V, three phase, AC supplies controlled by 100A four pole MCBs with auto changeover provision, and to distribute five (5) three phase ac supplies controlled by 32A four pole MCBs. It shall also be provided with 63A, 3 phase 4 pin industrial grade receptacle with rotary switch. - To receive three phase incoming from first compartment and to distribute ten (10) single phase ac supplies controlled by 16A two pole MCBs. - 150 nos. terminal blocks in vertical formation for interlocking facility.			
9.11.00	AUXILIARY SWITCH: The auxiliary switch shall conform of following type tests: a) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test. b) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination c) Heat run test on contacts d) IR/HV test, etc. TERMINAL BLOCKS: i)They shall be non-disconnecting stud type of extensible design equivalent to Elmex type CAT-M4. ii)The terminal blocks shall be of 850 V grade, and rated to continuously carry maximum expected current. The conducting part shall be tinned or silver plated.			
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Clause No.	TECHNICAL REQUIREMENTS		
9.12.00	<p>iii)Unless otherwise required (expected current rating) or specified, terminal blocks shall be suitable for connecting the following conductors on each side:</p> <p>a) All CT & VT circuits - Min. four 2.5 sq.mm. copper flexible conductor b) AC & DC power supply -Two 16 sq.mm. aluminium conductor. c) Circuits Other control circuits - Min. two 2.5 sq.mm. copper flexible conductor</p> <p>CABLE RACKS INCLUDING SUPPORTS, TRAYS AND ACCESSORIES:</p> <p>i) Cable Support Structures & Accessories :</p> <p>The Contractor shall fabricate and install mounting arrangements for the cable tray supports or use the flexible cable tray supports and required accessories with bolted arrangement and installation of all the cables in Cable tray in the trenches / above ground.. These mounting shall be fabricated from structural steel members (channels, angles and flats) of the required size.</p> <p>i) Cable Trays:</p> <p>a)Hot dip galvanised ladder type , perforated type cable trays of adequate width are to be provided for cables in the control room building, out door, above ground cable tray arrangement.</p> <p>b)Aux. power cables are to be laid on the top tray and DC control cables in bottom trays. Cable trays shall be designed to carry cables load without bending and proper tray supports shall be provided at every 1000mm interval .</p> <p>c)Cable trays having power and control cable are spaced at Min.300 mm and between control cable trays, the spacing is min.225 mm. For tray lengths more than 2.5 m coupler plates are to be used for joining the two standard tray lengths. Suitable 'L' and 'T' bends are included under the scope of this contract</p> <p>d) Cable trays shall be made of 2 mm thick sheet steel having a slotted rung spacing of 250 mm. Height of cable tray channel shall be 75 mm and the standard length of trays shall be 2.5 mt</p> <p>e)All nuts, bolts, washers etc. to be supplied by the Contractor shall be hot dip galvanised after fabrication.</p> <p>f)The Contractor shall perform all tests and inspection to ensure that material and workmanship are according to the relevant standards</p> <p>For Detailed specification Refer Chapter B-10 (cabling , earthing, lighting) of Part-B, Section-VI.</p>		
9.13.00	<p>Wiring:</p>		
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Clause No.	TECHNICAL REQUIREMENTS		
	<p>All wiring shall be carried out with 1100 V grade stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows: a) All circuits except CT circuits 2.5 sq.mm b) CT circuits 4 sq. mm (minimum number of strands shall be 3 per conductor.</p>		
9.14.00	CABLE GLANDS AND LUGS:		
9.14.01	Cable glands shall be Double compression type, tinned/Nicked plated (coating thickness not less than 20 microns in case of tin and 10 to 15 microns in case of nickel) brass cable glands for all power and control cables. They shall provide dust and weather proof terminations. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and off tested quality. Required number of packing glands to close unused openings in gland plates shall also be provided.		
9.14.02	The cable glands shall be tested as per BS:6121. The cable glands shall also be duly tested for dust proof and weather proof termination.		
9.14.03	Cables lugs shall be tinned copper solder less crimping type conforming to IS:8309 and 8394 suitable for aluminum or copper conductor (as applicable). The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.		
9.15.00	CONDUITS, PIPES AND ACCESSORIES :		
9.15.01	The Contractor shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes, etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushing reduces, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes, etc The size of the conduit/pipe shall be selected on the basis of maximum 40% fill criterion. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed in an approved manner, to prevent damage to threaded portion and entrance of moisture and foreign material.		
9.15.02	Rigid conduits shall be flow-coat metal conduits. The outer surface of the conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/ pipes shall be of a reputed make.		
9.15.03	Flexible conduits shall be heat-resistant lead coated steel, water-leak, fire and rust proof, and be of PLICA make or equivalent.		
9.16.00	Type tests: All equipment with their terminal connectors, control cabinets, main protective relays, etc. as well as insulators, insulator strings with hardwares, clamps and		
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Clause No.	TECHNICAL REQUIREMENTS			
	connectors, marshalling boxes, etc., shall conform to type tests and shall be subjected to routine and acceptance tests in accordance with the requirements stipulated under respective equipment sections.			
10.00.00	INSTALLATION:			
10.01.00	EARTHING: The earthing shall be done in accordance with requirements given in Annexure-II of this section and drawing enclosed with the specifications. Earthing of panels shall be done in line with the requirements given in respective equipment section of this specification.			
10.02.00	CIVIL WORKS: The civil works shall be done in accordance with requirements stipulated elsewhere in the specification.			
10.03.00	STRUCTURAL STEEL WORKS: The structural steel works shall be done in accordance with requirements stipulated elsewhere in the specification.			
10.04.00	BAY EQUIPMENT:			
10.04.01	The disposition of equipment to be supplied are shown in enclosed tender drawings.			
10.04.02	The Contractor shall prepare layout drawings and submit the same for approval of the Employer. The approval of drg. shall not absolve Contractor from his responsibility regarding designing & engineering of switchyard and Contractor shall be fully responsible for all works covered in the scope of this specification.			
10.05.00	LIGHTNING PROTECTION:			
10.05.01	Direct stroke lightning protection (DSLPP) shall be provided in the switchyard by lightning masts (at least 50 m high) and shield wires.			
10.05.02	Lightning protection System down conductors shall not be connected to other conductors above ground level. Also no intermediate earthing connection shall be made to Surge arrester, Voltage Transformer, earthing leads for which shall be directly connected to rod electrode.			
10.05.03	Every down conductor shall be provided with a test joint at about 150mm above ground level. The test joint shall be directly connected to the earthing system.			
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Clause No.	TECHNICAL REQUIREMENTS		
10.05.04	The lightning protection system shall not be in direct contact with underground metallic service ducts and cables.		
10.06.00	EQUIPMENT ERECTION NOTES:		
a)	All support insulators, circuit breaker interrupters and other fragile equipment shall be handled with cranes with suitable booms and handling capacity.		
b)	Where, assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense. The contractor shall strictly follow manufacturer’s recommendations for handling and erection of equipment.		
c)	The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc. Handling equipment, sling ropes etc. should be tested before erection and periodically thereafter for strength.		
d)	Bending of piping should be done by a bending machine and through cold bending only. Bending shall be such that inner diameter of pipe is not reduced. The pipes shall be thoroughly cleaned before installation.		
e)	Cutting of the pipes wherever required shall be such as to avoid flaring of the ends. Hence only a proper pipe cutting tool shall be used. Hack saw shall not be used.		
f)	For cleaning the inside and outside of hollow insulators only Muslin or leather cloth shall be used.		
10.07.00	CABLING:		
10.07.01	Cabling shall be on cable racks, in trenches, vertical shafts, excavated trenches for direct burial, pulled through pipes and conduits run clamped on steel structures etc. in accordance with the requirements specified elsewhere in the specification.		
10.07.02	Cables inside the switchyard shall be laid on bolted GI angle supports at 1000mm spacing with separate tiers for control and power cables. The GI angles shall be bolted / welded to galvanized insert plates inside RCC trenches.		
10.07.03	Cables shall be generally located adjoining the electrical equipment through the pipe insert embedded in the ground. In the case of equipment located away from cable trench either pipe inserts shall be embedded in the ground connecting the cable trench and the equipment or in case the distance is small, notch/opening		
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Clause No.	TECHNICAL REQUIREMENTS		
10.07.04	shall be provided. In all these cases necessary bending radii as recommended by the cable supplier shall be maintained.		
10.07.05	Cabling in the control room shall be done on ladder type cable trays with supports at an interval of 1000mm.		
10.08.00	All interpole cables (both power & control circuit) for equipments shall be laid in cable trenches/G.I. Conduit Pipe of NB 50/100mm which shall be buried in the ground at a depth of 300mm.		
10.08.00	EQUIPMENT ERECTION NOTES : a)All support insulators, circuit breaker interrupters and other fragile equipment shall be handled with cranes with suitable booms and handling capacity. The contractor shall strictly follow manufacturer's recommendations for handling and erection of equipment. b)The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc. Handling equipment, sling ropes etc. should be tested before erection and periodically thereafter for strength. c)Bending of piping should be done by a bending machine and through cold bending only. Bending shall be such that inner diameter of pipe is not reduced. The pipes shall be thoroughly cleaned before installation.		
10.09.00	STORAGE OF EQUIPMENT: Contractor is responsible for the proper storage and maintenance of all materials/equipment entrusted to him. The Contractor shall provide & construct adequate storage shed for proper storage of equipment. Sensitive equipment shall be stored indoors. All equipment during storage shall be protected against damage due to acts of nature or accidents. Contractor shall take all required steps to carryout subsequent inspection of materials/equipment stored as well as erected until the same is taken over by the Employer. The storage instruction of the equipment manufacturers/Engineer-in-Charge shall be strictly adhered to.		
a)	EARTHING NOTES FOR SWITCHYARD: GENERAL:	ANNEXURE-II	
i)	Earthing of operating boxes, cubicles shall be done by 50 X 6 mm GS flat while cable trenches and structure by 75 X 12 mm GS flat.		
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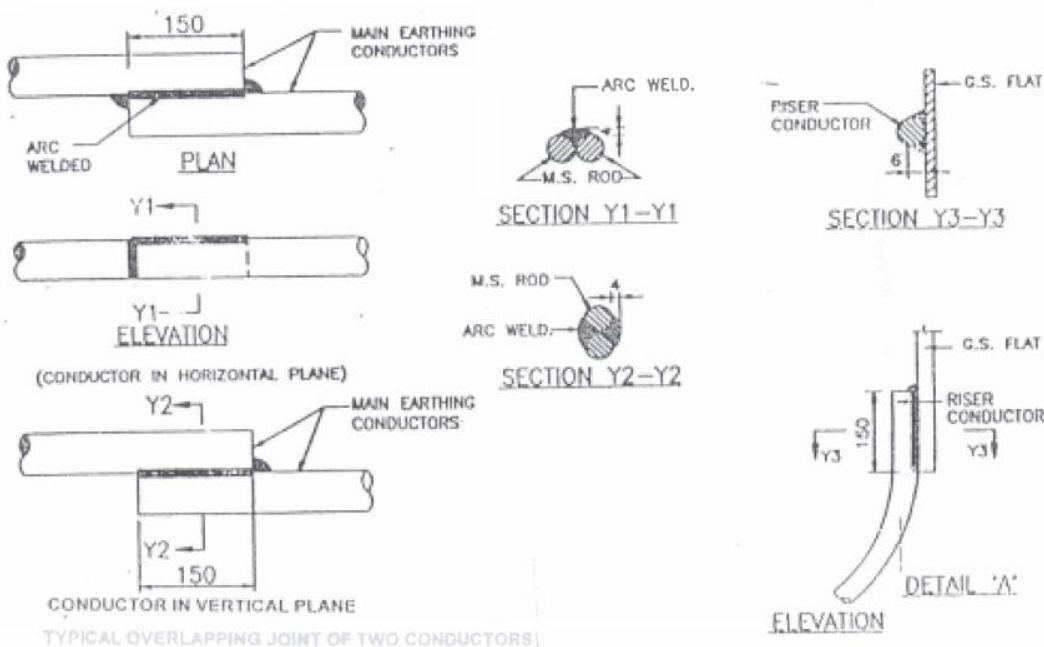
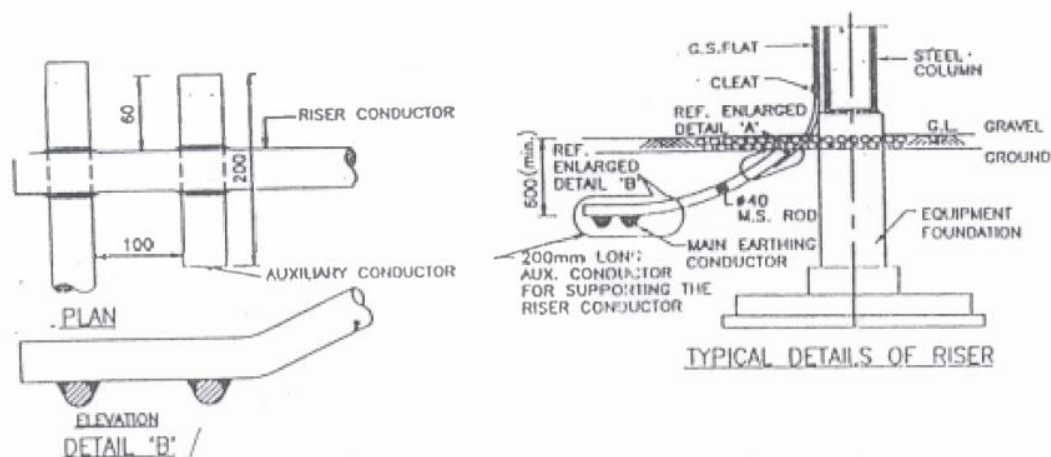
Clause No.	TECHNICAL REQUIREMENTS		
	<p>ii. Neutral points of systems of different voltages, metallic enclosures and frame works associated with all current carrying equipments and extraneous metal works associated with electric system shall be connected to a single earthing system unless stipulated otherwise.</p> <p>iii. Earthing system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, relevant Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.</p> <p>b) EARTHING OF GIS:</p> <p>i) The grounding system shall be designed and provided as per IEEE-80-2000 and CIGRE-44 to protect operating staff against any hazardous touch voltages and electro-mechanical interferences.</p> <p>ii.) The GIS contractor shall define clearly what constitutes the main grounding bus of the GIS. The GIS contractor must supply, commission the entire grounding work of GIS viz conductor, clamps, joints, bimetallic strips (for connection between different type of earthing materials), operating and safety platforms etc.</p> <p>iii.) The enclosure of the GIS shall be grounded at several points so that there shall be grounded cage around all the live parts. A minimum of two nos. of grounding connections should be provided for each of circuit breaker, transformer terminals, cable terminals, surge arrestors, earth switches and at each end of the bus bars. The grounding continuity between each enclosure shall be effectively interconnected with links or straps to bridge the flanges. Subassembly-to-subassembly bonding shall be provided to provide gap & safe voltage gradients between all intentionally grounded parts of the GIS assembly & between those parts and the main grounding bus of the GIS.</p> <p>iv) The enclosure grounding system shall be designed to minimize circulating currents and to ensure that the potential rise is kept to an acceptable level. Each marshalling box, local control panel, power and control cable sheaths and other non current carrying metallic structures shall be connected to the grounding system of GIS via connections that are separated from GIS enclosures.</p> <p>u) The contractor shall provide suitable measure to mitigate transient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrester, phase/earth fault and discharges between contracts during switching operation. The grounding system shall ensure safe touch & step voltages in all the enclosures. The contractor shall provide suitable barrier of non-liner resistor/counter discontinued SF6/Transformer and SF6/ HV cable bushing etc. to mitigate transient enclosure voltage.</p>		
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Clause No.	TECHNICAL REQUIREMENTS			
c)	DETAILS OF EARTHING SYSTEM:			
	Item	Size	Material	
	Main Earthing conductor	40mm dia rod	Mild steel	
	Conductor above ground & earthing leads (for equipment)	75 x 12/ G.S. Flat 50 x 6	Galvanized steel	
	Rod Electrode	40mm dia, 3000mm	Mild steel	
	G.I. Earthwire	7/8 SWG	GI	
	Copper Flat (if required)	as per requirement		
d)	For Step and Touch Potential the following parameters shall be considered			
	i) Current distribution factor – 1 (one)			
	ii) Duration of fault current – 0.5 sec			
	iii) Human body weight – 50kg			
e)	Grid resistance shall be less than 1(one) ohm.			
f)	EARTHING CONDUCTOR LAYOUT:			
	i. Earthing conductors in outdoor areas shall be buried atleast 600mm below finished grade level unless stated otherwise.			
	ii. Minimum 6000mm or higher spacing between rod electrodes shall be provided based on the earthmat design calculations.			
	iii. Wherever earthing conductors cross cable trenches, underground service ducts, pipes, tunnels, railway tracks etc., it shall be laid atleast 300mm below them and shall be re-routed in case it fouls with equipment/structure foundations.			
	iv. Tap connections from the earthing grid to the equipment/structure to be earthed, shall be terminated on the earthing terminals of the equipment/structure, if the equipment is available at the time of laying the grid. Otherwise, “earth insert” with temporary wooden cover or “earth riser” shall be provided near the equipment foundation/pedestal for future connections to the equipment earthing terminals.			
	v. Earthing conductor along their run on cable trench ladder columns, beams, walls, etc. shall be supported by suitable welding/cleating at intervals of 750mm. Earthing conductors along cable trenches shall be on the wall nearer to the equipment. Wherever it passes through walls, floors etc. galvanized iron sleeves			
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Clause No.	TECHNICAL REQUIREMENTS			
	<p>shall be provided for the passage of the conductor. Both ends of the sleeves shall be sealed to prevent the passage of water through the sleeves.</p> <p>vi. Earthing conductor around the building shall be buried in earth at a minimum distance of 1500mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500mm away from such location.</p> <p>vii. In outdoor areas, tap connections shall be brought 300mm above ground level for making connections in future, in case equipment is not available at the time of grid installations.</p> <p>viii. Earthing conductors crossing the road shall be either installed in hume pipes or laid at greater depth to suit the site conditions.</p> <p>ix. Earthing conductors embedded in the concrete fibre shall have approximately 50mm concrete cover.</p> <p>g) EQUIPMENT AND STRUCTURE EARTHING:</p> <p>i. The connection between earthing pads and the earthing grid shall be made by short and direct earthing leads free from kinks and splices. In case earthing pads are not provided on the item to be earthed, same shall be provided in consultation with engineer.</p> <p>ii. Metallic pipes, conduits and cable tray sections for cable installation shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to earthing system.</p> <p>iii. Metallic conduits shall not be used as earth continuity conductor.</p> <p>iv. A separate earthing conductor shall be provided for earthing lighting fixtures, lighting poles, receptacles, switches, junction boxes, lighting conduits, etc.</p> <p>v. Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam, conduits, etc. and steel reinforcement in concrete it shall be bonded to the same.</p> <p>vi. Cable and cable boxes/glands, lockout switches etc. shall be connected to the earthing conductor running alongwith the supply cable which, in turn, shall be connected to earthing grid conductor at minimum two points, whether specifically shown or not.</p> <p>vii. Railway tracks within switchyard area shall be bonded across fish plates and connected to earthing grid at several locations.</p>			
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Clause No.	TECHNICAL REQUIREMENTS			
h)	viii.	Earthing conductor shall be buried 2000mm outside the switchyard fence. Every post of the fence and gates shall be connected to earthing loop by one lead.		
	ix.	Flexible earthing connectors shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.		
	x.	Equipment earthing (Riser & welding of two conductors) shall be done as per standard drawing enclosed in this part.		
	JOINTING:			
	i.	Earthing connections with equipment earthing pads shall be of bolted type. Contact surfaces shall be free from scales, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making each connection. Equipment bolted connections, after being checked and tested, shall be painted with anti-corrosive paint/compound.		
	ii.	Connection between equipment earthing lead and between main earthing conductors shall be welded/brazed type. For rust protections, the welds should be treated with red lead and afterwards thickly coated with bitumen compound to prevent corrosion.		
	iii.	Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.		
	iv.	Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.		
	v.	All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.		
	vi.	Bending of large diameter rod/thick conductor shall be done preferably by gas heating.		
	vii.	All arc welding with large diameter conductors shall be done with low hydrogen content electrodes.		
	i)	POWER CABLE EARTHING:		
		Metallic sheaths and armour of all multi core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.		
	j)	SPECIFIC REQUIREMENT FOR EARTHING SYSTEMS:		
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Clause No.	TECHNICAL REQUIREMENTS		
i.	Earthing terminal of each surge arrester, capacitor voltage transformer and lightning down conductors shall be directly connected to rod electrode which in turn, shall be connected to station earthing grid.		
ii.	Auxilliary earthing mat of 1500mm X 1500mm size comprising of closely spaced conductors at (300mm x 300mm) spacing and at 300mm below ground shall be provided below the operating handles of the isolators. Operating handle shall be directly connected to earthing mat.		
k)	SPECIFIC REQUIREMENTS FOR LIGHTNING PROTECTION SYSTEM:		
i.	Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.		
ii.	Down conductors shall be cleated on the structures at 2000mm interval.		
iii.	Connection between each down conductor and rod electrodes shall be made via test joint located approximately 150mm above ground level.		
iv.	Lightning conductors shall not pass through or run inside G.I. conduits.		
v.	Lightning protection system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.		
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NOTE : WELDING OF EARTHING CONDUCTOR SHALL BE CONDUCTED IN VERTICAL PLANE
WHEREVER POSSIBLE


EQUIPMENT EARTHING DETAILS


STANDARD DRAWING


11.00.00

SITE TESTING AND COMMISSIONING:

Clause No.	TECHNICAL REQUIREMENTS			
11.01.00	INTRODUCTION: An indicative list of tests for GIS as applicable is given below. Contractor shall perform any additional test based on specialties of the items as per the field QP/ instructions of the equipment supplier or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall get the list of instruments approved from the Employer.			
11.02.00	GENERAL CHECKS: a) Check for physical damage. b) Visual examination of zinc coating/ plating c) Check from name plate that all items are as per older/ specification. d) Check tightness of all bolts, clamps and connecting terminals using toque wrenches. e) For oil filled equipment check for oil leakage, if any. Also check oil level and top up. f) Check ground connections for quality of weld and application of zinc rich paint over weld joint of galvanized surfaces. g) Check cleanliness of insulator and bushings. h) All checks and tests specified by the manufactures in their drawings and manuals as well as all tests specified in the relevant code of erection. i) Check for surface finish of grading rings (corona control ring.) j) Pressure test on all pneumatic lines at 1.5 times the rated pressure shall be conducted.			
11.03.00	CIRCUIT BREAKERS: a) Insulation resistance of each pole. b) Check adjustments, if any, suggested by manufacturer. c) Breaker closing and tripping time. d) Slow and power closing operation and opening e) Trip free and anti pumping operation. f) Minimum pick up volts of coils g) Contact resistance h) Functional checking of compressed air plant and all accessories i) Functional checking of control circuits, interlocks, tripping through protective relays and auto-reclose operation. j) Insulation resistance of control circuits, motor etc. k) Resistance of closing and tripping coils.			
11.04.00	ISOLATORS: a) Insulation resistance of each pole b) Manual and electrical operation on interlocks c) Insulation resistance of control circuits and motors. d) Ground connections e) Contact resistance			
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Clause No.	TECHNICAL REQUIREMENTS	
	<div><div>f) Proper alignment to minimise the vibration to the extreme possible during operation.</div><div>g) Measurement of operating torque for isolator and Earth switch</div><div>h) Resistance of operating and interlocking coils.</div></div>	
11.05.00	<div><div>CURRENT TRANSFORMERS:</div><div><div>a) Insulation Resistance Test</div><div>b) Polarity test.</div><div>c) Ratio identification test-checking of all ratios on all cores by primary injection of current.</div><div>d) Dielectric test of oil (wherever applicable).</div><div>e) Magnetizing characteristics test.</div><div>f) Capacitance and tan delta measurement at minimum 10kV.</div></div></div>	
11.06.00	<div><div>VOLTAGE TRANSFORMERS/CAPACITOR VOLTAGE TRANSFOREMER:</div><div><div>a) Insulation resistance test.</div><div>b) Polarity test.</div><div>c) Ratio test.</div><div>d) Dielectric test of oil (if applicable).</div><div>e) Capacitance and tan delta measurement at minimum 10kV.</div></div></div>	
11.07.00	<div><div>SURGE ARRESTER:</div><div><div>a) Grading leakage current.</div><div>b) Resistance of ground connection.</div><div>c) Resistive current drawn at rated voltage after energisation.</div></div></div>	
11.08.00	<div><div>PHASING OUT:</div><div>The phasing out of all supplies in the station system shall be carried out.</div></div>	
11.09.00	<div><div>STATION EARTHING:</div><div><div>a) Check soil resistivity</div><div>b) Check continuity of grid wires</div><div>c) Check earth resistance of the entire grid as well as various sections of the same.</div><div>d) Check for weld joint and application of zinc rich paint on galvanised surface.</div><div>e) Dip test on earth conductor prior to use.</div></div></div>	
11.10.00	<div><div>CONDUCTOR STRINGING AND POWER CONNECTORS:</div><div><div>a) Physical check for finish</div><div>b) Electrical clearance check</div><div>c) Testing of torque by torque by torque wrenches on all bus power connectors and other accessories.</div><div>d) Sag and tension check on conductors.</div></div></div>	
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Clause No.	TECHNICAL REQUIREMENTS			
11.11.00	INSULATORS: Visual examination for finish damage, creepage distance, etc.			
12.	GIS TO CABLE TERMINATION – CABLE SEALING END 13.1. This scope covers the supply, erection, commissioning of connection assembly of fluidfilled or extruded cables to gas-insulated metal enclosed switchgear (GIS) as per IEC 62271-209 13.2. The XLPE cables shall be connected to GIS by the interfacing of XLPE cable sealing end to GIS Cable termination enclosure. 13.3. The GIS to XLPE cable termination shall conform to IEC-62271-209. 13.4. The rating of XLPE cables for different voltages is specified in the Section project. 13.5. The limits of supply of gas-insulated metal-enclosed switchgear and the cable termination shall be in accordance with IEC 62271-209. 13.6. Cable termination and cable connection enclosure shall be suitable for the requirements for which it is designed. This interface section shall be designed in a manner which will allow ease of operation and maintenance. 13.7. The SF6 cable end unit and connection support structure should be equipped with provisions for isolating the cable sheath or pipe to permit cathodic protection of cable system.(see IEC 62271-209) 13.8. The provision shall be made for a removable link. The gap created when the link is removed should have sufficient electric strength to withstand the switchgear high voltage site tests. The contractor may suggest alternative arrangements to meet these requirements. The corona rings/stress shields for the control of electrical field in the vicinity of the isolation gap shall be provided by the GIS manufacturer. 13.9. All supporting structures for the SF6 bus-duct connections between the XLPE cable sealing ends and the GIS shall be the scope of the			
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Clause No.	<div> <div> TECHNICAL REQUIREMENTS </div> <div>  </div> </div>		
	<p>contract. The supplier may specify alternative connecting & supporting arrangements for approval of the Employer.</p> <p>13.10. The opening for access shall be provided in each phase terminal enclosures as necessary to permit removal of connectors to isolate the XLPE cables to allow carrying out the insulation tests. The general arrangement drawing of interconnecting bus-duct from GIS bay module to XLPE cable termination end shall also be submitted.</p>		
<div> <div> GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE </div> </div>	<div> <div> TECHNICAL SPECIFICATIONS SECTION-VI ,PART B BID DOC NO: CS-6401-001-2 </div> </div>	<div> <div> B-17: SWITCHYARD </div> </div>	<div> <div> PAGE 78 of 78 </div> </div>

SUB-SECTION-B – 18

NOT USED

SUB-SECTION-B – 19

BATTERY

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00	BATTERY AND DC HEALTH MONITORING SYSTEM			
	BATTERY RATINGS			
1.01.00	1. For Ni-Cd Type Battery			
	a)	Battery Voltage	110V DC	
	b)	No. of Cells	As per Sizing Calculations	
	c)	Battery type	Stationary Nickel-Cadmium Pocket Plate High discharge type (KPH)	
	d)	Capacity for five(5)hour rate	As per requirement	
	e)	Nominal discharge voltage per Cell	1.2 V	
	f)	Float voltage	As per manufacturer's standards for float application	
	2. For Lead Acid Plante type Battery			
	a)	Battery Voltage	220V/110V/48 V DC	
	b)	No. of Cells	As per Sizing Calculations	
	c)	Battery type	Stationary Lead Acid Plante high discharge type	
	d)	Capacity for ten(10)hour rate	As per requirement	
	e)	Nominal voltage per cell discharge	2.0 V	
	f)	Float Voltage	As per manufacturer's standards for float application	
	<p>Note:</p> <p>DC health monitoring system shall be offered integral with each battery set for Main Plant & Switchyard batteries.</p>			
	Commissioning of Battery			
	<p>Commissioning of each battery at site shall only be carried out either by the battery manufacturer himself or under the supervision of the battery manufacturer.</p>			
	GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB-SECTION B-19 BATTERY AND DC HEALTH MONITORING SYSTEM
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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनडीपीसी NTPC</div>
	IS 8320	General requirements and methods of tests for lead acid storage batteries.		
	IS 6071	Specification for synthetic separators for lead acid batteries.		
		Indian Electricity Rules		
		Indian Electricity Acts		
5.00.00	TESTS			
5.01.00	For conductance/report submission/validity of type tests, refer Sub Section-II B, Section-VI, Part A of technical specifications. The Contractor shall submit for Owner’s approval the reports of all the type tests carried out as per latest IS-1146 (for rubber & plastic containers for lead-acid storage batteries)/IS 1652 (for lead-acid plante batteries). The complete type test reports shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier.			
5.02.00	Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of battery.			
5.03.00	Commissioning Checks: Commissioning of each battery at site shall only be carried out either by the battery manufacturer himself or under the supervision of the battery manufacturer.			
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SUB-SECTION-B – 20


NOT USED

SUB-SECTION-B – 21

NOT USED

SUB-SECTION-B – 22


BUSDUCTS

CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.00.00 <				

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
a)	The current transformers shall be epoxy cast-resin, single core, mounted within the bus duct enclosure and suitable for operation at an ambient temperature existing within the bus duct enclosure which may be in range of 90 deg. C to 100 deg.C. Mounting arrangement of CT shall be so designed so as to avoid equalizing connections between live conductor and CT inner surface. All measuring CTs shall be 0.2 accuracy class and ABT type metering CT shall be 0.2s accuracy class. Protection CTs shall be PS/5P20 as applicable. However the location of CT mounting as per contractor standard proven practice is also acceptable.			
b)	CT secondary leads shall be brought out through non-magnetic metallic conduits to a marshalling box (MB) with degree of protection IP-55 (IS:13947 Pt.1). The MB shall be provided with removable aluminum gland plant. The facility for shorting and grounding shall be provided at the terminal blocks. PTs shall be dual accuracy class (3P/0.2)			
7.01.02	Voltage Transformer and Surge protection Cubicles			
a)	The V.T and S.P cubicles for each phases shall be metal clad, dust and vermin proof, free standing, dead front assemblies housing VTs, surge capacitor, lightning arrester, V.T. L.V. side fuses etc.			
b)	Each VT and SP cubicle shall have seal off busing at the terminations of tap-off busduct to cubicle.			
c)	Lightning arrester shall be Gapless type station class, hermetically sealed, connected between line and ground, specifically suitable for generator protection as per technical parameters given elsewhere in the specifications.			
d)	A discharge counter shall be provided for each lightning arrester. The discharge counter register shall be visible without having to open the compartment door.			
e)	Mineral oil filled/Askarel (PCBS) filled surge capacitor shall not be acceptable.			
f)	The voltage transformer shall be epoxy cast-resin type, suitable for nominal voltage operation, connected from line to ground, and as per Technical Parameters given elsewhere in the specifications.			
g)	The voltage transformer along with secondary fuses shall be mounted on draw out type carriage. Suitable guide slots and stops shall be provided to ensure easy withdrawal and positioning. The fixed and draw out contacts of voltage transformer primary shall be tinned or silver plated. No fuse shall be used in voltage transformer primary circuit.			
h)	In the disconnected position, the voltage transformer primary and secondary circuits shall be automatically disconnected. The draw out frame shall be grounded at all times. A reliable automatically operated shutter mechanism shall be provided for isolating and shrouding the bus bar live parts when the VT is in drawn out position.			
i)	The secondary leads from the voltage transformer shall be extended to two separate fuses for dual accuracy PT and terminal cabinet flush mounted in the compartment.			
j)	From phase cabinets the VT secondary leads shall be brought to marshalling box having sufficient number of terminals with 20% spare, to accommodate all VT leads. Facility of making star points and undrilled gland plate for cable connections shall be provided in the marshalling box.			
k)	VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks, provided in the instrument transformer marshalling boxes. The facility for connecting to earthing grid shall be provided by the contractor through suitable connectors in the marshalling box with isolating links for testing of instrument transformers.			
7.01.03	Neutral Grounding Cubicle			
a)	The transformer and resistor shall be located in separate cubicles/compartment adjacent to each other. The cubicles shall have hinged access doors capable of being pad locked.			
b)	The transformer cubicle shall be made of angle frame steel construction with formed sheet sides. The resistor cubicle shall be made of angle frame steel construction with hot dip galvanised screen sides. Alternatively it can be painted with heat resistant paint suitable for 250 deg.C. The neutral grounding equipment shall be completely assembled, wired and connected to the neutral bus tap through seal-off bushing.			
c)	The neutral grounding transformer shall be cast epoxy resin type natural air cooled single phase			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6401-001-2	SUB SECTION-B – 22 GENRATOR AND MV BUSDUCTS	PAGE 2 OF 6

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
<p>d)</p> <p>e)</p> <p>7.01.04</p> <p>a)</p> <p>b)</p> <p>c)</p> <p>7.01.05</p> <p>a)</p> <p>b)</p> <p>c)</p> <p>7.01.06</p> <p>a)</p> <p>b)</p> <p>7.01.07</p> <p>a)</p> <p>b)</p> <p>c)</p> <p>7.02.00</p> <p>7.02.01</p> <p>7.02.02</p>	<p>connected between generator neutral and ground.</p> <p>The loading resistor shall be formed of non-aging, corrosion resistant punched stainless steel grid element provided with necessary insulation and designed for indoor service for a temperature rise not exceeding 300 deg.C.</p> <p>All alarm, protection and indication leads shall be wired up to terminal blocks that shall be mounted in a IP:52 enclosure suitable for flush mounting and having a fully hinged cover with lock.</p> <p>Cubicle Construction (V.T. & S.P., N.G. Cubicle Etc.)</p> <p>All cubicles shall be fabricated from cold rolled sheet steel for minimum 2mm thick suitably reinforced to ensure structural rigidity. The degree of protection for all indoor cubicle shall be IP:52 except for neutral grounding resistor enclosure which shall be minimum IP:23.</p> <p>Space heater, Illumination and Grounding</p> <p>Each cubicle shall be equipped with space heater with thermostat, internal illumination lamp, 240 V AC, 5A receptacle. Ground bus suitable for receiving two (2) numbers of 50x6mm galvanised steel flats shall be provided on each cubicle.</p> <p>Wiring</p> <p>All wiring shall be done with insulated stranded copper conductor of not less than 2.5 sq.mm cross-section with suitable lugs on both sides.</p> <p>The wiring inside the bus duct enclosure (i.e. for CT etc.) shall be suitable for operating in the ambient temperature existing inside the bus duct.</p> <p>Not more than two wires shall be connected to a terminal. Spare terminals equal in number to 20% of active terminals shall be furnished and these shall be uniformly distributed through out the cubicle CT terminal blocks shall be of stud type and suitable for round type lugs with a facility for isolation, shorting and grounding. It shall be Elmex type CATD or equivalent.</p> <p>Name Plate</p> <p>Name plates shall be furnished for each equipment, disconnect link, voltage transformer compartment, lightning arrester compartment and fuse block, current transformer TB, Air pressurisation cubicles etc.</p> <p>Material for name plate shall be plastic / lamicaid 3mm thick using white letters on black background.</p> <p>Finish</p> <p>Except for supporting steel structures which shall be galvanised, all equipment including bus duct enclosure shall be finished with an under coats of high quality primer followed by two coats of synthetic enamel paint which shall have a thickness not less than 50 microns.</p> <p>The interior surface finish of bus duct enclosure shall be as per manufacturer's standard. The shade of exterior surface shall be shade RAL 5012 for busduct and equipment. The shade of interior surface of cubicles shall be glossy white. The identification tag shall be signal red shade ISC 537 or RAL 3001</p> <p>Pre-treatment consisting of degreasing, de-rusting etc. shall be done on all fabricated parts before painting of cubicles, cabinets, marshalling boxes and galvanization of steel structures.</p> <p>Generator/MV Busducts</p> <p>Enclosure</p> <p>Aluminum alloy with minimum thickness of 3mm, naturally cooled. Each section shall be welded construction. Sections may be joined through bolted connections. Suitable rain hoods for outdoor joints shall be provided. Adequate number of thermostat controlled space heaters or any other proven arrangement to prevent condensation to be provided.</p> <p>Phase barriers</p>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6401-001-2	SUB SECTION-B – 22 GENRATOR AND MV BUSDUCTS	PAGE 3 OF 6	

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>																		
7.02.03	<p>MV busduct phase barriers shall be made of Aluminum alloy of minimum thickness of 3.0 mm.</p> <p>Conductor</p> <p>Shall be of high conductivity, aluminum alloy or Copper, sections shall be welded or bolted.</p>																					
7.02.04	<p>Flexibles for Conductors to be provided at all equipment termination and in bus duct run to accommodate thermal expansion / contraction, vibration and misalignment as also for providing adequate clearances for independently testing the equipment being connected.</p>																					
7.02.05	<p>The busduct shall be provided with adequate number of thermostatically controlled space heaters of adequate capacity to maintain the internal temperature above the dew point to prevent moisture condensation within the busduct. Space heaters shall be rated for 240V, single phase, 50Hz AC supply.</p>																					
7.02.06	<p>Joints</p> <p>Shall be bolted and flexible joints for conductor and enclosures.</p>																					
7.02.07	<p>NOT USED.</p>																					
7.02.08	<p>Bimetallic connectors</p> <p>Shall be provided in case equipment terminals and material of bus conductor are different for the non silver plated joints.</p>																					
7.02.09	<p>Insulators</p> <p>Glazed porcelain/ high strength epoxy cast resin with a minimum creepage distance of 20 mm/kV. The insulators shall be designed and mounted to facilitate easy inspection, removal & inspection along with provision of conductor fastening by fixed and sliding joints.</p>																					
7.02.10	<p>Seal Off Bushing</p> <p>Shall be provided at terminations and wall crossing and at each of the switchgear terminations.</p>																					
7.02.11	<p>Wall Frame Assembly</p> <p>Shall be provided wherever bus-duct penetrates plant walls Expansion bellows</p> <p>Neoprene/EPDM or metallic expansion bellows shall be provided on enclosures for thermal expansion, vibrations and misalignment. To be provided at terminations and as required.</p>																					
7.02.12	<p>Enclosure supports</p> <p>Shall be provided Hot dip galvanised mild steel support structures to withstand normal operation, vibration, thermal expansion and short circuit forces.</p>																					
7.02.13	<p>Minimum clearances for MV busduct shall be :</p> <table><tr><td>Phase to phase</td><td>:</td><td>100 mm (for 6.6KV)</td></tr><tr><td></td><td></td><td>130 mm (for 11KV)</td></tr><tr><td></td><td></td><td>70 mm (for 3.3 kV)</td></tr><tr><td>Phase to earth</td><td>:</td><td>90 mm (for 6.6KV)</td></tr><tr><td></td><td></td><td>120 mm (for 11KV)</td></tr><tr><td></td><td></td><td>60 mm (for 3.3 kV)</td></tr></table>				Phase to phase	:	100 mm (for 6.6KV)			130 mm (for 11KV)			70 mm (for 3.3 kV)	Phase to earth	:	90 mm (for 6.6KV)			120 mm (for 11KV)			60 mm (for 3.3 kV)
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7.02.14	<p>Openings covered with louvers backed up with removable dust filters shall be provided at appropriate location to enable the MV busduct enclosure to breathe in a manner so that possibility of condensation is minimised.</p>																					
7.02.15	<p>Earthing of Enclosure</p> <p>Adequately sized Galvanised mild steel earth bar shall run along the length of busduct. Each enclosure section shall be connected to the earth bar at both ends. Both ends of earth bar shall be connected to</p>																					
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6401-001-2	SUB SECTION-B – 22 GENRATOR AND MV BUSDUCTS	PAGE 4 OF 6																		

CLAUSE NO.	TECHNICAL REQUIREMENTS			
8.00.00 8.01.00 				

CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>																																																																																																																																																																																									
	<div><div>Details of Current Transformer Parameters</div><table><tr><th>Sl.No</th><th>CT Ref</th><th>CTR</th><th>Accuracy Class</th><th>Burden (VA)</th><th>Kpv(V)</th><th>Max Ie at Kpv/2(mA)/ISF (max)</th><th>Max Rct at 75 deg C(Ohms)</th><th>Location</th><th>Purpose</th></tr><tr><td>1</td><td>CT-A</td><td>27000/5</td><td>PS</td><td>-</td><td>2000</td><td>150</td><td>5</td><td rowspan="5">Neutral Bus Duct</td><td>Overall Differential</td></tr><tr><td>2</td><td>CT-B</td><td>27000/5</td><td>PS</td><td>-</td><td>2000</td><td>150</td><td>5</td><td>Generator Protection</td></tr><tr><td>3</td><td>CT-C</td><td>27000/5</td><td>0.2</td><td>75</td><td>-</td><td>5</td><td>-</td><td>Perf Testing, LFPR, Reverse Power</td></tr><tr><td>4</td><td>CT-D</td><td>27000/5</td><td>0.2</td><td>75</td><td>-</td><td>5</td><td>-</td><td>Governor Channel#1, AVR Channel#1</td></tr><tr><td>5</td><td>CT-E</td><td>27000/5</td><td>PS</td><td>-</td><td>2000</td><td>150</td><td>5</td><td>Generator Differential Protection</td></tr><tr><td>6</td><td>CT-F</td><td>27000/5</td><td>PS</td><td>-</td><td>2000</td><td>150</td><td>5</td><td rowspan="4">Phase Bus Duct</td><td>Generator Differential Protection</td></tr><tr><td>7</td><td>CT-G</td><td>27000/5</td><td>0.2</td><td>75</td><td>-</td><td>5</td><td>-</td><td>Metering, Governor Channel#2</td></tr><tr><td>8</td><td>CT-H</td><td>27000/5</td><td>0.2</td><td>75</td><td>-</td><td>5</td><td>-</td><td>Governor Channel#3, AVR Channel#2</td></tr><tr><td>9</td><td>CT-J</td><td>27000/5</td><td>PS</td><td>-</td><td>2000</td><td>150</td><td>5</td><td>Generator Protection</td></tr><tr><td>10</td><td>CT-K1</td><td>1600/1</td><td>5P20</td><td>30</td><td>-</td><td>-</td><td>-</td><td>At Tap-Off</td><td>UT Back up OC Protection</td></tr><tr><td>11</td><td>CT-L1</td><td>1600/1</td><td>PS</td><td>-</td><td>500</td><td>30</td><td>6</td><td rowspan="2">Bus Duct for UT#1A</td><td>UT Differential Protection</td></tr><tr><td>12</td><td>CT-M1</td><td>27000/5</td><td>PS</td><td>-</td><td>2000</td><td>150</td><td>5</td><td>Overall Differential Protection</td></tr><tr><td>13</td><td>CT-K2</td><td>1600/1</td><td>5P20</td><td>30</td><td>-</td><td>-</td><td>-</td><td>At Tap-Off</td><td>UT Back up OC Protection</td></tr><tr><td>14</td><td>CT-L2</td><td>1600/1</td><td>PS</td><td>-</td><td>500</td><td>30</td><td>6</td><td rowspan="2">Bus Duct for UT#1B</td><td>UT Differential Protection</td></tr><tr><td>15</td><td>CT-M2</td><td>27000/5</td><td>PS</td><td>-</td><td>2000</td><td>150</td><td>5</td><td>Overall Differential Protection</td></tr><tr><td>16</td><td>CT-N</td><td>As per system requirment/5</td><td>1.0</td><td>60</td><td>-</td><td>5</td><td>-</td><td>NG Cubicle</td><td>Stator Earth Fault Protection</td></tr></table></div> <div><div>Details of Voltage Transformer Parameters</div><table><tr><th>Sl.No</th><th>VT Ref</th><th>VT Ratio</th><th>Class</th><th>Burden (VA)</th><th>Purpose</th></tr><tr><td>1</td><td>01VT</td><td>(Gen. Terminal Voltage/$\sqrt{3}$) / (110/$\sqrt{3}$)</td><td>3P/0.2 (Dual Accuracy Class)</td><td>100</td><td>GRP#1 Protection, Governor Channel#1</td></tr><tr><td>2</td><td>02VT</td><td>(Gen. Terminal Voltage/$\sqrt{3}$) / (110/$\sqrt{3}$)</td><td>3P/0.2 (Dual Accuracy Class)</td><td>100</td><td>GRP#2 Protection, Governor Channel#2, AVR Channel#1</td></tr><tr><td>3</td><td>03VT</td><td>(Gen. Terminal Voltage/$\sqrt{3}$) / (110/$\sqrt{3}$)</td><td>0.2</td><td>100</td><td>Metering, Governor Channel#3, AVR Channel#2, Synchronisation and Performance Testing</td></tr></table></div> <div><div>Note:</div><div>Each type of CT/VT mentioned in above table shall have 3 nos (R,Y,B) of CTs/VTs except for CT-N which is one in number. Details provided above is for one unit.</div></div>	Sl.No	CT Ref	CTR	Accuracy Class	Burden (VA)	Kpv(V)	Max Ie at Kpv/2(mA)/ISF (max)	Max Rct at 75 deg C(Ohms)	Location	Purpose	1	CT-A	27000/5	PS	-	2000	150	5	Neutral Bus Duct	Overall Differential	2	CT-B	27000/5	PS	-	2000	150	5	Generator Protection	3	CT-C	27000/5	0.2	75	-	5	-	Perf Testing, LFPR, Reverse Power	4	CT-D	27000/5	0.2	75	-	5	-	Governor Channel#1, AVR Channel#1	5	CT-E	27000/5	PS	-	2000	150	5	Generator Differential Protection	6	CT-F	27000/5	PS	-	2000	150	5	Phase Bus Duct	Generator Differential Protection	7	CT-G	27000/5	0.2	75	-	5	-	Metering, Governor Channel#2	8	CT-H	27000/5	0.2	75	-	5	-	Governor Channel#3, AVR Channel#2	9	CT-J	27000/5	PS	-	2000	150	5	Generator Protection	10	CT-K1	1600/1	5P20	30	-	-	-	At Tap-Off	UT Back up OC Protection	11	CT-L1	1600/1	PS	-	500	30	6	Bus Duct for UT#1A	UT Differential Protection	12	CT-M1	27000/5	PS	-	2000	150	5	Overall Differential Protection	13	CT-K2	1600/1	5P20	30	-	-	-	At Tap-Off	UT Back up OC Protection	14	CT-L2	1600/1	PS	-	500	30	6	Bus Duct for UT#1B	UT Differential Protection	15	CT-M2	27000/5	PS	-	2000	150	5	Overall Differential Protection	16	CT-N	As per system requirment/5	1.0	60	-	5	-	NG Cubicle	Stator Earth Fault Protection	Sl.No	VT Ref	VT Ratio	Class	Burden (VA)	Purpose	1	01VT	(Gen. Terminal Voltage/ $\sqrt{3}$) / (110/ $\sqrt{3}$)	3P/0.2 (Dual Accuracy Class)	100	GRP#1 Protection, Governor Channel#1	2	02VT	(Gen. Terminal Voltage/ $\sqrt{3}$) / (110/ $\sqrt{3}$)	3P/0.2 (Dual Accuracy Class)	100	GRP#2 Protection, Governor Channel#2, AVR Channel#1	3	03VT	(Gen. Terminal Voltage/ $\sqrt{3}$) / (110/ $\sqrt{3}$)	0.2	100	Metering, Governor Channel#3, AVR Channel#2, Synchronisation and Performance Testing	<div>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</div> <div>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: CS-6401-001-2</div> <div>SUB SECTION-B – 22 GENRATOR AND MV BUSDUCTS</div> <div>PAGE 6 OF 6</div>
Sl.No	CT Ref	CTR	Accuracy Class	Burden (VA)	Kpv(V)	Max Ie at Kpv/2(mA)/ISF (max)	Max Rct at 75 deg C(Ohms)	Location	Purpose																																																																																																																																																																																		
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SUB-SECTION-B – 23

132KV EHV CABLE & ACCESSORIES

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	132KV CABLE & ACCESSORIES			
1.00.00	CODES AND STANDARDS			
1.01.00	The design, manufacture, testing and performance of the cables supplied under this specification shall comply with the latest edition of the following Standards, Rules and Acts.			
	IEC Standards			
	IEC 60840	Power cables with extruded insulation and their accessories for rated voltages above 30kv (Um=36kv) upto 150 kV (Um=170kv) Test methods and requirements		
	IEC 60060	H.V.Test Techniques		
	IEC 885	Electrical test methods for Electric cables.		
	IEC 60228	Conductors of Insulated cables		
	IEC 60229	Tests on cable oversheath which have a special protective function and are applied by extrusion.		
	IEC 61462	Composite Insulators- Hollow insulators for use in outdoor and indoor electrical equipment - Definitions, test methods, acceptance criteria and design recommendations		
	IEC 60183	Guide to the selection of high voltage cables		
	IEC 60230	Impulse tests on cables and their accessories.		
	IEC 60270	High Voltage Test Techniques - Partial discharge measurements		
	IEC 60287	Electric cables - Calculations of the current ratings		
	IEC 60811	Common test methods for insulating and sheathing		
	Part-1 to 4	materials of electric cables		
	IEC 60885 Part-3	Electrical test methods for electric cables -Test methods for partial discharge measurements on lengths of extruded power cables.		
	ANSI/ IEEE Std	Guide Electrical safety and Sub- station grounding 80-1986		
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CLAUSE NO.	TECHNICAL REQUIREMENTS
	<p>Indian Standards & Rules</p> <p>IS 5216 Guide for safety procedures and practice in electrical works.</p> <p>Indian Electricity Act 1910.</p> <p>Indian Electricity Rules 1956.</p> <p>2.00.00 GENERAL FEATURES</p> <p>2.01.00 Unless otherwise specified 132 KV cable shall conform to the standards specified above.</p> <p>2.02.00 The design ambient air temperature for cable shall be 50 deg C, when laid in air. The design ambient ground temperature for cables shall be 40 deg C. Cables shall be installed in air, in built up concrete trench.</p> <p>3.00.00 132 KV CABLE</p> <p>3.01.00 GENERAL</p> <p>3.01.01 The cable shall confirm to IEC-60840. The cable shall consists of single core 800 sq.mm min stranded copper compacted circular conductor, extruded semi conducting compound conductor screen, cross linked polyethylene (XLPE) dry cured insulation, extruded semi conducting compound insulation screen, bedding of swellable type water blocking semi conducting tape, copper wire screen with copper binder tape(as per requirement), aluminium or lead or lead alloy sheath and extruded PVC outersheath with overall graphite coating or overall extruded semiconducting layer</p> <p>3.01.02 The conductor screen, insulation and semiconducting insulation screen shall be extruded in one operation, so as to obtain continuously smooth interfaces. The conductor screen and insulation screen shall be of semiconducting compound. The copper wire/tape screen together with aluminium or lead or lead alloy sheath shall be capable of withstanding the short circuit current of 31.5KA for one second. The Bidder shall furnish the supporting calculation for screen sizing.</p> <p>3.01.03 The cable shall be suitable for use in solidly earthed system.</p> <p>3.01.04 The cable shall be suitable for installation in air, in built up concrete trench and/or directly buried in soil with chances of flooding by water. The cable shall withstand all mechanical and thermal stresses under steady state and transient operating conditions.</p>
<p>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW \pm5 MW) EPC PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO:CS-6401-001-2</p> <p>SUB -SECTION – B -23 132 KV CABLE & ACCESSORIES</p> <p>PAGE 2 OF 8</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.01.05	Repair to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are also not acceptable.
3.01.06	Cable ends shall be kept sealed by heat shrinkable PVC caps to prevent damage and ingress of moisture.
3.01.07	Each cable length shall be provided with a pulling socket eye which shall be fitted to the pulling end. Pulling socket eye shall be able to take the pulling force.
3.01.08	The Eccentricity of the core shall not exceed 10% and Ovality of the core shall not exceed 5%.
	The Eccentricity shall be calculated as $(t_{\max} - t_{\min})/t_{\max} \leq 0.15$
	The Ovality shall be calculated as $(d_{\max} - d_{\min})/d_{\max} \leq 0.05$ where t_{\max}/t_{\min} are the maximum/minimum thickness of insulation and d_{\max}/d_{\min} are the maximum/minimum diameter of the core.
3.02.00	CONDUCTOR
	Conductor shall consist of plain annealed copper wires in accordance with IEC-60228 or equivalent and the shape shall be circular and very well compacted to facilitate a smooth interface between conductor screen(shield) and the insulation. The conductor shall have smooth surface with no intermediate joint.
3.03.00	CONDUCTOR SCREEN (SHIELD)
	Conductor screen shall consist of extruded semi-conducting compound applied over the conductor, which shall be firmly bonded to the inner surface of the insulation layer. The semi-conducting compound shall be free from any void and protrusion.
3.04.00	INSULATION
	Insulation shall be of extruded Cross Linked Polyethylene (XLPE). The insulation shall be free from any void and contaminant.
3.05.00	INSULATION SCREEN(SHIELD)
	Insulation screen shall consist of extruded semi-conducting compound and shall firmly be bonded to the insulation. The semi-conducting compound shall be free from any void and protrusion.
3.06.00	BEDDING
	Bedding shall consist of layer(s) of swellable semi conducting tape(s) to be applied over the extruded semi-conducting insulation screen with suitable overlap. Semiconducting swelling tape(s) shall also be provided over copper wire screen(if applicable).
3.07.00	METALLIC SHEATH
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW \pm 5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO:CS-6401-001-2
SUB -SECTION – B -23 132 KV CABLE & ACCESSORIES	PAGE 3 OF 8

CLAUSE NO.	TECHNICAL REQUIREMENTS
<p>3.08.00</p> <p>3.09.00</p> <p>4.00.00</p> <p>4.01.00</p> <p>4.02.00</p> <p>5.01.00</p>	<p>The metallic innersheath shall consist of aluminium or lead or lead alloy. The calculations for sizing and short circuit withstand capability of the metallic sheath, alongwith copper wire screen & copper binder tape(if applicable) shall be submitted during detailed design stage.</p> <p>OUTER SHEATH</p> <p>Outer sheath shall consist of extruded black PVC compound, in accordance with IEC-60840.</p> <p>CABLE IDENTIFICATION/ MARKING</p> <p>Atleast the following clear markings shall be provided over outer sheath of the cable at an interval of five metres throughout the length of the cable by embossing: Rated voltage Conductor size Type of insulation Manufacturer's name Year of manufacture Purchaser's name Sequential marking of length of cable in metres by embossing/printing at every meter.</p> <p>The embossing/printing shall be progressive, automatic, in line and marking shall be legible and indelible and incase of printing it should be done with the help a contact less printer.</p> <p>CABLE DRUMS</p> <p>Cables shall be supplied in steel drums of heavy construction.</p> <p>The drum lengths to be supplied shall be finalised by the contractor before commencement of manufacturing of the cable. The contractor shall supply the cables as per finalised drum length.</p> <p>Cable accessories</p> <p>The termination and jointing kits shall be suitable for the cable and shall be complete with all accessories including crimping type cable lugs, jointing materials and consumables. Accessories offered shall be of proven design.</p> <p>Out Door Sealing Ends</p> <p>The termination shall be suitable for outdoor installation in heavily polluted atmosphere and shall be made completely weather proof through cable sealing ends. Accessories shall consist of stress relief system comprising of premoulded material. The termination for open connection shall be housed in porcelain insulator/composite insulator to give high creepage resistance. The minimum nominal specific creepage distance shall be 25mm/kV. Each outdoor type sealing ends shall be supplied complete with mounting plate insulators to insulate the sealing end from supporting structures. Each sealing end shall be provided with two terminals, diametrically</p>
<p>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO:CS-6401-001-2</p> <p>SUB -SECTION – B -23 132 KV CABLE & ACCESSORIES</p> <p>PAGE 4 OF 8</p>

CLAUSE NO.
TECHNICAL REQUIREMENTS

5.02.00

Link Boxes

5.02.01

Link boxes shall be suitable for outdoor installation in heavily polluted atmosphere and shall be made completely weather proof. There shall be one link box for each phase. The cable screen/sheath connections shall be bolted type. The connecting bar and disconnecting link shall be of copper. The arrangement shall be installed in a water tight box of min. 2mm thick CRCA steel having degree of protection as IP 55.

5.02.02

The cost of link boxes shall be deemed to be included in the supply price of 132KV cable outdoor sealing ends.

5.03.00

FRP TRENCH COVER

The FRP Trench cover shall be made of non biodegradable & non corrosive material/fillers, suitable designed for required strength. FRP trench cover shall be of medium duty type as per IS1726. Suitable locking & lifting features shall be provided for the FRP trench Cover. Further FRP trench cover shall be UV resistant type. Surface profile of the FRP trench cover shall be anti-skid type. Erection of FRP trench covers shall be in the scope of contractor.

5.04.00

All accessories shall be suitable for the technical parameters as specified and shall be suitably derated to the site conditions.

6.00.00

CABLE /ACCESSORIES PARAMETERS

1	Type of Cables	Cross-linked polyethylene insulated
2	No. of Cores	Single.
3	Conductor size	800 sq. Mm min
4	Conductor material	Copper
5	Normal system voltage	132KV
6	Maximum system voltage	145kV
7	Fault current	Symmetrical short circuit 31.5 kA r.m.s for 1 second
8	System frequency	50hz
9	Frequency variation	+/- 5%
10	Rated continuous Current	As per system requirement
11	Overload capacity	Nil
12	Maximum allowable temperature for cable and accessories.	
a)	At rated full load and at site conditions.	90 deg C
b)	The conductor temperature after a short circuit for 1 second shall not exceed (with conductor temp. at inception of short circuit as 90 deg. C)	250 deg C

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	13	Basic impulse insulation level (1.2/50 micro second wave) 650 kV (peak)
	14	Laying conditions
	(a)	Built up Cable Trench. 500 mm (min) (Refer enclosed drg)
	(b)	Earthing of screen Bonded to earth at both ends.
	(c)	Ambient air temp. 50 deg. C
	(d)	Type of atmosphere Heavily polluted
	(e)	Ground temperature 40 deg C
	(f)	Thermal resistivity of soil 150 degC.cm/watt
7.00.00	INSTALLATION WORK AT SITE	
7.01.00	Cable installation shall be carried out generally as per applicable standard/ manufacturer guidelines. Cable shall be laid in built up trench. Typical sectional drawing for 132 KV built up cable trench enclosed with this chapter shall be followed for preparing the detailed drawing by contractor. All necessary work like cable tagging, marking, dressing etc. as required shall be in contractor's scope.	
7.02.00	Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall the drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out from over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be kept sealed by heat shrinkable PVC caps to prevent damage and ingress of moisture.	
7.03.00	While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangement. Pulling tension shall not exceed the values recommended by cable Manufacturer. Cable ends shall be kept sealed by heat shrinkable PVC caps to prevent damage and ingress of moisture. Selection of cable drums for each run shall be so planned so as to avoid straight through joints. Cable splices will not be allowed except where called for by the drawings or is unavoidable and permitted by the Project Manager. Care should be taken while laying the cables so as to avoid damage to cables.	
7.04.00	Bending radii for cables shall be as per manufacturer's recommendations. Manufacturer's instructions shall be strictly adhered to and necessary conducting medium for checking healthiness of outersheath shall be applied.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
7.05.00	Where cables cross roads/rail tracks underground, the cables shall be laid in HDPE pipes embedded in PCC in ground with a minimum cover of 1 metre. HDPE pipe shall also be provided where cables cross existing HT/LT cable trenches. The HDPE pipes and accessories shall be supplied, laid and encased in PCC. Ends of HDPE pipes shall be sealed properly after laying of cable.			
7.06.00	In each cable run, extra length shall be kept at suitable point to enable two straight joints to be made, should the cable develop fault at a later stage.			
7.07.00	NOT USED			
7.08.00	NOT USED			
7.09.00	Bidder shall ensure that the drawings, instructions and recommendations are correctly followed to avoid damage to the equipment.			
7.10.00	Bidder shall carry out the bonding of screen at the both ends of terminal using the insulated conductor of required size with earth mat.			
7.11.00	The bidder shall ensure that the cables and accessories supplied by him are installed in a neat workman-like manner such that it is levelled, properly aligned and well oriented. The tolerance shall be as established in the bidder's drawing and/or as stipulated by the Employer.			
7.12.00	The cable termination work shall be carried out by an experienced cable jointer who shall have adequate experience in jointing and termination of 132kV or higher grade XLPE cables. The successful bidder shall submit, sufficiently in advance, the bio-data of the cable jointer giving the details of his qualification and experience for employer's approval.			
8.00.00	TYPE, ROUTINE AND ACCEPTANCE TESTS			
8.01.00	FOR 132 KV CABLES :			
	All type tests on 132kV cables shall be carried out as per IEC 60840.			
8.01.01	Routine tests and Acceptance tests shall be conducted on cables as per IEC 60840, QA table and other relevant standards.			
8.02.00	FOR 132 KV CABLE ACCESSORIES:			
a)	Type Test reports shall be furnished in accordance with standard IEC 60840/ IEC 61462 as applicable.			
b)	Routine tests and Acceptance tests on the accessories shall be conducted in accordance with standard IEC 60840/ IEC 61462.			
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CLAUSE NO.

TECHNICAL REQUIREMENTS

8.03.00 SITE TESTS:

Following site tests shall be carried out by the bidder and all the equipment required for the site tests shall be arranged by the bidder.

- a) HV test as per clause 15.2 IEC 60840.
- b) After completion of installation non metallic outer sheath shall be tested in accordance with clause- 5 IEC 60229.
- c) The insulation resistance of the cable shall be checked before & after the HV test on cable.
- d) The core resistance shall be measured and the value corrected in accordance with clause 5 of IEC 60228.


SUB-SECTION-B – 24

ROOF TOP SOLAR

GENERAL INSTALLATION REQUIREMENTS

SCOPE OF WORK:


S.No.	Requirement	Details / Description
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	1.	Determination of capacity	Optimal grid-connected rooftop Solar PV power plant capacity on all the buildings/shades of the power plant.	
	2.	EPC & O&M package	Complete design, engineering, manufacture, inspection, supply, transportation, storage, insurance, civil work, erection, testing, commissioning and O&M of the rooftop Solar PV plants including all auxiliaries.	
	3.	Supply & logistics	All materials, manpower, scaffolding materials, machinery tools and tackles, transportation & loading/unloading, packaging/unpackaging, safe storage etc. to be arranged by contractor. Includes all transportation inside working site and manpower required for completion of work.	
	4.	Metering	Suitable arrangement for metering of output from each solar PV feeder.	
	5.	Termination	Termination of solar PV feeder at owner's LT switchgear panels.	
	6.	Power quality tests	As per CEA connectivity regulation: annual measurement of Total Harmonics Distortion (THD), DC injection and Flicker at point of connection. Contractor to arrange measuring instruments on returnable basis and carry out tests during O&M period.	
	7.	Cleaning system	Provision of suitable Solar PV module cleaning & water washing system. Bidder to provide water connection from nearest service water line with pumping arrangement and adequate taps with isolating valves as per roof/shade area.	
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8.	Operation & Maintenance	O&M for one year from date of trial run. Trial run (min. 1 day) to demonstrate trouble-free operation. During O&M, bidder responsible for supply of spare parts, preventive/major maintenance, replacement of defective modules, inverters, transformers, etc. Maintain log sheets, deploy staff for continuous operation, qualified engineer for supervision, complaint logging & resolution. PV modules to be cleaned/water-washed at least once a week.
9.	Statutory approvals	Facilitate statutory approvals including CEIG clearance (if applicable) and bear incidental/logistic expenses.
10.	Disposal	Disposal of packing material, surplus/unused materials, waste etc. generated during EPC at NTPC-identified location(s).

2.00.00
TECHNICAL SPECIFICATIONS
2.01.00
SOLAR PHOTO – VOLTAIC MODULES

S.No.	PARAMETER	Details/Specifications
1.	Design Qualification & Type Approval	PV Modules shall conform to latest IEC 61215 / IS 14286 for Crystalline Silicon Terrestrial PV Modules – design qualification and type approval.
2.	Minimum Module Capacity	Each module shall have a capacity ≥ 540 Wp. No negative tolerance from quoted power rating shall be permitted in any inverter string.
3.	Module Identification	Module must have visually distinct identification mark based on measured output within a band of

CLAUSE NO.	TECHNICAL REQUIREMENTS				
2.02.00			max. 5 Wp. Glass thickness as per approved manufacturer's design but not less than 3.2 mm.		
	4.	Safety & Reliability Standards	Modules must conform to: i. IEC 61730 Part-1 (construction requirements) ii. IEC 61730 Part-2 (testing requirements for safety qualification) or equivalent IS. iii. IEC 61701 (salt mist corrosion testing).		
	5.	Proven Track Record	The offered PV module design series (as per type certificate) must have been in successful field operation for at least 6 months on the date of submission of Techno-Commercial Bid.		
	6.	RFID Requirement	Each PV module shall be provided with a durable RFID tag (resistant to harsh environmental conditions) carrying complete technical details of the module.		
	MODULE MOUNTING STRUCTURE				
	S.No.	Parameter	Details/Specifications		
	1.	Module Tilt Angle & Layout	PV modules to be suitably inclined for maximum insolation. Minimum tilt angle: 12°. Layout must ensure: 1200 mm wide clear pathway along roof parapet for safe access and Inter-row gap ≥ 1000 mm for maintenance.		
	2.	MMS Suitability & De-sign Basis	1. MMS must be suitable to mount PV modules at tilt as per site latitude (preferably fixed tilt). 2. Design calculations to be support-ed with sketches, technical references, and IS stand-ards.		
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		3. For design analysis and determination of forces (Preferably STAAD), contractor shall submit computer program details, input/output data, and write-up for approval of EIC.
3.	Roof Protection	Fixation/anchoring of MMS shall not damage or reduce strength, durability and performance of the roof/shade including water proofing carried out on the roof.
4.	Load & Wind Consideration	Mounting arrangement to be selected based on roof load-bearing capacity and applicable wind load at roof level (refer Annexure A for wind data).
5.	Mounting Arrangement	Self-standing holding-down blocks/skids to be positively located above purlins. Reference arrangement for metal deck shuttering and RCC roofs given in Annexure C .
6.	Structure Material & Protection	<p>1. If MS structure: Hot Dip Galvanization as per IS 4759 or equivalent for frames and complete leg assemblies.</p> <p>2. If Aluminium Alloy: Anodization coating AC25 grade as per IS 1868.</p>
7.	Structural Strength	<p>MMS shall withstand extreme weather conditions. Design parameters as per IS 875 Part 3 (2015):</p> <p>Risk coefficient (K1): 1.05</p> <p>Terrain factor (K2) and topography factor (K3) as per code.</p>
8.	Fasteners & Hardware	<p>1. All nuts/bolts for connection between MMS members to be Stain-less Steel SS 304 (min. grade).</p> <p>2. Other hardware must be hot dip galvanized.</p>


2.03.00

		3. Bolts to be tightened to specified torque mechanically. 4. All fasteners shall be provided according to the connection design requirement.
9.	MMS Design Approval	Complete MMS design, base/foundation details, and connection arrangements to be submitted to NTPC for approval prior to manufacturing/fabrication.
10.	Construction Methodology	Detailed construction methodology to be submitted for NTPC approval before works execution.
11.	Corrosion Protection	Design shall follow principles of IS 9172 and relevant IS codes to pre-vent/minimize corrosion.

PCU/STRING INVERTER

S.No.	Parameter	Details/Specifications
1.	Capacity	PCU/String Inverter of $\geq 90\%$ of solar field nameplate capacity to be provided for converting DC to AC power. Must be grid interactive and output compatible with grid frequency.
2.	Design & Efficiency	Transformer-less design with minimum Euro efficiency $\geq 97\%$.
3.	MPPT Feature	Inverter shall have MPPT functionality, selected to maintain string voltage within MPPT range under ambient temperature conditions from 10°C to 50°C
4.	Harmonics	Must allow parallel operation with Total Harmonic Distortion (THD) of current $\leq 4\%$ at 50% load.
5.	Temperature Capability	Capable of continuous operation at ambient temperature $\geq 50^{\circ}\text{C}$ without derating.

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	6.	Automatic Operation	Fully automatic including wake-up, synchronization, and shutdown functions.	
	7.	Monitoring & Metering	1. Built-in meter at PCU/String Inverter. 2. Integrated data logger for monitoring via external computer. 3. Customized solar monitoring solutions from inverter OEM preferred.	
	8.	Efficiency & Environmental Standards	Comply with IEC 61683 (efficiency measurements) and IEC 60068 (environmental tests) or equivalent BIS standards.	
	9.	Grid Connectivity Standards	Must comply with IEC 61727 and IEC 62116 or equivalent for grid integration.	
	10.	Protection Class	1. Electronic components: IP65 (For outdoor) 2. Balance of system: IP54 (indoor) 3. Other equipment (ACDB, DCDB, etc.) as per relevant clauses. 4. Testing from NABL/BIS accredited or MNRE-approved test centre / International labs (TÜV, Intertek, UL, etc.).	
	11.	Central PCU/ String PCU Usage	Central PCU allowed only for main powerhouse building with final evacuation (as per SLD). Must be indoor type, IP40 or better. For all other buildings, only string inverters to be used. All PCU/String inverters shall be 3-phase.	
	12.	Combiner Box (if used)	Central Inverter(s) may pool power to two station service boards at 415 V (as per Annexure-B).	
	13.	Auxiliary Power Supply	PCU/String Inverter shall have provision to draw auxiliary power supply from its own output terminals.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.04.00	TRANSFORMERS			
	S.No.	Requirement	Details/Specifications	
	1.	Type & Application	Isolation / Step-up / Step-down transformer, converter duty, suitable for solar inverter application. Shall be dry type, 50 Hz, with protections, switch-gear, breakers, cables, and civil works. Rating & vector group as per inverter manufacturer recommendation, with one side winding delta. Shall be Highly Efficient and Must withstand inverter DC & harmonic injection.	
	2.	Omission Criteria	If inverter output matches switchgear voltage & grid connection is suitable without galvanic isolation, transformer may be omitted except for: a. Main Powerhouse building b. Switchyard building c. Ash Slurry Pump house. Isolation transformer must be provided if recommended by inverter OEM.	
	3.	Standards	Dry type transformer construction as per: a. IS: 2026 b. IS: 11171 c. Indian Electricity Act 2003 d. BEE guidelines e. CEA notifications or equivalent international standards.	
	4.	Duty & Rating	Rating and all related technical parameters (including tap changer, if applicable) as per system requirement / SLD and relevant standards. Transformer shall be supplied complete & functional.	
	5.	Duty	Suitable for continuous indoor duty.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>	
2.05.00	6.	Enclosure	Transformer housed in metal protective enclosure with minimum IP-42 protection, provided with suitable hardware.	
	7.	Conductors	Windings made of electrolytic grade copper, free from scales and burrs.	
	8.	Insulation	Dry type windings of Class F insulation or better.	
	9.	Core	Constructed from non-ageing, cold-rolled, grain-oriented silicon steel laminations.	
	10.	Losses	Maximum losses not to exceed limits specified in latest ECBC (Energy Conservation Building Code) of BEE.	
	11.	Accessories	All required fittings/accessories, including protection and monitoring devices, to be provided for reliable operation.	
	12.	Rain Protection	Suitable rain shed arrangement to be provided.	
	13.	Painting	Painting as per Employer's requirement (to be finalized during detailed engineering).	
	CABLES AND CONNECTORS			
	S.No.	Parameters	Details/Specifications	
1.	Cable Type & Specification	ISI marked, PVC or XLPE insulated, FRNC (Fire Retardant, Non-Corrosive), armoured cables. Conductor shall be Copper/Aluminium as per design.		
2.	Size Selection	Cable sizes to be selected as per load requirement for: <ul style="list-style-type: none">Module/array to junction boxesJunction boxes to DC distribution boxDC distribution box to inverter		
3.	Armouring Requirement	Armoured type cables are mandatory if laid in switchyard area or directly buried.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.06.00	4.	DC-Side Cable Standard	DC cables for PV system must comply with EN-50618 or equivalent international standard.
	5.	Conduits for Cable Protection	Industrial grade B rigid conduits shall be used for connections between PV array and inverter. All cable entries must prevent access of rodents, termites, and insects into the inverter.
	6.	Voltage Drop Limit	Maximum permissible voltage drop from PV Module to inverter shall not exceed 2% of peak power voltage of the source.
	7.	Electronic Connections	All electronic connections must be properly terminated, soldered, and/or sealed against environmental elements (outdoor/indoor). Compliance with relevant codes and operating manuals is mandatory.
	8.	Wiring & Terminations	Extensive wiring and proper terminations to be provided for all PV components, including electrical connection to grid injection point.
	9.	Use of Existing Infra-structure	Contractor may utilize existing cable trays and trestles, subject to Owner's approval.
2.06.00	INTEGRATION OF SOLAR PV WITH GRID		
	S.No.	Parameter	Details/Specifications
	1.	Grid Failure & Re-synchronization	In case of grid failure or abnormal voltage (low/high), the Solar PV system shall disconnect automatically. Once the grid is re-stored/normalized, the system shall automatically re-synchronize and supply load to the extent of power availability.
	2.	Power Evacuation Voltage	Power evacuation at all locations shall be at 415 V, 3-phase, 4-wire system. (Refer Annexure-B Single Line Diagram).
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2.07.00


3.	Metering Accuracy	Accuracy class: 0.5. MFM must withstand 2.0 kV RMS test voltage.
4.	Switchgear at Transformer End	For general rooftop systems: Load Break Switch (LBS) or MCCB with CT, PT and Multi-Functional Meter (MFM) at transformer end. For main powerhouse solar system: Air Circuit Breaker (ACB) with CT, PT and MFM at transformer end.
5.	Switchgear Enclosure Protection	Switchgear enclosure shall be minimum IP55 protection class or better.
6.	Fabrication – Switchboard Frames	Load-bearing members and frames: MS structural sections or pressed and shaped cold-rolled sheet steel, thickness 2.0 mm. Enclosure sheet steel: 1.6 mm thick. Doors and covers: 1.6 mm cold-rolled sheet steel. Gland plate: 3.0 mm (steel) or 4.0 mm (non-magnetic material). Stiffeners to be provided wherever required.
7.	Interconnection Point	Interconnection of solar plant power to be made at the nearest available 3-phase 415 V feeder, finalized during detailed engineering


PROTECTIONS


S.No.	Parameter	Details/Specifications
1.	General Protection	System shall be provided with all necessary protections including Earthing, Lightning, Surge Protection, and Grid Islanding, in line with latest codes, standards, and best industry practices

CLAUSE NO.	<div> TECHNICAL REQUIREMENTS  </div>		
2.08.00	2.	Equipment Earthing	Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to the earthing system, each capable of carrying 100% fault current capacity.
	3.	Compliance Standard	Protection scheme shall comply with CEA's "Technical Standards for Connectivity of Distributed Generation Resources," Regulation 2013.
	DATA MONITORING		
	S.No.	Requirement	Details/Specifications
	1	Data Aggregation	Bidder shall aggregate data from each inverter to a single PC in the Control Room. Irradiance and temperature sensor set may be installed at one rooftop location.
	2.	Inverter-Level Measurements	Each String Inverter must provide measurement and display of: <ul style="list-style-type: none"> • AC Voltage & Current • DC Voltage & Current • AC Power • Energy Generated. Provision for data logging via Modbus (RS-485) protocol shall be included.
	3.	Solar Irradiance	An integrating Pyranometer (Class II or better) to be provided. Sensor to be mounted on horizontal plane at a shadow-free location near the solar arrays.
	4.	PV Module Temperature	Temperature probes to record PV cell/module temperature, installed at one module in a shadow-free area.
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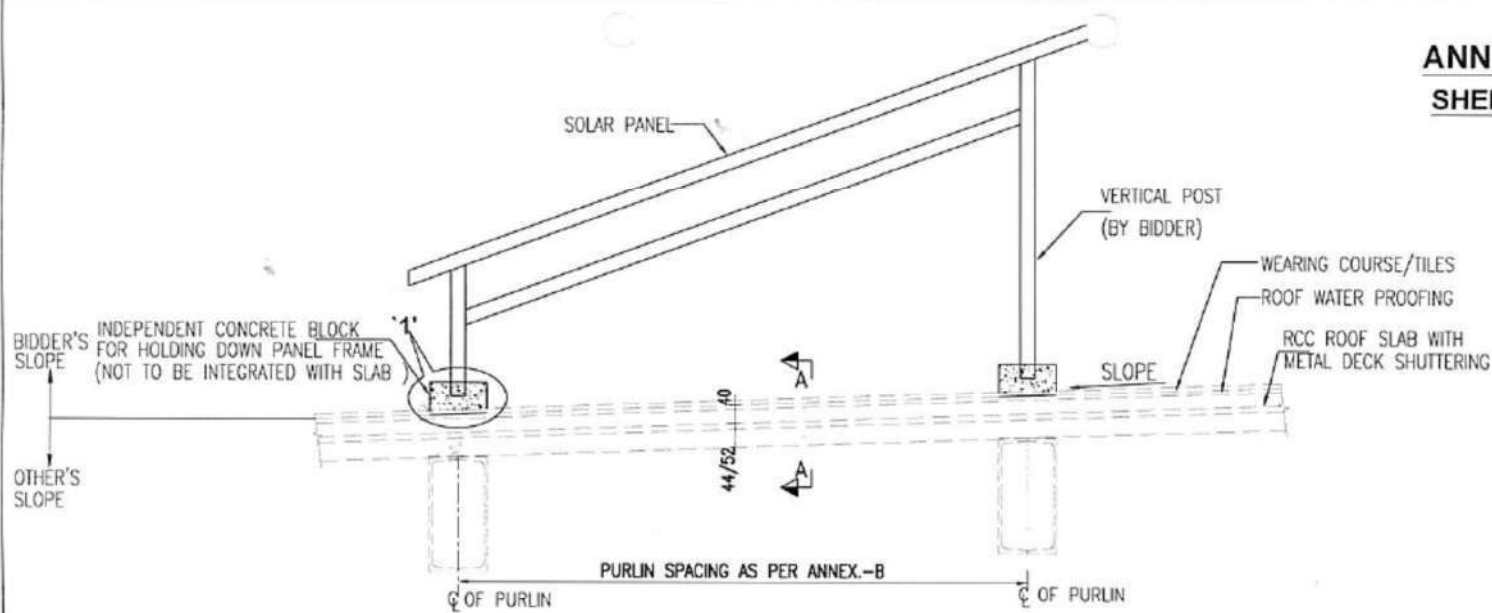
CLAUSE NO.	TECHNICAL REQUIREMENTS				
2.09.00	5.	Data Availability & Integration	Data must be made available at a separate terminal integrated into the plant network. Bidder may use any suitable data transmission mode. All required hardware is in bidder's scope of supply.		
	CLEANING & WATER WASHING ARRANGEMENT FOR PV PANELS				
	S.No.	Requirement	Details/Specifications		
	1	Cleaning System Scope	A complete Solar PV module cleaning & water washing system shall be provided, including GI pipes, valves, hose pipes, wipers, mops, etc.		
	2.	Cleaning Tools	Minimum two sets of microfiber-based cleaning tools to be provided for each rooftop location.		
	3.	Environmental Suitability	System shall be specially designed to withstand harsh and dusty environments of thermal power plants.		
	4.	Drainage	Adequate drainage arrangement for cleaning and washing water shall be provided by the bidder.		
	5.	Water Supply & Treatment	Clean water will be made available at the nearest point. Bidder shall make necessary pumping, treatment (if required), and piping arrangements for water washing of PV modules.		
	2.010.00	BALANCE OF SYSTEM (BOS) ITEMS / COMPONENTS			
		S.No.	Requirement	Details/Specifications	
1		BOS Components	The BOS items / components of the Solar PV plant(s)/ system(s) deployed must conform to the latest edition of IEC/equivalent BIS Standards		
3.00.00	TYPE TEST REQUIREMENTS				
	S.No.	Requirement	Details/Specifications		
	1.	Type Test Reports	If bidder has conducted type tests in last 10 years or as per the latest CEA Amendments, reports may be submitted for waiver. Reports must be from independent labs or witnessed by client, and for similar equipment. If not available, or found		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
			non-compliant, bidder shall conduct all specified tests at no additional cost to Employer and submit reports.
	2.	Routine & Acceptance Tests	Tests to be conducted as per the corresponding IS/IEC Standards.
4.00.00	WARRANTY OF ROOF TOP SOLAR PV		
	S.No.	Equipment	Key Requirements
	1.	Solar PV Module Performance Warranty	PV modules shall be warranted for output peak watt capacity as follows: ≥ 90% at the end of 10 years ≥ 80% at the end of 25
	2.	Mechanical & Inverter Warranty	All mechanical mounting systems, structures, and string inverters shall be warranted against manufacturing, design, and installation defects for a minimum period of one (1) year from the date of successful trial run of all rooftop locations.
	5.00.00	COMMISSIONING OF ROOF TOP SOLAR PV	
	S.No.	Requirement	Details
	1.	Commissioning	Individual solar rooftop location is deemed to be commissioned after the completion all the facilities pertaining to scope of work of that rooftop location.
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB-SECTION-B-24 ROOF TOP SOLAR
		PAGE 14 OF 16	

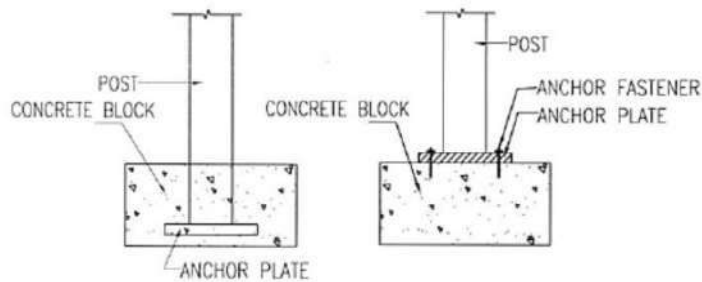
CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p style="text-align: right;"><u>Annexure-A</u></p> <p style="text-align: center;"><u>WIND DATA</u></p> <p><u>CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT</u></p> <ol style="list-style-type: none"> 1. All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. Site specific information is given below. 2. Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard. 3. Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method. 4. Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz. 5. Susceptibility of structures to across-wind forces, galloping, flutter, ovaling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards. 6. It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects. 7. No reduction in wind forces shall be considered due to parapet walls. 8. An increase in allowable stresses of structural material should not be considered during design analysis. 9. The Module Mounting structure and its foundation system design shall include at least the MMS Structural system design (structural members, bolts, base plates, anchors dead loads required etc.), check for uplifting of MMS structure, 			
<p>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2</p>	<p>SUB-SECTION-B-24 ROOF TOP SOLAR</p>	<p>PAGE 15 OF 16</p>	

CLAUSE NO.	TECHNICAL REQUIREMENTS																																	
	<p>toppling of structure during wind loads and safety of supporting slab for downward reaction passing on the structure.</p> <p>Damping in Structures:</p> <table><tr><th>S.No.</th><th>Structure Type</th><th>Maximum Damping Factor (% of Critical Damping)</th></tr><tr><td>1.</td><td>Welded steel structures</td><td>1.0%</td></tr><tr><td>2.</td><td>Bolted steel structures</td><td>2.0%</td></tr><tr><td>3.</td><td>Reinforced concrete structures</td><td>1.6%</td></tr><tr><td>4.</td><td>Steel stacks</td><td>As per IS:6533 or CICIND Model Code, whichever is more critical</td></tr></table> <p>SITE SPECIFIC DESIGN PARAMETERS</p> <p>The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:</p> <table><tr><th>S.No.</th><th>Parameter</th><th>Value / Reference</th></tr><tr><td>1.</td><td>Basic wind speed (Vb) at 10 m above mean ground level</td><td>As per IS:875 (Part-3)</td></tr><tr><td>2.</td><td>Risk Coefficient (K1)</td><td>1.05</td></tr><tr><td>3.</td><td>Terrain Category</td><td>Category - II</td></tr><tr><td>4.</td><td>Steel stacks</td><td>As per IS:6533 or CICIND Model Code, whichever is more critical</td></tr></table>				S.No.	Structure Type	Maximum Damping Factor (% of Critical Damping)	1.	Welded steel structures	1.0%	2.	Bolted steel structures	2.0%	3.	Reinforced concrete structures	1.6%	4.	Steel stacks	As per IS:6533 or CICIND Model Code, whichever is more critical	S.No.	Parameter	Value / Reference	1.	Basic wind speed (Vb) at 10 m above mean ground level	As per IS:875 (Part-3)	2.	Risk Coefficient (K1)	1.05	3.	Terrain Category	Category - II	4.	Steel stacks	As per IS:6533 or CICIND Model Code, whichever is more critical
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GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B BID DOC NO: CS-6401-001-2	SUB-SECTION-B-24 ROOF TOP SOLAR	PAGE 16 OF 16																														

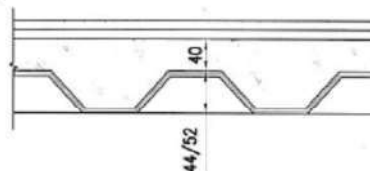
ANNEXURE-C
SHEET- 1 OF 2



**INDICATIVE SUPPORT ARRANGEMENT OF
SOLAR PANEL ON ROOFS WITH METAL DECK SHUTTERING**
(FOR MAIN POWER HOUSE, PERMANENT STORES, WORKSHOP)



DETAIL - 1

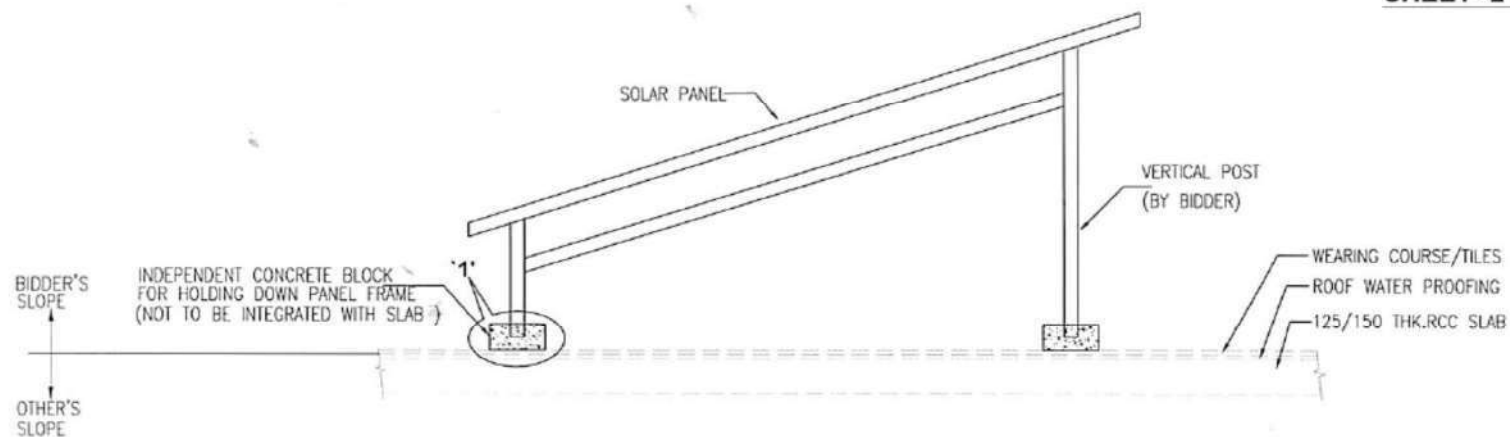


SECTION A-A

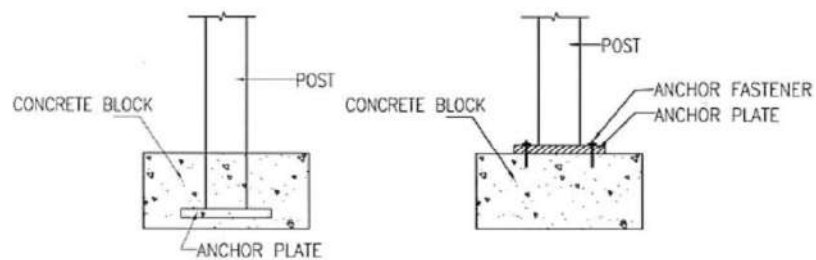
NOTE:-

1. CONCRETE BLOCK FOR HOLDING DOWN PANEL FRAMES SHALL BE LOCATED OVER ROOF PURLINS.
2. CONTRACTOR TO ENSURE THAT NO DAMAGE IS CAUSED TO ROOF & ROOF WATER PROOFING TREATMENT WHILE HANDLING OR INSTALLATION OF SOLAR PANELS

ANNEXURE- C
SHEET- 2 OF 2



INDICATIVE SUPPORT ARRANGEMENT OF
SOLAR PANEL ON ROOF WITH RCC. SLAB



ALT.-1

ALT.-2


DETAIL - 1


NOTE:-


1. CONTRACTOR TO ENSURE THAT NO DAMAGE IS CAUSED TO ROOF & ROOF WATER PROOFING TREATMENT WHILE HANDLING OR INSTALLATION OF SOLAR PANELS


PART-B
VOLUME – III
CONTROL & INSTRUMENTATION

CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एनटीपीसी NTPC</div>	
1.00.00	BASIC DESIGN CRITERIA		
1.01.00	The Contractor shall provide Independent Control & Instrumentation system for control, monitoring and operation of associated drives in all regimes of operation in safe and most efficient manner including Primary and Secondary Instruments, Panels/ Desks, Process Connection and Piping, charges & batteries, associated Instrumentation Cables, Control Valves etc. as identified in the specification.		
1.02.00	Each component and system offered by the Contractor shall be of established reliability. The minimum target reliability of each piece of equipment like each electronic module/card, Power supply, Peripheral etc. shall be established by the Contractor, considering its failure rate/mean time between failures (MTBF), meantime to repair (MTTR), such that the availability of the complete C&I system is assured.		
1.03.00	The system shall be arranged so that the failure of any monitoring device or control components or spurious intermediate grounding in the signal path shall not open the signal loop nor cause the loss or malfunction of signal to other devices using the same signal.		
1.04.00	To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.		
1.05.00	The design of the control systems and related equipments shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved and shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided / minimized.		
1.06.00	The types of failure that shall be taken into account for ensuring operability of the plant shall include but shall not be limited to – Failure of sensor/transmitter, main and/or redundant controller/other modules, motive power to final control element, control power, instrument air etc.		
1.07.00	The equipment shall employ latest state of the art technology to guard against obsolescence. In any case, Contractor shall be required to ensure supply of spare parts for lifetime of the plant. In case, the Contractor feels that certain equipment/component is likely to become obsolete, the Contractor shall clearly bring out the same in his Bid and indicate steps proposed to deal with such obsolescence.		
1.08.00	<p>Instruments, devices and equipment's for outdoor and indoor locations without air conditioning shall be designed to withstand max. 55 Deg C & 100% Relative Humidity and its protection class should be minimum IP 55. For air conditioned areas or panels (With a suitable canopy at the top to prevent ingress of dripping water), they should be designed to withstand max. 50 Deg C (during AC Failure) & 95% Relative Humidity and its protection class should be minimum IP 22.</p> <p>For PCs, OWS, EWS, Servers, Printers and other peripherals, maximum temperature limit shall be 35 Deg.C. For mini-UPS, the same shall be 40 Deg.C.</p>		
1.09.00	<p>All panels, desks, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels.</p> <p>The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable).</p> <p>Shield on instrumentation cables shall be grounded on panel side.</p>		
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS- 6401-001-2	SUB-SECTION-III-C CONTROL & INSTRUMENTATION
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Grounding scheme shall be as finalized during detailed engineering.			
2.00.00	<u>PROGRAMMABLE LOGIC CONTROLLER</u>			
2.01.00	STANDARDS FOR COMPLIANCE			
2.01.01	The PLC shall comply with the latest versions of the following Standards and Specifications as a minimum.			
2.01.02	Requirement specific to programmable controllers: Functional characteristics, Immunity, Resistance, Safety etc.: IEC / EN 61131-2 and IEC / EN 61010-2-201; IEC-61131-3 [Programming Language Standard]			
2.01.03	ISA S 71.01 [Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity].			
2.01.04	IEC-62443 [Standard for Cyber security].			
2.02.00	PLC SYSTEM REQUIREMENTS			
2.02.01	The PLC (Programmable Logic Controller) shall be chosen for simplicity, use of established proven components, use of techniques that minimize the need for maintenance, ease of configuration and overall integrity of design.			
2.02.02	It shall be possible to remove / replace online, various modules (like Controller, I/O module, interface module, etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing so, undefined signaling and releases do not occur and controller operation in any way is not affected (including controller trip to manual, etc) except that information related to removed module is not available to controller.			
2.02.03	All Electronic modules of PLC shall have conformal protective coating as per G3 / GX classification in accordance with ISA S-71.04 standard. The conformal coating version shall be a standard product from the manufacturer's factory. The hardware that is being conformal coated locally shall not be acceptable.			
2.02.04	The system design shall be modular and scalable to facilitate easy system expansion. Further it shall ensure that no single failure in the system results in loss of system operation.			
2.02.05	Details of various components and associated systems shall be as given below:			
	a) Processor	Two (2) numbers, one as primary and another as hot standby. It shall be based on dual core multi-function microprocessor technology as a minimum and shall carry the latest error correction (ECC) technology.		
	b) Controller Redundancy	Controllers shall be fully redundant operating in Hot-standby mode. The hot standby configuration hardware shall be based on two separate identical hardware configuration set. Either controller can serve as primary or backup. The Hot-standby function shall be the inherent property of the controllers. Engineered solutions developed for implementing redundancy functionality, for example switch over function shall not be acceptable. Wherever multiple functional groups have been specified / are required, the above requirements are applicable for each functional group.		
	c) Memory	Integrated flash memory based on Maintenance free battery-less design on its mother board. Internal Memory shall be non-volatile, based on latest semiconductor (NAND flash) storage technology and scalable (min. 8 MB) for programming, process application and data storage. In case of non-scalable memory-based design, minimum 16 MB shall be provided. CPU memory shall have minimum 30% spare capacity for future use.		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<div><div><div>d) I/O racks and modules</div><div>e) Analog Signal conditioning</div><div>f) Isolation between Input, Output and controller</div><div>g) Diagnostics Indication &</div><div>h) Fail safe mode</div><div>i) Fusing philosophy</div><div>j) Switching capacity</div><div>k) Data Communication Sub-System</div><div>l) Provision for Third Party Connectivity</div></div><div><p>Modular design. All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply. In general, all Output cards shall be sourcing type and Input cards shall be sinking type.</p><p>Galvanic isolation of input and output signals for which power supply source is derived from source external to the control system power supply.</p><p>Transmitter power supply with per point current limiting or fuse protection for loop powered transmitters.</p><p>Monitor sensor wire break/open circuit/short circuit and take suitable actions in logic/loop. (This will include blocking of trip signals in case of RTD failure).</p><p>All analog outputs shall be short circuit proof.</p><p>1.5 KV with opto couplers.</p><p>Channel Level Diagnostics (with reverse polarity, wire break, short circuit & optical /galvanic isolation) for DI / DO, AI & AO shall be provided. Each individual Channel healthiness shall be monitored at workstation / GUI level.</p><p>Individual signal status of each Input / Output, power supply status shall be indicated on the module faceplates.</p><p>The PLC system shall be "Fault tolerant". On power supply failure / both PLCs failure / communication failure etc. the output shall be automatically switched over to fail safe mode. In CPU, memory should record when / where the sequence was aborted. Further, in case of such failures, operating drives / equipment shall be tripped or kept running as per a pre-determined programmable requirement finalized during detailed engineering.</p><p>Individual fuses with blown fuse indicator for each output. Individual fuses for each input/ group of inputs, keeping in view of system availability.</p><p>Output modules shall be rated to switch on/off coupling relays of 3VA at 24V DC and solenoid valves at 110 V AC.</p><p>The communication sub-system shall be a digital communication bus, based on standard Ethernet technology as its infrastructure backbone. Based on existing IEEE 802.3 Ethernet standards, the network system shall be compatible with commercial off-the-shelf Ethernet products. HMI network between controllers and HMI devices shall be a minimum 100 Mbps redundant Ethernet control network (based on TCP/IP) to ensure high availability. Similarly, the redundant I/O bus / ring network shall be based on TCP / IP with minimum 100 Mbps data transmission speed.</p><p>The PLC system shall be OPC compliant and shall be provided with necessary hardware and software for successfully establishing dual redundant fiber optic/ wireless connectivity using bidirectional OPC</p></div></div>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS- 6401-001-2	SUB-SECTION-III-C CONTROL & INSTRUMENTATION	PAGE 3 OF 53


CLAUSE NO.	TECHNICAL REQUIREMENTS			
		<p>communication through OPC DA / UA protocol.</p> <p>Suitable OPC server and client software and sufficient no. of licenses shall be procured by the contractor for fully meeting the intent as stated above.</p>		
	m)	Support for standard industrial communication protocol	The control system shall have interface and be able to communicate with several Open Industrial standard communications viz. HART, Profibus / Foundation Fieldbus, Modbus Serial / TCP-IP, ASI, OPC DA / OPC UA.	
	n)	Power supply	<p>2 nos. 230V AC UPS input feeders (primary & secondary) shall be provided for each PLC / RIO panel.</p> <p>Redundant power supply system for CPU, I/O system, interposing relays shall be provided. Power distribution shall be performed in such a way that any single power supply failure shall not cause loss of operation of any module.</p> <p>A suitable power supply scheme for extending power through PLC to solenoids shall be devised and finalized during detailed engineering</p> <p>230V AC power supply for PC / monitor & printer units shall be derived from dedicated feeders of the UPS ACDB. Surge protected power sockets shall be considered for powering the PC, monitor and printer units.</p>	
	o)	Command hierarchy	Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.	
	p)	Temperature & humidity for continuous operation	55 deg. C and 5% to 95% non-condensing humidity	
	q)	Time Synchronization system.	The PLC processor should be capable of receiving clock signals from Master Slave Clock system of the Owner in either NTP, DCF77 or IRIG-B format.	
	r)	System reaction time	Less than 100 msec. from input signal to output signal including logic processing.	
	s)	Display response	Max 1 sec for control related displays. 2 to 3 sec for other displays.	
	t)	Feedback / field interrogation	By 24V DC. Status feedback from MCC/field shall be in the form of one changeover contact. Discrepancy shall be alarmed. All analog signals shall be routed through analog cards.	
	u)	Programming functionalities	<p>The controller shall be function block based besides ladder logic complying with IEC 61131-3 standard for PLC programming languages. The programming language shall be based on object model approach, it should be user friendly with graphical user interface. All standard libraries of FBs as per IEC 61131-3 shall be provided.</p> <p>The controller platform shall have the ability to change configuration online while the system is running normally without stopping the process. Facility to simulate and test logic before on-line loading shall be available in the programming / configuration software.</p>	
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CLAUSE NO.	<div>TECHNICAL REQUIREMENTS</div> <div>  </div>		
	<div> <div>v) HMIS (Human Machine Interface System)</div> <div> <p>Operator shall be able to access all control / information related data under all operating conditions including a single processor / computer failure in the HMIS. The operator functions for each OWS shall as a minimum include Control System operation (A/M selection, raise/lower, set point/bias change, on/off, open/close operation, mode/device selection, bypassing criteria, sequence auto, start/stop selection, drive auto selection, local-remote/other multi-position selection etc.); alarm acknowledge; call all kind of displays, logs, summaries, calculation results, etc.; printing of logs & reports; retrieval of historical data; and any other functions required for smooth operation, control & management of information as finalized during detailed engineering.</p> <p>The system design shall provide for non-disruptive repairs of faulty equipment and on-line, non-disruptive system expansion in the field.</p> <p>The system shall support notification of a service disruption and recovery including computer name of failed server.</p> <p>Normal/Test/Program/Off facility shall be provided. In test mode all outputs shall be blocked. Manual intervention shall be possible at any stage of operation.</p> </div> <div>w) Long time storage & retrieval</div> <div> <p>Minimum 168 hours latest data on hard disc.</p> </div> <div>x) Software</div> <div> <p>Industry standard operating system like UNIX/WINDOWS (latest version) etc. to ensure openness and connectivity with other system in industry standard protocols (TCP-IP/ OPC etc.) shall be provided.</p> <p>Contractor shall provide all system / application soft wares with locks and passwords for PLC operation meeting the intent, functional and parametric requirements of the specification. Complete set of documents for modifications / editing / additions/ deletions of features in software shall be provided. Comprehensive list of all application/ system software shall be provided.</p> </div> <div>y) Accessories</div> <div> <p>Industrial grade furniture shall be provided along with Control desk / OWS / printer.</p> </div> <div>z) Software license</div> <div> <p>The Contractor shall provide software license for all software being used in PLC based control system including HMI. The software licenses shall be provided for the project and shall not be hardware/machine specific. All licenses shall be valid for the continuous service life of the plant.</p> </div> <div>a1) Software upgrades</div> <div> <p>As a customer support the Contractor shall periodically inform the designated officer of the Employer about the software upgrades / new releases that would be taking place after the system is commissioned and in service.</p> </div> <div>b1) OWS / EWS & Printers</div> <div> <p>Operator work station (OWS) shall perform control, monitoring and operation of all auxiliaries / drives interacting with PLC based control system. It shall be possible to use the same system as EWS. The quantity of PCs, its associated peripherals and printers shall be finalized during detailed engineering. The minimum Technical specification requirements are as per Clause no. 2.04.00 of this chapter.</p> </div> <div>c1) Remote I/O</div> <div> <p>Contractor shall provide Remote Input /Output modules housed in free-standing cabinets / racks (with suitable redundant datalink to the central</p> </div> </div>		
<p>GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS- 6401-001-2</p>	<p>SUB-SECTION-III-C CONTROL & INSTRUMENTATION</p>	<p>PAGE 5 OF 53</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
2.03.00	panels	PLC system) as finalized during detailed engineering. These Input / Output modules shall meet the technical requirements as mentioned in the above clauses and shall be designed to continuously work under the environment expected to be encountered in assigned areas without any air-conditioning support. Connectivity to the Central PLC shall be as per scheme approved during detailed engineering. These RIO panels shall be located in Air conditioned environment or otherwise the RIO Panels shall be provided with panel mounted ACs.		
	d1) PLC system security & Cyber Security	The PLC system shall comply with IEC-62443 standards for Industrial Automation and Control System security. The system may preferably be Achilles level 2 / ISA Secure EDSA / Equivalent certified.		
	Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, Control System shall have spare capacity and necessary hardware/ equipment/ accessories to meet following requirement for future expansion at site:			
2.04.00	SPARE QUANTITY REQUIREMENT			
	1. Spare channels in input / output modules fully wired up to cabinets' TBs	10%	of as Engineered	
	2 Spare capacity in Processor / Controller to handle additional inputs / outputs of each type over and above implemented capacity.	30%	spare functional capacity	
2.05.00	3 Spare relays & isolators of each type and rating mounted and wired in cabinets' TBs	20%	of as Engineered	
	SPECIFICATIONS OF OWS / EWS			
	The minimum requirement of a PC based OWS / EWS shall be as indicated below, however the latest configuration (superior than that indicated below) available at the time of supply shall be provided. Microprocessor: latest family of Intel core i7 with min 3.4 GHz with HD Graphics 4600 RAM : 16 GB 16000 MHz Storage : 1 TB 7200 rpm 3.5" SATA drive Drive : 8 / 16 / Slim line x DVD+/-RW Drive Network : Network card for supporting redundant link Ports : <ul style="list-style-type: none">• USB 3.0• RJ 45 Network port• Serial• HDMI• SATA 6Gb/s Operating System: Windows Server 2016 / Win 10 Professional / Latest Printer: Colour laser printer shall be suitable for A4 size paper, 4 page per minute, 600 dpi (black) and heavy duty (>= 30000 pages per month) And all the peripheral for the EWS / OWS to work properly as intended such as keyboard, mouse KVM switches etc. shall be in the scope of the contractor. Each operator workstation shall be equipped with two 24" Flat LCD monitors. Software requirement :- General MS Windows latest version, MS-Office, Microsoft Visual Studio, Adobe Acrobat Professional, Latest Anti-virus software & Application software - to suit project specific requirement.			
FACTORY ACCEPTANCE TEST				
FAT shall include Functional testing of software and hardware in accordance with the approved logic drawings and simulation of the system with switches, relays and solenoid valves etc. or equivalent loads. All other parametric tests as decided during detailed engineering shall be				
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS- 6401-001-2	SUB-SECTION-III-C CONTROL & INSTRUMENTATION	PAGE 6 OF 53

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
2.06.00	<p>undertaken during FAT.</p> <p>TRAINING</p> <p>Further to the relevant clause regarding training specified elsewhere, Contractor's experienced personnel/engineers shall also provide training courses on offered PLC system to Employer's engineers in the following areas viz. Operator training, Hardware maintenance training, Software training, any other specialized training as required.</p>			
3.00.00	MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)			
3.01.00	<p>Measuring instruments/equipment and subsystems offered by the Contractor shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Employer's approval.</p>			
3.02.00	<p>All transmitters, sensors, switches and gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price.</p>			
3.03.00	<p>The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.</p>			
3.04.00	<p>(i) All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor).</p> <p>(ii) For coastal areas, all instruments shall be provided with durable epoxy/ polyurethane coating for housings and all exposed surfaces of the instruments.</p> <p>(iii) For hazardous area, explosions proof enclosure as described in NEC article 500 shall be provided in instruments as applicable.</p>			
3.05.00	SPECIFICATION FOR ELECTRONIC TRANSMITTERS			
3.05.01	SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS			
	<p>Minimum technical requirements shall be as follows: -</p> <p>Microprocessor based 2 wire loop powered electronic transmitter with 4-20 mA DC HART output signal shall be provided. For calibration ranges greater than or equal to 400mmwc, accuracy of transmitter shall be ± 0.060 % of calibrated range(min), stability 0.25 % of calibrated range for 10 years and 50:1 turn down. For calibration ranges less than 400mmwc accuracy shall be ± 0.10 % of calibrated range (min) and 20:1 turndown. Overpressure rating of transmitter shall be 150% of maximum operating pressure.</p>			
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW \pm 5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS- 6401-001-2	SUB-SECTION-III-C CONTROL & INSTRUMENTATION	PAGE 7 OF 53

CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.05.02	<p>Transmitter shall have weather proof IP-67 metallic housing with durable corrosion resistant coating, integral digital display with self-indicating diagnostics, ,plug and socket type electrical connection, calibration using HART calibrator, 2/3/5 Valve non integral manifold and rack with canopy.</p> <p>For air and flue gas applications, DPT shall be provided for pressure measurement below range of 2000 mmwc. For corrosive, viscous, solid bearing, slurry type process fluids, suitable diaphragm seal shall be provided. Parts below seal shall be removable for cleaning. Entire volume shall be completely filled with inert liquid suitable for instruments. LVDT type transmitter is not acceptable.</p>			
	<p>RADAR TYPE LEVEL TRANSMITTER</p> <p>Minimum technical requirements shall be as follows: -</p> <p>Microprocessor based 2 wire type, HART protocol compatible, output signal 4-20mA along with superimposed digital signal (based on HART protocol), accuracy $\pm 0.5\%$ of calibrated span or minimum 5 mm, Load impedance 500 Ohm (minimum), weather proof IP-65 metallic housing with durable corrosion resistant coating, Plug in socket type electrical connection, zero & span adjustment- temper proof remote as well as local from instrument, integral digital display and self-indicating type diagnostic features, power supply 24V DC+/-10%, calibration using hand held HART calibrator. It should be possible to calibrate the instrument without any level in the tank/sump etc. All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.</p> <p>In case of Guided wave radar (GWR) type level transmitters coaxial probe of SS316L shall be provided. However, Rod probe, cable probe of SS316L can be used for applications wherever coaxial probe is not suitable.</p> <p>External cage and other mounting accessories shall be provided wherever side mounting is required. Wherever top mounting is required, all mounting accessories, stilling well (as required) etc., shall be provided by the contractor.</p> <p>Four wire type transmitters can be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.</p> <p>For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It shall be possible to mount the electronic unit at accessible location.</p>			
	<p>3.05.03 TEMPERATURE TRANSMITTER (TT)</p> <p>Single input temperature transmitter shall be 2-wire loop powered directly from 4-20mA input cards of DDCMIS. Transmitter shall be fully compatible with thermocouples and RTDs being provided. It shall be capable to handle Pt-100 RTD, Thermocouple –K, R & S types (selectable through HART terminal/calibrator). Temperature compensation for T/C shall be performed in the transmitter itself. In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output.</p> <p>Transmitter shall be HART compatible, have EMC compatibility as per EN 61326, weatherproof IP-67 metallic housing with durable corrosion resistant coating, plug and socket type electrical connection, integral digital display with self-indicating diagnostics, operating ambient temperature of 85 deg C without display & 70 deg C with display, suitable for 2-inch pipe mounting in enclosure/rack.</p> <p>Composite Accuracy for RTD shall be $\leq 0.25\%$ of 0-250 deg C span, for T/C-K type $\leq 0.2\%$ of 0-600 deg C span and CJC accuracy (for thermocouples) shall be ≤ 1 deg C.</p>			
3.05.04	<p>HART HANDHELD CALIBRATOR</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.06.00	<p>Handheld calibrator with latest HART version shall be provided for adjustment/calibration/maintenance of the HART compatible transmitters. The handheld calibrator shall be suitable for all types of HART transmitters supplied in the package. If one type of handheld type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided for that specific type of transmitter.</p>			
	<p>Temperature Elements and accessories</p> <p>K type (Chromel-Alumel) thermocouple, R type (Pt- Rhodium Pt) thermocouple, Pt100 (Platinum 100) type resistance temp detectors (RTDs) shall be provided for temperature measurement depending on temperature range meeting the following minimum technical requirements: -</p> <p>(i) Swaged type Mineral insulated (magnesium oxide), SS316 sheathed, Duplex element, ungrounded separate junction, housing/head die cast aluminum IP65, plug in socket type electrical connection, Accuracy class 1 as per IEC-584/ ANSI-MC-96.1 for thermocouples & class A as per IEC-751/ DIN-43760 for RTDs.</p> <p>(ii) Reference Standards: For Thermocouple : IEC-584/ ANSI-MC-96.1 For RTD : IEC-751/ DIN-43760 For Thermowell : ASME PTC-19.3</p> <p>(iii) The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be Pt100.</p> <p>(iv)The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.</p> <p>(v) Thermo well (for all process temp. elements):- Shall be one piece solid bored type of 316 SS of step-less tapered design as per ASME PTC 19.3). Solid sintered tungsten carbide material shall be used for high abrasive medium. For Air & Flue gas applications protection tube with welded cap of 316 SS or better material shall be provided. For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges shall be provided.</p>			
3.07.00	<p>FUEL GAS FLOW MEASUREMENT</p> <p>Minimum technical requirements shall be as follows:-</p> <p>Turbine type Gas flow meter shall be provided for individual Gas Engines. The accuracy of the flow meter shall be 1% at max. gas flow. The Gas Flowmeter shall be calibrated at NABL certified laboratory.</p> <p>An electronic volume corrector for online pressure and temperature compensation shall be provided for each Gas Engine. Analog 4-20 mA signal corresponding to corrected Gas flow and totalized flow shall be available from the volume corrector and shall be wired to the PLC panel of individual Gas Engine.</p> <p>However standard and proven practice of the contractor is also acceptable based on documentary evidence.</p>			
4.00.00	<p>CONTINUOUS EMISSION MONITORING SYSTEM (CEMS): -</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>																				
4.01.00	<div><div><div>(i) CEMS comprising of analysers and associated items for measurement of SO_x, NO_x, CO, PM (Particulate Matter) and O₂ measurement for compensation shall be provided for each Gas Engine by the Contractor for stack emission monitoring.</div><div>(ii) Measurement of NO and NO₂ shall be done. Total NO_x values shall be reported as NO₂ i.e. NO_x = NO + NO₂ = NO X 1.53 + NO₂ = NO_x as NO₂.</div><div>(iii) Oxygen (O₂) measurement in stack emission based on Paramagnetic/ Zirconia type instrument shall be provided by the Contractor for correction of SO₂, NO_x value corresponding to the standard/reference O₂.</div><div>(iv) CEMS Parameters shall be normalized for temperature, pressure, moisture (applicable in case wet measurement techniques), etc. This facility shall be available in the respective analysers. Necessary measurement shall be provided by the Contractor for these parameters. All the CEMS parameters shall be reported on dry basis.</div><div>(v) CEMS analysers for which dual ranges are specified shall be calibrated for range near to operating process value.</div><div>(vi) Offered CEMS should be capable of operating unattended over the prolonged period of time.</div></div><div>The common requirements to be met for all types of analysers are as below. The specific requirements to be met by each type of analyser are detailed in the subsequent clauses.</div><div>Common Requirements for all Analysers</div><table><tr><td>1.</td><td>Type</td><td colspan="2">Microprocessor based with self-indicating type diagnostic feature. Output signal: 4-20 mA DC galvanically isolated. Digital signal transmission: RS232/ RS485 Modbus Protocol/ Ethernet TCP/IP protocol shall be provided in CEMS analysers for bidirectional communication of stack emission data to Employer's cloud server.</td></tr><tr><td>2.</td><td>Display</td><td colspan="2">Digital display with reading in engineering units. Display of the measurement values as well as all the information required for checking/maintenance of the analyzer.</td></tr><tr><td>3.</td><td>Zero & span Adjustment</td><td colspan="2">To be provided for all selectable ranges.</td></tr><tr><td>4.</td><td>Ambient temp.</td><td colspan="2">0-50°C unless defined otherwise.</td></tr><tr><td>5.</td><td>Analyser enclosure Type/Material</td><td colspan="2">Weather protection for analyser mounted inside analyser panel shall be IP-22 or better. For all other analysers, weather protection class shall be IP-55.</td></tr></table></div>				1.	Type	Microprocessor based with self-indicating type diagnostic feature. Output signal: 4-20 mA DC galvanically isolated. Digital signal transmission: RS232/ RS485 Modbus Protocol/ Ethernet TCP/IP protocol shall be provided in CEMS analysers for bidirectional communication of stack emission data to Employer's cloud server.		2.	Display	Digital display with reading in engineering units. Display of the measurement values as well as all the information required for checking/maintenance of the analyzer.		3.	Zero & span Adjustment	To be provided for all selectable ranges.		4.	Ambient temp.	0-50°C unless defined otherwise.		5.	Analyser enclosure Type/Material	Weather protection for analyser mounted inside analyser panel shall be IP-22 or better. For all other analysers, weather protection class shall be IP-55.	
	1.	Type	Microprocessor based with self-indicating type diagnostic feature. Output signal: 4-20 mA DC galvanically isolated. Digital signal transmission: RS232/ RS485 Modbus Protocol/ Ethernet TCP/IP protocol shall be provided in CEMS analysers for bidirectional communication of stack emission data to Employer's cloud server.																					
	2.	Display	Digital display with reading in engineering units. Display of the measurement values as well as all the information required for checking/maintenance of the analyzer.																					
	3.	Zero & span Adjustment	To be provided for all selectable ranges.																					
	4.	Ambient temp.	0-50°C unless defined otherwise.																					
	5.	Analyser enclosure Type/Material	Weather protection for analyser mounted inside analyser panel shall be IP-22 or better. For all other analysers, weather protection class shall be IP-55.																					
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CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>
4.02.00	6.	Calibration	Auto & Manual (from Remote). CEMS analyser should have inbuilt zero and calibration check capability.
	7.	Power Supply	To be arranged by Contractor subject to Employer's approval.
	8.	Others	<div>i) All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to DCS (in respective unit control room) are to be provided by Contractor.</div> <div>ii) All the calibration gases (certified cylinder) required for one year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas.</div>
	9.	Location of probe	To be decided during detail engineering.
	10.	Location of the analysers (other than insitu type)/Analyser Panel.	AT 0' Mtrs near stack for CEMS analysers except particulate matter analyser. For particulate matter preferred location is '0' meter near stack. Remote display cum configuration unit for particulate matter analyser should be provided at '0' meter near stack in the analyser panel in case particulate matter analyser is kept near the sample point due to technical limitation.
	11.	Compliance to standards	USEPA, TUV, MCERTS or equivalent standards
	12.	Type of Technology	<div>SO2/NOx :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Path) type</div> <div>CO :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Cross-duct) type. (can be combined with SO2/NOx)</div> <div>Note:- For Hot extractive sampling type and Dilution extractive sampling type system – The components involved in sample handling system shall be sourced from Original Analyzer Manufacturer (OAM) approved reputed suppliers having successful trouble free operation duly certified by Original Analyzer Manufacturer (OAM) & further, Sample handling system design shall be vetted by Original Analyzer Manufacturer (OAM). Necessary documents shall be furnished during detailed engineering in order to establish the above requirement. Technical expert of OAM shall witness testing of sample handling system and validate it. Alternatively sampling handling system assembled at Original Analyzer manufacturer (OAM) works shall also be accepted.</div>
	Specific requirements for Hot-extractive sampling type SO2, NOx & CO analysers		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	Specification Requirements	SO2 Analyser and Nox Analyser cum monitor (combined)	CO Analyser	
	Type of Instrument	Sampling type - Hot Extractive type	Hot-extractive type	
	Principle of Measurement	Radiation absorption	NDIR absorption	
	Measurement Range	0-100 / 0-1000 mg/Nm3 (selectable)	0-100/ 0-1000 mg/Nm3 (selectable)	
	Accuracy	+/- 1% of lowest measurement range or better	+/- 1% of lowest measurement range or better	
	Linearity	≤ +/-1% of lowest measurement range	≤ +/-1% of lowest measurement range	
	Repeatability	≤ 1% of lowest measurement range	≤ 1% of lowest measurement range	
	Minimum detection limit	≤ 0.5% of lowest measurement range	≤ 0.5% of lowest measurement range	
	a) Temperature Drift	≤ +/- 2%/10 Deg.C	≤ +/- 2%/10 Deg.C	
	b) Zero Drift	≤ +/-1% of lowest measurement range /week	≤ +/-1% of lowest measurement range/week	
	e) Span Drift	≤ +/-1% of lowest measurement range /week	≤ +/-1% of lowest measurement range/week	
	Analyser Response time (up to 90% of full scale)	≤ 5 secs	≤ 5 secs	
	Operating Temperature Range for probe	0-300 deg.C	0-300 deg.C	
	Filter	Ceramic 3.5 Micron	Ceramic 3.5 Micron	
	Accessories for purging system	Purging system including Auto Scavenging facility shall be provided	Purging system including Auto Scavenging facility shall be provided	
	Sample gas inlet temperature to analyser	Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards.	Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards.	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>							
4.03.00	Specific requirements for Dilution Extractive type SOx/NOx & CO Analysers										
	<p>The design of the Dilution Extractive type system shall be satisfying the following requirements. The sampling system shall consist of In-situ dilution probe, dilution probe controller, sample conditioning system like air drier and filters etc and other accessories meeting the following requirements as a minimum. All system components and accessories required for completion of this system shall be furnished although these may not be individually specified herein. Following are the minimum requirements:</p> <p>a) Modular Electronic Design.</p> <p>b) Heatless Air dryer with inlet filter, chemical scrubbers to remove traces of NOx/SO2 from air and accumulator.</p> <p>c) Self test facility with screen display.</p> <p>d) Protection of instrument in case ambient or surrounding temp going high beyond stipulated limit.</p> <p>e) The following are the minimum requirement for the probe:-</p> <ul style="list-style-type: none">Flange and counter flange for inserting probeCoarse and Fine filtersCritical orificeAutomatic blow back or purging facilitySS316L probe material <p>f) Further dilution probe controller shall be provided with the ability to control dilution ratio</p> <p>(g) Unheated umbilical chord to be provided for transportation of the diluted sample, zero air, vacuum pressure, and calibration gas. This chord has to be a single bundle in FRLS PVC outer sheath. The sample line has to be of PTFE.</p> <table><tr><th>Specification Requirements</th><th>SO2 Analysyer</th><th>NOx Analysyer</th><th>CO Analysyer</th></tr><tr><td>Principle of measurement</td><td>Pulsed/UV Fluorescence technology.</td><td>Chemiluminescence technology.</td><td>Gas Filter Correlation technology</td></tr></table>				Specification Requirements	SO2 Analysyer	NOx Analysyer	CO Analysyer	Principle of measurement	Pulsed/UV Fluorescence technology.	Chemiluminescence technology.
Specification Requirements	SO2 Analysyer	NOx Analysyer	CO Analysyer								
Principle of measurement	Pulsed/UV Fluorescence technology.	Chemiluminescence technology.	Gas Filter Correlation technology								
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Measurement Range	0-100 / 0-1000 mg/Nm ³ (selectable)	0-100 / 0-1000 mg/Nm ³ (selectable)	0-100/ 0-1000 mg/Nm ³ (selectable)
	Probe operating temp	0-300 deg C	0-300 deg C	0-300 deg.C
	Accuracy	+/- 1% of lowest measurement range or better	+/- 1% of lowest measurement range or better	+/- 1% of lowest measurement range or better
	Linearity	≤ +/-1% of lowest measurement range	≤ +/-1% of lowest measurement range	≤ +/-1% of lowest measurement range
	Repeatability	≤ 1% of lowest measurement range	≤ 1% of lowest measurement range	≤ 1% of lowest measurement range
	Minimum detection limit	≤ 0.5% of lowest measurement range	≤ 0.5% of lowest measurement range	≤ 0.5% of lowest measurement range
	Zero drift	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week
	span drift	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week
	Response time (up to 95% of full scale)	100 sec	60 sec	60 sec
	Sample gas inlet temperature to analyser	5 deg.C - 40 deg.C	5 deg.C - 40 deg.C	5 deg.- 40 deg.C
4.04.00	Specific requirements for In-situ (Path) type SO ₂ , NO _x & CO analysers			
	Specification Requirements	SO ₂ /NO _x Analyser cum monitor	CO Analyser cum monitor	
	Principle of Measurement	Differential Optical Absorption Spectroscopy	IR absorption	
	Measurement Range	0-100 / 0-1000 mg/Nm ³ (selectable)	0-100/ 0-1000 mg/Nm ³ (selectable)	
	Accuracy	+/- 1% of lowest measurement range or better	+/- 1% of lowest measurement range or better	
	Linearity	≤ +/-1% of lowest	≤ +/-1% of lowest	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
4.05.00			
		measurement range	measurement range
	Repeatability	$\leq 1\%$ of lowest measurement range	$\leq 1\%$ of lowest measurement range
	Minimum detection limit	$\leq 0.5\%$ of lowest measurement range	$\leq 0.5\%$ of lowest measurement range
	a) Temperature Drift	$\leq \pm 2\%/10$ Deg.C	$\leq \pm 2\%/10$ Deg.C
	b) Zero Drift	$\leq \pm 1\%$ of lowest measurement range/week	$\leq \pm 1\%$ of lowest measurement range/week
	c) Span Drift	$\leq \pm 1\%$ of lowest measurement range/week	$\leq \pm 1\%$ of lowest measurement range/week
	Response time(up to 90% of full scale)	≤ 5 sec	≤ 5 sec
	Probe Operating Temperature Range	0 to 300 deg C	0 to 300 deg C
	Accessories for purging system	Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.	Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.
	Temperature compensation	Automatic temperature compensation to be provided	Automatic temperature compensation to be provided
	Specific requirements for Particulate Matter (Dust density) monitor		
	Specification Requirements		PARTICULATE EMISSION (Dust density Stack Opacity) monitor
	Type of Instrument	Extractive type with reheating or dilution.	
	Principle of Measurement	Scattered Light measurement/Light transmission & absorption measurement based	
	Measurement Range	0-50 mg/Nm ³ / 0 - 300 mg/Nm ³ (Programmable)	
	Accuracy	$\pm 2\%$ of lowest measurement range or better	
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CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनडीपीसी NTPC</div>												
4.07.00	<table><tr><td>Operating Temp Range</td><td>0 to 300 deg C</td></tr><tr><td>Filter</td><td>To be provided</td></tr><tr><td>Accessories purging system</td><td>Purging system to be provided.</td></tr><tr><td>Temperature compensation/measurement</td><td>Temperature compensation to be provided, if applicable.</td></tr><tr><td></td><td>First site Calibration of the instrument should be done based on the results of an extractive IsoKinetic Test by the Contractor.</td></tr></table>		Operating Temp Range	0 to 300 deg C	Filter	To be provided	Accessories purging system	Purging system to be provided.	Temperature compensation/measurement	Temperature compensation to be provided, if applicable.		First site Calibration of the instrument should be done based on the results of an extractive IsoKinetic Test by the Contractor.			
	Operating Temp Range	0 to 300 deg C													
	Filter	To be provided													
	Accessories purging system	Purging system to be provided.													
	Temperature compensation/measurement	Temperature compensation to be provided, if applicable.													
		First site Calibration of the instrument should be done based on the results of an extractive IsoKinetic Test by the Contractor.													
	NOTES:-														
	01. Hot extractive sampling type/ Dilution extractive type systems shall be provided with dual sample probes along with all required accessories such as redundant heavy duty pumps with continuous rated motors, moisture detection facility, pre-fabricated heated (for sampling type only) sample lines from probes to analyser panel, solenoid valves, filters, coolers along with level switch in gas coolers for auto draining purpose and flow meter etc as applicable. Alternatively, permeation based dryer (located near the tapping point) alongwith necessary sample conditioning devices to ensure full protection, to avoid clogging & long life of permeation tubes may also be provided in place of sample cooler. Also, healthiness status/alarm/indication of permeation based dryer shall be provided in analyser panel.														
	02. In case IR based technique is used for SO2/NOx measurement, correction for H2O cross interference shall be available in the analyser.														
	03. If the SOx, NOx & CO (if sampling/dilution type) analyzers do not meet the environmental conditions specified in Part-A and/or Part-B Section VI, all weather Local Panel fitted with integral Air Conditioner located in non-air conditioned area shall be provided for housing analysers etc.														
04. For O2 Analyser, the construction of the sensor shall be such that joints between dissimilar materials are avoided to prevent formation of cracks.															
05. For each Gas Engine, SOx, NOx and CO analyser may be provided as a single unit/combined unit meeting specification requirements.															
Connectivity with PLC and provision for bidirectional communication with Employer's Cloud Server															
1. 4-20mA signals from all the above analysers/ flow meters/ stack gas temperature ,, stack pressure, stack gas moisture, stack gas O2 shall be wired to PLC															
2. RS232/ RS485 Modbus protocol/ Ethernet TCIP/IP protocol for bidirectional communication with Employer's Cloud Server.															
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CLAUSE NO.	TECHNICAL REQUIREMENTS																											
	<p>All the accessories and cables required for connecting Analysers outputs to DCS and provision of bidirectional communication as defined above shall be provided by Contractor on as required basis.</p>																											
5.00.00	AMBIENT AIR QUALITY MONITORING STATION (AAQMS)																											
5.01.00	General Specifications for AAQMS																											
5.01.01	<p>The Analysers / Monitors should be 19" Rack Mounted with the ON / OFF switch and display of all important status signals including Lamps, etc should be preferably on the front panel.</p>																											
5.01.02	<p>The system must function properly in the weather and atmospheric conditions mentioned in Basic design Criterion, in view of ambient temperature, relative humidity and high dust levels for instruments / equipments housed in an enclosure.</p>																											
5.01.03	<p>The system should function without frequent servicing / maintenance. The parts requiring regular service / maintenance must be easily accessible.</p>																											
5.01.04	<p>All ambient Gas Analysers and Dust Monitor shall conform to the US EPA reference or equivalent method. A proof of approvals and certificates of the above compliance along with copy of the Test Report (in English) from internationally reputed agencies such as US EPA, TUV / UAB of Germany, Env't Canada, Env't. Japan, EEC etc shall be furnished.</p>																											
5.01.05	<p>All Analysers shall be micro-processor controlled with automatic calibration. All Analysers, Monitors and Sensors should be fully integrated in the 19" Rack Cabinet, fully calibrated and tested before supply.</p>																											
5.01.06	<p>The vendor shall provide warranty for the entire system. as defined elsewhere in the Contract.</p>																											
5.01.07	<p>Four (4) Nos. of local AAQMS stations to be provided for the project. One (1) no. of local AAQMS station shall be installed in the plant premises. Location of other three (3) nos. of local AAQMS stations shall be decided during detailed engineering. Additionally, Roadside monitors for biogenic VOCs are also to be provided. The quantity for AAQMS will be as follows:</p> <table><tr><td>Sl. No.</td><td>Ambient air quality monitoring system (AAQMS)</td><td>Quantity</td></tr><tr><td>1.</td><td>SO2 ANALYSER</td><td>04 Nos.</td></tr><tr><td>2.</td><td>NOX ANALYSER</td><td>04 Nos.</td></tr><tr><td>3.</td><td>CO ANALYSER</td><td>04 Nos.</td></tr><tr><td>4.</td><td>SUSPENDED PARTICULATE MONITORS</td><td>08 Nos.</td></tr><tr><td>5.</td><td>SAMPLING INLET HEADS (PM 10, PM 2.5 AND TSP)</td><td>4 Sets for each type</td></tr><tr><td>6.</td><td>MULTI GAS CALIBRATION SYSTEM</td><td>04 Sets</td></tr><tr><td>7.</td><td>PC BASED DATA LOGGER FOR INDIVIDUAL AAQMS STATIONS</td><td>03 Nos.</td></tr></table>				Sl. No.	Ambient air quality monitoring system (AAQMS)	Quantity	1.	SO2 ANALYSER	04 Nos.	2.	NOX ANALYSER	04 Nos.	3.	CO ANALYSER	04 Nos.	4.	SUSPENDED PARTICULATE MONITORS	08 Nos.	5.	SAMPLING INLET HEADS (PM 10, PM 2.5 AND TSP)	4 Sets for each type	6.	MULTI GAS CALIBRATION SYSTEM	04 Sets	7.	PC BASED DATA LOGGER FOR INDIVIDUAL AAQMS STATIONS	03 Nos.
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GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS- 6401-001-2	SUB-SECTION-III-C CONTROL & INSTRUMENTATION	PAGE 17 OF 53																								

CLAUSE NO.	TECHNICAL REQUIREMENTS																																														
	<table border="1"> <tr> <td>8.</td><td>PC BASED DATA LOGGER FOR CENTRAL STATION WITH A4 LASER PRINTER</td><td>1 No.</td></tr> <tr> <td>9.</td><td>Wind Speed Sensor</td><td>1 No.</td></tr> <tr> <td>10.</td><td>WIND DIRECTION SENSOR</td><td>1 No.</td></tr> <tr> <td>11.</td><td>AIR TEMPERATURE SENSOR</td><td>1 No.</td></tr> <tr> <td>12.</td><td>RELATIVE HUMIDITY (RH) SENSOR</td><td>1 No.</td></tr> <tr> <td>13.</td><td>SOLAR RADIATION SENSOR</td><td>1 No.</td></tr> <tr> <td>14.</td><td>METEOROLOGICAL MAST</td><td>1 No.</td></tr> <tr> <td>15.</td><td>RAIN GAUGE</td><td>1 No.</td></tr> <tr> <td>16.</td><td>SAMPLE HANDLING SYSTEM</td><td>1 LOT</td></tr> <tr> <td>17.</td><td>CONNECTIVITY FROM CENTRAL AAQMS STATION TO INDIVIDUAL STATIONS THROUGH WIRELESS LINK</td><td>1 LOT</td></tr> <tr> <td>18.</td><td>WINDOW A/C FOR EACH OF INDIVIDUAL AAQMS STATIONS (1.5 TONS EACH)</td><td>08 Nos.</td></tr> <tr> <td>19.</td><td>UPS FOR EACH INDIVIDUAL AAQMS STATION</td><td>04 Nos.</td></tr> <tr> <td>20.</td><td>UPS FOR PC BASED CENTRAL STATION</td><td>01 No.</td></tr> <tr> <td>21.</td><td>BIOGENIC VOCs MONITORS WITH ACCESSORIES</td><td>2 Set</td></tr> <tr> <td>22.</td><td>OUTDOOR LED DISPLAY FOR AAQMS DATA</td><td>2 Nos.</td></tr> </table>	8.	PC BASED DATA LOGGER FOR CENTRAL STATION WITH A4 LASER PRINTER	1 No.	9.	Wind Speed Sensor	1 No.	10.	WIND DIRECTION SENSOR	1 No.	11.	AIR TEMPERATURE SENSOR	1 No.	12.	RELATIVE HUMIDITY (RH) SENSOR	1 No.	13.	SOLAR RADIATION SENSOR	1 No.	14.	METEOROLOGICAL MAST	1 No.	15.	RAIN GAUGE	1 No.	16.	SAMPLE HANDLING SYSTEM	1 LOT	17.	CONNECTIVITY FROM CENTRAL AAQMS STATION TO INDIVIDUAL STATIONS THROUGH WIRELESS LINK	1 LOT	18.	WINDOW A/C FOR EACH OF INDIVIDUAL AAQMS STATIONS (1.5 TONS EACH)	08 Nos.	19.	UPS FOR EACH INDIVIDUAL AAQMS STATION	04 Nos.	20.	UPS FOR PC BASED CENTRAL STATION	01 No.	21.	BIOGENIC VOCs MONITORS WITH ACCESSORIES	2 Set	22.	OUTDOOR LED DISPLAY FOR AAQMS DATA	2 Nos.	
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5.01.08	Vendor shall give complete list of spares, consumables etc. along with their costs required for trouble-free operation.																																														
5.01.09	The system shall be supplied with all ancillaries and consumables necessary for trouble free operation during the Warranty period. In case self-life of any consumable is shorter, such supplies to be done in suitable phases. Vendor shall give details of self-life, quantity of consumables required etc. to last the warranty period.																																														
5.01.10	O&M Manuals shall be supplied in line with the general requirement indicated in sub-section GTR indicating details of installation, operation and calibration; preventive, routine & corrective maintenance.																																														
5.01.11	A Sampling System compatible with the Analyzers / Monitors for Total Suspended Particulates (TSP), PM10, PM2.5, NOx, SOx, and CO shall be provided by the vendor. The system, wherever applicable, shall have the facility for moisture removal.																																														
5.01.12	Minimum requirements like power supply, space, building, ventilation & approach road required for installation and commissioning of the AAQMS shall be provided by the																																														
GREAT NICOBAR ISLAND GAS ENGINE POWER PROJECT (108 MW ±5 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS- 6401-001-2	SUB-SECTION-III-C CONTROL & INSTRUMENTATION PAGE 18 OF 53																																													

CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.01.13	vendor. Vendor shall obtain statutory and other clearances for purchase, commissioning and operation & maintenance of the AAQMS.		
5.01.14	Vendor shall furnish, along with the bid documents, the details of calibration system provided with each Analyzer / Monitor.		
5.01.14	In addition to connection with respective local data logger and central data logger as defined in subsequent clauses, AAQMS analysers shall have provision for bidirectional connectivity with Employer's central cloud server.		
5.02.00	SPECIFICATIONS OF CONTINUOUS MONITORING AMBIENT AIR ANALYSERS		
5.02.01	Oxides of Nitrogen (NO-NO2-NOX) Analyser		
	1.	Principle	Chemi-luminescence
	2.	Measurement	NO, NO2, NOx in Ambient Air
	3.	Display	LCD
	4.	Ranges	0-1000 PPB in multi-ranges (minimum four selectable ranges) Preferably as below:
			0-100 PPB, 0-200 PPB, 0-500 PPB and 0-1000 PPB
	5.	Minimum Detectable Limit	1 PPB
	6	Noise Level	0.5 PPB or less
	7	Zero Drift at Lowest Range	<1PPB in 24 hours
	8	Span Drift at Lowest Range	+ 2% in 7 days of full scale
	9	Response Time at Lowest Range	2 minutes or less
	10	Linearity	+ 1% of full scale
	11	Calibration	Built-in Calibration Facility
	12	Consumables and spares	Recommended requirements of 3 years of continuous operation
	13	Digital Signal	RS 232 link. Analyser shall be capable to transfer all the data through RS 232 link to a
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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
5.02.02		Transmission	PC based data logger.	
	Sulphur Dioxide (SO2) Analyser			
	1.	Principle	UV Fluorescence	
	2.	Measurement	Sulphur Dioxide in Ambient Air	
	3.	Display	LCD	
	4.	Ranges	0-1000 PPB in multi-ranges (Minimum four selectable ranges) Preferably as below:	
	5.		0-100 PPB, 0-200 PPB, 0-500 PPB and 0-1000 PPB	
	6.	Minimum Detectable Limit	1 PPB	
	7.	Noise Level	0.5 PPB or less	
	8.	Zero Drift at Lowest Range	<1PPB in 24 hours with automatic zero Compensation.	
	9.	Span Drift at Lowest Range	+ 2% in 7 days of full scale	
	10.	Response Time at Lowest Range	2 minutes or less	
	11.	Linearity	+ 1% of full scale	
	12.	Calibration	Built-in Calibration Facility	
	13.	Consumables and spares	Recommended requirements of 3 years Continuous operation	
14.	Digital Signal Transmission	RS 232 link. Analyser shall be capable to transfer all the data through RS 232 link to a PC based data logger.		
5.02.03	NOT USED			
5.02.04	Continuous ambient air measurement of TSP, PM 10 & PM 2.5			
		Principle	The suspended Particulate Matter (SPM) Monitor for monitoring ambient air shall be based on the principle of beta attenuation by	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
			<p>particulates sampled through the instrument and collected on movable filter tape. Before and after sampling, beta radiation shall be measured by appropriate counter. An internal microprocessor shall handle all sequences and automatically calculate the concentration of the particulate matter being measured. Contractor shall provide two nos SPM analysers in each AAQMS station for continuous measurement of suspended particulate matter. Each analyzer shall be designed for measurement of TSP, PM 10 & PM 2.5 so that any analyzer can be freely configurable at site for either TSP, PM 10 & PM 2.5. These analysers shall be provided with sampling heads suitable for continuous measuring of TSP and PM10. Additional sampling arrangement for PM 2.5 shall also be provided and it shall be possible to easily connect it to the Analyser normally measuring TSP.</p>	
		Measurement	Continuous ambient air measurement of TSP, PM10 & PM 2.5.	
		Sampling System	System for sampling of particulates of following sizes	
			(a) Total Suspended Particulates (TSP)	
			(b) 10 microns or less.	
			(c) 2.5 microns or less.	
			The system shall have provision for removal of moisture from the sample, wherever applicable.	
		Measurement Range	0-2000 microgram per cubic meter (microgram/m ³) in programmable multi-ranges	
		Display	LCD	
		Resolution	1% of the concentration	
		Minimum Detectable Limit	2 micrograms/m ³	
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		Filter material		glass fiber filter
		Roll length		Approximately 30 meters
		Measurement result		1 hour average or shorter
		Digital Signal Transmission		RS 232 link. Analyser shall be capable to transfer all the data through RS 232 link to a PC based data logger.
5.02.05	Multi-Gas Calibration System			
	To cross check the built-in-calibration facility of the Analysers/Monitors, a standard Multi-Gas Calibration System for each AAQMS station with fast response time shall be offered by the Vendor for SO2 and NOx (Vendor to give complete details thereof) which can be used as manual or remote multi-point generation of gas concentrations from one to several high concentration Span Gas Cylinders. The Multi-Gas Calibration System shall meet the US EPA or TUV/UAB of Germany, Env Canada, Env Japan, EEC etc. requirements.			
5.02.06	Carbon Monoxide (CO) Analyser			
	1	Principle		NDIR spectroscopy
		Measurement		CO
		Display		LCD
		Ranges		0-1 PPM to 0-1,000 PPM selectable.
		Minimum detectable limit		0.05 ppm
		Zero drift at lowest range		< 0.1 ppm/day
		Span drift at lowest range		< 1% of reading per day
		Response time at lowest range		<60 sec.
		Linearity		1% of Full-Scale
		Precision		0.5% of reading
		Calibration		Built-in Calibration facility
		Consumable and Spares		Recommended requirement of 3 year continuous operation
		Digital signal transmission		RS 232 link. Analyser shall be capable to
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CLAUSE NO.		TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>																										
5.03.00	5.03.01	<table><tr><td></td><td></td><td></td><td colspan="2">transfer all the data through RS 232 link to PC based Data logger.</td></tr></table>							transfer all the data through RS 232 link to PC based Data logger.																					
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Specifications of Wind Direction Sensor																														
<table><tr><td>1.</td><td>Principle</td><td></td><td colspan="2">Potentiometric type Sensor (Resistance proportional to Wind direction)</td></tr><tr><td>2.</td><td>Range</td><td></td><td colspan="2">0-360 deg</td></tr><tr><td>3.</td><td>Accuracy</td><td></td><td colspan="2">2 % of full scale</td></tr><tr><td>4.</td><td>Threshold</td><td></td><td colspan="2">0.3 m/ sec</td></tr><tr><td>5.</td><td>Operating Temperature</td><td></td><td colspan="2">0 to 50 deg C</td></tr></table>				1.	Principle		Potentiometric type Sensor (Resistance proportional to Wind direction)		2.	Range		0-360 deg		3.	Accuracy		2 % of full scale		4.	Threshold		0.3 m/ sec		5.	Operating Temperature		0 to 50 deg C			
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Specifications of Relative Humidity (Rh) Sensor																														
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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	1.	Principle		Thin film capacitance type sensor
	2.	Range		0-100% RH
	3.	Accuracy		3 % for range 10% to 90%
	4.	Sensitivity		0.2% RH
	5.	Operating Temperature		0 to 50 deg C
	6.	Radiation Shield		Non-aspirated Radiation Shield
5.03.05	Specifications of Solar Radiation Sensor (Solarimeter)			
	1.	Principle		Thermopile/Thermo couple based with Appropriate Wind Shield
	2.	Range		0.3 to 60 microns
	3.	Measurement Range		0-1500 watt/m2
	4.	Accuracy		+ 3.5 %
	5.	Operating Temperature		0 to 50 deg C
5.03.06	Specifications of Rain Gauge			
	Rain Gauge shall be of Self Recording Type and of reputed make & recording facility shall be provided in Electronics. The Gauge shall be rugged having material of construction resistant to atmospheric corrosion. The Instrument shall have automatic functions for computing rainfall for pre set time periods.			
	1.	Accuracy		+ 1 % to + 5% for rainfall rates Ranging from the lowest to 125 mm/hr or more
	2.	Sensitivity		0.5 mm
	3.	Operating Temperature		0 to 50 deg C
5.03.07	Meteorological Mast			
	One Meteorological Mast of telescopic type and of specified height to be placed on an existing structure (such as Buildings etc.) so that height of the Meteorological Sensors from the Ground Level (GL) is 10 meters. The Mast is required for mounting the Meteorological Sensors. Necessary Hangers and Holders along with electrical Grounding Set shall be provided by the vendor for installation of the Sensors. Material of Construction of the Mast shall be metallic and robust and shall be resistant to atmospheric corrosion.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
5.04.00	DATA LOGGER AT AAQMS & METEOROLOGICAL STATION			
	<div>a) There shall be one PC based Data Logger for each AAQMS and Meteorological Station. The entire data capture and mean value calculation as well as control of Analyzers should be through user-friendly software and operate on the latest Windows software system. Connection of Analyzers with serial Interface should be done through standard Connectors. Diagnostic features should be clearly indicated by the system and any unauthorized access should be protected by a password. PPB to micrograms per cubic meter (ug/m3) conversion factors should be part of the system.</div> <div>b) The Data Logger shall be provided with at least 8 Analog and 24 Digital Inputs and internal memory for all collected parameters. The Data Logger shall have ability to log Channels at different intervals and should have capability of averaging and displaying real time data and averaged data over selectable periods (minutes, hours, days, months and years) such as 1 min, 10 min, ½ hr, 1 hr., 4 hrs., 8hrs., 24 hrs., 1 month, 3 months, 6 months, year etc. It shall have adequate capability of connecting to all Analysers/ Monitors including the optional Analysers and Sensors for meteorological parameters.</div>			
5.04.01	Functional Requirements of Data Logger			
	<div>1. Calculate vector mean of wind direction and wind speed</div> <div>2. Graphic & tabular display of the current air quality monitoring data.</div> <div>3. Generation of Wind Roses, Pollution Roses etc.</div> <div>4. Data reports, calibration reports and status reports for user selectable time period (instantaneous or averaged over a period of ½ hr, 1 hr, 4 hrs, 8 hrs, 24 hrs, weekly, monthly or yearly).</div> <div>5. Control panel window for controls of each Analyser, including calibration.</div> <div>6. Alarm for all parameters.</div> <div>7. Real time multi-curves/graphs over user selectable time period.</div> <div>8. Historic multi-curves/graphs over user selectable time period.</div> <div>9. Real time status and diagnostics for maintenance people.</div> <div>10. Programmable down loading of data.</div> <div>11. Diurnal variation, standard deviation, regression and other statistical parameter reporting possibilities with various available models.</div> <div>12. Possibility to export the data files in other formats.</div>			
5.04.02	Central Station for AAQMS			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.04.03	There shall be separate Data Logger for the Central Station having configuration similar to the individual AAQMS. Location of central station shall be control room.			
	Data Communication System for The Central Station Data Communication system shall handle the data transmission of an ambient air quality network and receive incoming messages/ signals from remote Stations. The following additional features should be part of the system: <div><div>1.</div><div>To collect all the data from the remote Stations at prescribed time or on request.</div></div> <div><div>2.</div><div>Manage at least 3 or more remote air quality-monitoring Stations.</div></div> <div><div>3.</div><div>Should have the remote control facilities for calibrations (Zero & Span) and Measuring Range.</div></div> <div><div>4.</div><div>Should display multiple Stations on-line data (momentary values) in tabular text and graphic format.</div></div> <div><div>5.</div><div>Should connect the remote stations through Wireless Communication link.</div></div>			
5.04.04	Additional features of the Data Logger at Central Station <div><div>1.</div><div>Data Management, analysis and reporting</div></div> <div><div>2.</div><div>Latest Microsoft Windows operating System</div></div> <div><div>3.</div><div>32 bit application</div></div> <div><div>4.</div><div>Data collection from remote stations via Data communication Server</div></div> <div><div>5.</div><div>Inter-comparison of data between monitoring stations</div></div> <div><div>6.</div><div>Comparison of data of various parameters for the same monitoring station.</div></div> <div><div>7.</div><div>Integrates charts, tables and graphics.</div></div> <div><div>8.</div><div>Should support primary and secondary mean values of user defined time interval.</div></div> <div><div>9.</div><div>Should have data backup facilities</div></div> <div><div>10.</div><div>Should have the facilities for calculation of Arithmetic mean values, average ½ hr, 1 hr, 2 hrs, 3 hrs, 4 hrs, 8 hrs, 12 hrs, 24 hrs, weekly monthly and yearly</div></div> <div><div>11.</div><div>Minimum, Median, percentile, Maximum, standard deviation frequency analysis and cumulative frequency analysis</div></div> <div><div>12.</div><div>Calculation of pollution load and Wind Roses</div></div>			
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	<div>13. Reports of daily, weekly, annual and user defined period</div> <div>14. Reports of Pollution load and Wind Roses, frequency analysis, and calibration</div> <div>15. Should have the facilities of the following chart types:<div><div>▪ Line & column chart</div><div>▪ Simple 3 D, line & column chart</div><div>• Polar diagram and 3 D perspective column chart</div></div></div>			
5.04.05	<div>Data Communication System</div> <div>Each AAQMS station shall be connected to Central data Acquisition station through a two-way wireless communication link. This shall allow for wireless transmission of data periodically to individual and central DAS & do the necessary communication between stations. Contractors shall determine the optimal antenna type required to achieve data transfer rate between all wireless access points. Contractor shall use for this purpose, approved and standard equipment like antennas and/or amplification devices etc. required to achieve the above and shall provide agreement of technical support and support availability.</div> <div>Connectivity & transmission of data to CPCB/SPCB and customer DAS through a cyber-secured connectivity is in bidder's scope.</div> <div>Contractor shall obtain necessary approval for Licenses authorizing the use of communication equipment specified frequencies.</div>			
6.00.00	POWER SUPPLY SCHEME			
6.00.01	<div>General Requirements</div> <div>The functional requirements of Electrical Power Supply system are specified herein, Contractor shall be responsible for engineering and furnishing a complete, operational and reliable system fully meeting the intent and requirements of this specification. Employer approved drawings during detailed engineering and operational requirements of the system offered by the Contractor. All equipment and accessories required for completeness of this system shall be furnished by the Contractor whether these are specifically mentioned herein or not. All the equipment's and sub systems offered shall be from reputed experienced manufacturers. Complete System shall be manufactured, assembled, wired and fully tested as a complete assembly as per the requirements of this specification at the OEM/manufacture's works.</div>			
6.01.00	<div>POWER SUPPLY SYSTEM (UPS SYSTEM)</div> <div>Contractor shall provide UPS of suitable capacity for meeting the requirements of Technical Specifications. Contractor shall provide power supply distribution panels/cabinets/boxes for sub distribution of DC/Main UPS/Utility feeders on as required basis. The power supply distribution box shall include change over circuitry, switch fuse units, MCBs, terminal blocks etc. suitable for application.</div>			
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6.01.01	<p>The UPS Power Supply for various systems shall consist of one or more of the following configurations.</p> <p>Contractor shall clearly bring out in the proposal the redundancy feature along with configuration diagram, single line diagram and data sheets etc. & this shall be finalized subject to employer's approval during detailed engineering. The offered system design shall be tolerant towards single fault.</p> <p>UPS system shall consist of 1 x 100% charger and inverter, 1 x 100% Ni Cd Battery Bank for 1 hour, Bypass Line Transformers and Voltage Stabilizer, static switch, manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories.</p> <p>UPS System shall meet the following minimum functional requirements:</p> <p>(a) UPS KVA shall be guaranteed at 50 Deg C.</p> <p>(b) The charger should be capable to fully charge the required batteries as well as supply the full rated load through inverter. Furthermore the charger should be able to re-charge the fully discharged battery within 8 hours.</p> <p>(c) The charger output regulation shall be $\pm 1\%$ from no load to full load with an input power supply variation of $\pm 10\%$ in voltage and $\pm 5\%$ in frequency.</p> <p>(d) The minimum full load efficiency at nominal input and output shall be 90%. The ripple content shall be limited to $\pm 2\%$ of Charger output voltage.</p> <p>(e) The UPS system shall be capable of operating without D.C. battery in circuit under all conditions of load and the performance of various components of UPS like inverter, charger, static switch etc. shall be guaranteed without the battery in circuit.</p> <p>(f) The UPS system design shall ensure that in case of failure of mains input power supply to one of the chargers, the other charger whose mains input power supply is healthy, shall feed to one or both the inverters as the case may be as per manufacturer's standard practice & continue to charge the D.C. battery at all load conditions. The Contractor should note that this situation should not in any way lead to the discharge of the D.C. Battery.</p> <p>(g) The static inverter shall be of continuous duty, solid state type using proven Pulse Width Modulation (PWM)/Quasi square wave/step wave technique.</p> <p>(h) The inverter efficiency shall be at least 85% on full load and 80% on 50% load.</p> <p>(i) The steady state voltage regulation shall be $\pm 2\%$ and transient voltage regulation (on application/removal of 100% load) shall be $\pm 20\%$. Time to recover from transient to normal voltage shall not be more than 50 mSec.</p> <p>(j) Static & Manual Bypass Switches and SCVS to be provided.</p> <p>(k) Redundant AC feeders (one from each ACDB) shall supply each of the connected panels. However, 25% spare feeder (min. 1 no.) with fuses for each rating shall be provided in each ACDB.</p> <p>(l) The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall conform to IS: 10918.</p>			
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7.00.00	PROCESS CONNECTION PIPING Process connection & piping including LIE / LIR, all impulse piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories shall be provided on as required basis for proper installation & completeness of impulse piping system and air supply system. The Contractor shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this Sub-Section and QA sub section requirements on as required basis for the connection of all instruments and control equipments of entire plant. Hydrostatic and Pneumatic leakage tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.			
7.01.00	IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table:			
	Impulse Pipes, Tubes (Material, Rating)	ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70		
	Valves (Pr. Class, Size)	ASME 16.34		
	Fittings (Size, Rating, Material)	ANSI B31.1, ANSI B31.1a, ASME B16.11-2009		
	Installation Schemes	BS 6739-2009, ANSI/ISA 77.70		
	The material for Impulse pipes and associated fittings shall be SS304 or better. Seamless Tube, fittings of SS316 shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below:			
	Manifold	Application/Measurement		
	2 Valve	Pressure measurements using pressure transmitters/pressure switches		
	3 Valve	Pressure measurements using differential pressure transmitter/ switches		
	5 Valve	Differential Pressure, Flow and Level Measurements		
	For protection against sea environment all impulse pipes, fittings etc. shall be provided with durable epoxy coating with poly urethane finish. All pneumatic piping, fittings, valves, air filter cum regulator, purge rotameter and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided. This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements etc. Instrument air and Service air supply shall be provided for continuous and intermittent purging respectively for all transmitters of dirty air and flue gas applications.			
8.00.00	INSTRUMENTATION CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL (CABLE SUB-TRAYS ETC) a) All instrumentation cables (twisted & shielded, FRLS PVC insulated and sheathed), data highway / fibre optical cables including prefabricated cables (with plug-in connectors), cables as applicable for direct interconnection of two equipment/ system/ devices in Contractor's scope as well as for connection of signals from/to systems like MCC/LT SWGR/HT SWGR/ etc. shall be provided by Contractor on as required basis.			
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	<p>b) All power supply distribution cables required for directly connecting two equipment / systems devices in contractor's scope shall be provided by the contractor. All these cables shall be FRLS & as per IS-1554 Part – I latest edition.</p> <p>c) Above cables shall be provided along with necessary laying & termination accessories, hardware etc. All sub trays along with supporting, connecting hardware etc. required for laying of instrumentation, control, power and other cables etc. up to main cable trays are under Contractors scope.</p> <p>d) Junction boxes with requisite terminals shall be provided on as required basis.</p>			
8.01.00	General requirements			
8.01.01	All cables including special cables, internal wiring and electrical field construction material shall conform to this specification, Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Contractor shall furnish all material and services required for the completeness of the work identified in his scope as per this specification.			
8.01.02	The Contractor shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under Contractor's scope and ensuring completeness of the control system.			
8.01.03	Other type of cables like fiber optic/co-axial cables for system bus, cables for connection of peripherals etc. (under Contractor's scope) are also to be furnished by the Contractor.			
8.01.04	Contractor shall supply all cable erection and laying hardware from the main trunk routes like branch cable trays/sub-trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.			
8.01.05	Wherever the quantity has been defined as on as required basis, the same are to be furnished by contractor on as required basis within his quoted lump sum price without any further cost implication to the Employer.			
8.02.00	SPECIFICATION OF INSTRUMENTATION CABLE			
8.02.01	Common Requirements			
	S. No.	Property	Requirement	
	1	Operating Voltage	225 V (peak value)	
	2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IEC 60584, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.	
	3.	Continuous operation suitability	At 205 Deg C for Type-C cables & heat resistant cables, at 70 Deg C for all other type of cables.	
	4.	Marking :- a. <i>Progressive automatic on-line sequential marking of length in meters to be provided at every one meter on outer sheath.</i> b. Marking to read 'FRLS' to be provided at every 5 meters on outer sheath except for Type-C cable c. Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided on outer sheath.		
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8.02.02	S. No.	Property	Requirement		
	5.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet		
	6.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.		
	7.	Ovality at any cross-section	Not more than 1.0 mm		
	8.	Color	The outer sheath shall be of blue color except for KX & SX extension cables. For KX & SX extension cables color of outer sheath shall be as per ANSI MC 96.1/ IEC 60584.		
	9.	Others	Repaired cables shall not be acceptable.		
	Specific Requirements				
	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	
	A. CONDUCTORS				
	Cross section area	0.5 sq. mm			
	Conductor material	Type KX as per ANSI MC 96.1/ IEC 60584	Type SX as per ANSI MC 96.1/ IEC 60584	Annealed bare copper	
	Colour code	As per ANSI MC 96.1/ IEC 60584	As per ANSI MC 96.1/ IEC 60584	As per VDE-815	
	Conductor Grade	As per ANSI MC 96.1 / IEC 60584		Electrolytic	
	No & dia of strands	7x0.3 mm (nom)			
	No. of Pairs	2	2	2/4/8/12/16/24/48	
	Max. conductor loop resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1		73.4	
	Reference Standard	As per ANSI MC 96.1/ IEC 60584		VDE : 0815	
B. INSULATION					
Material	Extruded PVC type YI 3				
Thickness in mm	0.25/0.35				
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	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable		
	(Min/Max)					
	Volume Resistivity (Min) in ohm-cm	1 x 10 ¹⁴ at 20 deg. C & 1x10 ¹¹ at 70 deg. C.				
	C. PAIRING & TWISTING					
	Max. lay of pairs (mm)	50				
	Single layer of binder tape on each pair provided	Each core printed with number or Numbered binder tape to be provided on each pair	Yes			
	Bunch (Unit Formation) for more than 4P	N.A	To be provided			
	Conductor /pair identification as per VDE0815	N.A.	To be provided			
	D. SHIELDING					
	Type of shielding	Al-Mylar tape				
	Individual pair shielding	No	To be provided for F-type cable			
	Minimum thickness of Individual pair shielding	No	0.028mm (28 micron)			
	Overall cable assembly shielding	To be provided				
	Minimum thickness of Overall cable assembly shielding	0.055 mm (55 micron)				
	Coverage / Overlapping	100% / 20%				
	Drain wire provided for individual shield	N.A.	Yes (for F-type) Size- 0.5 sqmm No of strands-7 Dia of strands- 0.3mm Annealed Tin coated copper			
	Drain wire provided for overall shield	Yes, Size- 0.5 sqmm,No of strands-7,Dia of strands-0.3mm,Annealed Tin coated copper				
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	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	
	E. FILLERS (if applicable)				
	Non-hygroscopic, flame retardant	To be provided			
	F. OUTER SHEATH				
	Material	Extruded PVC compound YM1 with FRLS properties			
	Minimum Thickness at any point	1.8 mm			
	Nominal Thickness at any point	>1.8 mm			
	Resistant to water, fungus, termite & rodent attack	Required			
	Minimum Oxygen index as per ASTMD-2863	29 %			
	Minimum Temperature index as per ASTMD-2863	250 deg.C			.
	Maximum Acid gas generation by weight as per IEC-60754-1	20%			.
	Maximum Smoke Density Rating as per ASTMD-2843	60% (defined as the average area under the curve when the results of smoke density test plotted on a curve indicating light absorption vs. time as per ASTMD-2843)			
	Reference standard	VDE207 Part 5,VDE-816			
	G. Electrical Parameters				
	Mutual Capacitance Between Conductors At 0.8 Khz (Max.)	200 nF/km	120 nF/km for F type and 100 nF/km for G-type		
	Insulation Resistance (Min.)	100 M Ohm/Km			
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CLAUSE NO.	TECHNICAL REQUIREMENTS				<div>एनटीपीसी NTPC</div>																																			
	<table><tr><th>Specification Requirements</th><th>Type-A cable</th><th>Type-B cable</th><th>Type F & G cable</th><th></th></tr><tr><td>Cross Talk Figure (Min.) At 0.8 KHz</td><td colspan="2">60 dB</td><td>60 dB</td><td></td></tr><tr><td>Characteristic Impedance (Max) At 1 KHz</td><td colspan="2">N.A.</td><td>320 OHM FOR F-TYPE 340 OHM FOR G-TYPE</td><td>.</td></tr><tr><td>Attenuation Figure At 1 KHz (Max)</td><td colspan="2">N.A.</td><td>1.2 db/km</td><td></td></tr><tr><td>H. COMPLETE CABLE</td><td colspan="4"></td></tr><tr><td>Complete Cable assembly</td><td colspan="3">Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3.</td><td></td></tr><tr><td>Flammability</td><td colspan="3">Shall pass flammability as per IEEE-383 read in conjunction to this specification</td><td></td></tr></table>	Specification Requirements	Type-A cable	Type-B cable	Type F & G cable		Cross Talk Figure (Min.) At 0.8 KHz	60 dB		60 dB		Characteristic Impedance (Max) At 1 KHz	N.A.		320 OHM FOR F-TYPE 340 OHM FOR G-TYPE	.	Attenuation Figure At 1 KHz (Max)	N.A.		1.2 db/km		H. COMPLETE CABLE					Complete Cable assembly	Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3.				Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification							
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8.03.00	SPECIFICATION OF OPTICAL FIBER CABLES (OFC)																																							
8.03.01	Optic Fiber cable shall be 4/8/12 core, Electrolytically chrome plated corrugated steel taped (ECCST), fully water blocked with dielectric central member for outdoor/indoor application so as to prevent any physical damage. The cable shall have multiple single-mode or multi mode fibers on as required basis so as to avoid the usage of any repeaters. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturer, progressive automatic sequential on-line marking of length in meters at every meter.																																							
8.03.02	The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Dielectric central member, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for a maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum& crush resistance 4000 N minimum. The operating temperature shall be -20 deg. C to 70 deg.C																																							
8.03.03	All testing of the fiber optic cable being supplied shall be as per the relevant IEC, EIA and other international standards.																																							
8.03.04	Contractor to ensure that minimum 100% cores are kept as spares in all types of optical fibre cables.																																							
8.03.05	Cables shall be suitable for laying in conduits, ducts, trenches, racks and under ground buried installation.																																							
8.03.06	Spliced / Repaired cables are not acceptable.																																							
8.03.07	Penetration of water resistance and impact resistance shall be as per IEC standard.																																							
8.04.00	OFC AND UTP/STP CABLE INSTALLATION AND ROUTING																																							
8.05.00	CABLE LAYING AND ACCESSORIES																																							
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8.05.01	<p>CABLE LAYING</p> <p>Optical fiber cables (OFCs) :</p> <p>Outside Building Area - to be laid necessarily inside GI conduit with support from cable tray/Trestle structure</p> <p>Inside Building Area – to be laid on separate cable sub-trays</p> <p>While buried- in separate buried trench approx.1.0 meter depth, to be laid in 2" rodent proof HDPE conduits covered with sand, brick, laid breadth-wise and soil along the pipe line route by contractor;</p> <p>While crossing roads - to be laid in GI/ rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete;</p> <p>While crossing canals/river- to be laid in rodent proof HDPE conduits within hume pipe.</p> <p>Laying of Network Cable (UTP/STP) :</p> <p>Out side Building Area- to be laid necessarily inside GI conduits with support from cable tray / Trestle structure.</p> <p>Inside Building Area- to be laid necessarily inside GI conduits on separate cable sub-trays.</p>			
8.05.02	Contractor shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fibre Optic Card Cage, Fibre Optic Line Driver, Repeater / Modem (for Optical Fibre Cables), cable glands, grommets, lugs, termination kits etc. on as required basis.			
8.05.03	The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor.			
8.06.00	<p>FIELD MOUNTED LOCAL JUNCTION BOXES</p> <p>Material & thickness - Fiberglass Reinforced Polyester (FRP) of 4 mm (minimum thickness. Terminal blocks - Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm².</p> <p>Other requirements – Earthing stud, Weather & dust proof IP-65, Suitable for mounting on walls, columns, structures, brackets, bolts, nuts, screws, glands required for erection shall be of SS</p>			
8.07.00	CONDUITS			
8.07.01	<p>Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant terne coated steel with , water leak, fire and rust proof protected.</p> <p><i>And for remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided.</i> The temperature rating of flexible conduit shall be suitable for actual application.</p>			
8.07.02	All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.			
8.07.03	Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be utilised for all the application which shall be exposed to weather. Moisture pockets			
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8.07.04	shall be eliminated from conduits. Conduits shall be securely fastened to all boxes and cabinets.			
8.08.00	CABLE SUB-TRAY & SUPPORT			
8.08.01	The cable sub-trays and the supporting system, to be generally used between Local/Group JBs and the main cable trays and the same shall be furnished and installed by the Contractor. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure upto the main cable trays (trunk route).			
8.08.02	The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. & shall be electrically continuous and solidly grounded.			
9.00.00	TYPE TESTS (a) All equipment to be supplied shall be of type tested quality. The Contractor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. (b) However if the Contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests under this contract, at no additional cost to the Employer either at third party lab or in presence of clients/Employers representative and submit the reports for approval (c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price. (d) The type test reports once approved for any projects shall be treated as reference. For subsequent projects if NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No Design Change." Minor changes if any shall be highlighted on the endorsement sheet.			
9.01.00	TYPE TEST REQUIREMENT - PLC			
9.01.01	Following test reports shall be submitted for the equipment in line with IEC / EN 61131-2 / relevant IEC / EN standard: a). Dry heat withstand test as per IEC 60068-2-2 or equivalent b). Variation of temperature immunity test c). Variation immunity test d). Temperature cycle test e). Noise immunity test f). Dielectric test.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>
10.00.00	CONTROL VALVES & ACCESSORIES Control valves and accessories, shall be provided on as required basis to meet the functional and the other specification requirements.		
10.01.00	General Requirements		
10.01.01	The control valves and accessories equipment furnished by the Contractor shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, ISA and other standards specified elsewhere as well as in accordance with all applicable requirements of the “Federal Occupational Safety and Health Standards, USA” or acceptable equal standards.		
10.02.00	CONTROL VALVE SIZING & CONSTRUCTION		
10.02.01	The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.		
10.02.02	The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. While deciding the size of valves, Contractor shall ensure that valves trim outlet velocity are within limits as defined in ISA handbook for Control Valves.		
10.02.03	Control valves shall have leakage rate as per leakage Class-V. The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions.		
10.03.00	VALVE CONSTRUCTION All valves shall be of globe /Butterfly body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit. Cast Iron valves are not acceptable. All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing). Valve characteristic shall match with the process characteristics.Flanged valves shall be rated at no less then ANSI press class of 300 lbs.		
10.04.00	VALVE ACTUATORS All Control Valves shall be furnished with Pneumatic Actuators. The valve actuators shall be capable of operating at 60 deg.C continuously. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified. The travel time of the pneumatic actuators shall not exceed 10 seconds.		
10.05.00	CONTROL VALVE ACCESSORY DEVICES All pneumatically actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, Microprocessor based Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.		
10.06.00	SPECIFICATIONS FOR MICROPROCESSOR BASED POSITIONERS		
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CLAUSE NO.	TECHNICAL REQUIREMENTS				
11.00.00	Microprocessor Based Electronic Positioner is to be provided on as required basis with all the Control valves and all control dampers being provided by the contractor.				
	Microprocessor based positioners should be loop powered by control system, HART compatible, should have following features:				
	1	Environment	a) Operating Temp	(-)30 To 80 Deg. C	
			b) Humidity	0-95 %	
			c) Protection Class	IP-65 Minimum	
	2.	Fail Safe/Fail Freeze	Fail safe/Fail freeze feature is to be provided.		
	3	Performance	Characteristic Deviation	<=0.5 % Of Span	
			Ambient Temp Effect	<=0.01 %/Deg C Or Better	
	4	EMC & CE Compliance	Required To International Standard Like EN/IEC.	En50081-2& En50082 Or Equivalent	
12.00.00	Electric Actuator (ON/OFF & Inching Type):				
	Non-intrusive Hardwired Electric actuators with integral starters along with associated accessories etc shall be supplied on as required basis compatible for all Valves / Dampers to meet the functional and the other specification requirements. The actuators shall be totally enclosed weatherproof with IP-68 degree of protection. All actuator settings including torque, limit shall be possible without opening the actuator cover and LCD indication for actuator alarms, status, valve position indication and diagnostic information shall be available integral to actuator body.				
	415 V, 3 phase 3 wire power supply shall be given to the actuator from switch board as applicable through a switch fuse unit. The motor shall be squirrel cage induction motor, class F insulated suitable for Direct On Line (DOL) starting. Single Phasing Protection, over heating protection through Thermostat (as applicable) and wrong phase sequence protection shall be provided over and above other protection features standard to Contractor's design.				
	The Position/ Limit measurement shall be done using absolute encoders which will give information of position/ limit in both the directions. Electronic measurement of torque shall be provided. Open/Close command, open/ close status and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided hardwired. All actuators shall be certified for SIL 2 or better.				
	Further, 10% or min 2. configuration/ diagnostic tool (if applicable) for non-intrusive actuators shall be provided for complete package.				
MASTER CLOCK					
The Contractor shall provide a GPS based date insensitive master and slave clock system (common for the station) with adequate number of output signal to provide					
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	<p>uniform timing throughout the various plant facilities supplied by Contractor. The system shall be complete with receiving antennae (for receiving time from GPS or Radio signal), receiver and associated electronics, Redundant Master Clocks, Slave Clocks, interconnecting cables, cubicles, power supplies & any other accessories. However, a provision shall be kept for synchronisation of the master clock with other source as decided during detailed Engineering. The exact format/type of synchronization of master clock with other sources & slave/other system with master clock shall be finalized during detailed Engg. Stage.</p>			
13.00.00	CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM			
	<p>Minimum 20 nos. of CCTV cameras shall be provided by the Contractor. Location of the CCTV cameras shall be decided during detailed engineering.</p>			
13.01.00	General Requirements			
	<p>The intent of the specification is to define the functional & design requirements for the CCTV System meant for gathering video information from the various areas of the power plant with display and recording facilities with night vision and motion sensors as per requirement.</p>			
13.01.01	<p>The Contractor shall be responsible for selection, design, engineering, manufacture, testing at manufacturer's works/site, installation of all the equipments supplied as covered in this specification and commissioning of the system meeting the intent & functional requirements of the specification. All the power supply (UPS), cables, cable trays, power packs, erection hardware (viz. junction boxes, brackets glands, nut-bolts, conduits etc.) and mounting are also included in Contractor's scope.</p>			
13.01.02	<p>The Contractor's scope shall also include successful demonstration of functional requirements specified herein complete in all respects.</p>			
13.01.03	<p>The Contractor shall guarantee satisfactory performance of the equipment under stipulated variations of voltage and frequency.</p>			
13.01.04	<p>The design and manufacture shall be such that equipment / components of same type and rating are interchangeable.</p>			
13.01.05	<p>The number of camera units, servers, network switches, wireless equipment etc. and their locations shall; be finalized during detailed engineer for effective functional requirements.</p>			
13.01.06	<p>Any other equipment, module, software required for the safe and satisfactory operation, control, protection, monitoring, testing and maintenance of the system shall also be included by the Contractor within the lump sum quoted price.</p>			
13.01.07	<p>The equipment furnished under this section shall meet the requirements of all the applicable International codes and standards or their latest amendment Codes and Standards. Camera certification has to be CE/FCC/UL or equivalent.</p>			
13.02.00	POWER SUPPLY ARRANGEMENT			
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CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
13.02.01	The CCTV System along with all its components i.e. network switches, storage devices, servers, LAN switches, cameras etc. shall be powered from UPS system. Contractor shall also provide local power distribution boxes as required for sub-distribution of UPS supply.			
13.02.02	For cameras to be located in remote areas where the UPS power supply can not be extended due to voltage drop etc., then such cameras can be grouped and fed from mini UPS. Individual mini UPS shall be provided for the cameras which can not be grouped. Mini UPS are to be provided by the contractor within his quoted lumpsum price. Contractor shall also provide local power distribution boxes as required for sub-distribution of supply from these mini-UPS to cameras. The location of mini-UPS & power distribution scheme shall be finalized during detail engineering.			
13.02.03	If the offered equipment is operating at voltage level other than what is available as auxiliary supply, the Contractor shall provide all required hardware, to make the offered system compatible with specified power supply arrangement.			
13.03.00	DESIGN AND TECHNICAL REQUIREMENTS			
13.03.01	The CCTV system shall be able to provide surveillance of different locations in the plant, entry gate and all across periphery. The exact locations shall be decided during detailed engineering.			
13.03.02	The CCTV system shall be designed as a standalone IP based network architecture. System shall use video signals from different cameras at different locations, process the video signals for viewing on monitors at different locations and simultaneously record all the video streams using H.264 or better compression technique. Joystick and mouse-keyboard controllers shall be used for Pan, Tilt, Zoom and other functions of desired cameras.			
13.03.03	The monitoring of these cameras shall be done at main Control Room or as finalized in detailed engineering. The required no. of hardware/software licenses to meet the requirements shall be supplied by the contractor.			
13.03.04	Camera and database servers shall offer both video stream management, video stream storage management. These servers shall also manage and store configuration information/database for the whole system. Recording frame rate & resolution in respect of individual camera shall be programmable. It shall be possible to view and record at different resolutions and frame rates and this shall be individually programmable on every camera. It shall be possible to take back-up of system configuration and database on portable media device and restoring the same if required.			
13.03.05	System shall ensure that once recorded, video can not be altered.			
13.03.06	Camera server shall be provided with sufficient storage space to store recordings of all cameras at 25/30 FPS at 1920X1080, 100% activity level, for a period of Fifteen (15) days or more using necessary compression techniques. All recordings shall have camera ID, Location, Date and time of recording.			
13.03.07	It shall be possible to view, record, search and replay simultaneously without affecting performance of the system.			
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13.03.08	The system supplied shall be complete in all respects for reliable performance. The Contractor shall submit the detailed block schematic, video, signal & power wiring diagram, describing the connections between the network switch/camera server Systems and various cameras, monitors, keyboard, and joystick.												
13.03.09	The camera & Video Management Software shall conform to ONVIF profile S or latest available applicable ONVIF profile at the time of detail engineering.												
13.04.00	DETAILED DESCRIPTION OF THE SYSTEM COMPONENTS:												
13.04.01	Application Software for Video Monitoring, Recording & Management. <div><div>a)</div><div>The application software shall be used to display, store, control & manage the entire surveillance system.</div><div>b)</div><div>It shall be possible to control all cameras i.e. PTZ, auto/manual focus, selection of presets, video tour selection etc. The software shall support flexible 1/2/4 windows split screen display mode or scroll mode on the display monitors for live video.</div><div>c)</div><div>The system shall support video analytics in respect of the following<div><div>1. Video motion detection,</div><div>2. Object tracking</div><div>3. Object classification & Tracking</div></div></div><div>The feature can be an integral part of camera or a part of camera server. The features shall be user configurable for each camera. It shall be possible to activate recordings automatically based on events generated by video analytics. These events shall also be logged and suitably alarmed on the monitors.</div></div>												
13.04.02	Cameras: <div><div>a)</div><div>All the cameras shall be color, suitable for day and night surveillance and network compatible. PTZ cameras shall be high speed integrated dome type.</div><div>Camera shall be directly connected to network and use of external encoder for connecting to network is not acceptable. The cameras shall be rugged, high performance color cameras. These cameras shall provide high resolution and high sensitivity suitable for operation in a power plant, both in natural and artificial lighted areas.</div><div>b)</div><div>Detailed technical specification is given below.</div><div>PTZ Dome Cameras</div><div>High Definition (HD) PTZ cameras</div><table><tr><td>Image Device</td><td>1/2.8-1/3" Progressive scan CMOS</td></tr><tr><td>Lens</td><td>4.45-4.7 /89-94.0 mm focal length</td></tr><tr><td>Optical Zoom</td><td>20x or better</td></tr><tr><td>Digital Zoom</td><td>12x or better</td></tr><tr><td>Number of Pixels/Effective resolution</td><td>1920X1080 (Full HD)/2 MP at 25/30 IPS</td></tr></table></div>			Image Device	1/2.8-1/3" Progressive scan CMOS	Lens	4.45-4.7 /89-94.0 mm focal length	Optical Zoom	20x or better	Digital Zoom	12x or better	Number of Pixels/Effective resolution	1920X1080 (Full HD)/2 MP at 25/30 IPS
Image Device	1/2.8-1/3" Progressive scan CMOS												
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Video compression	H.264 Main Profile/High profile
Sensitivity	color mode 0.6 lux , B/W mode 0.04lux @30IRE, F1.6
Horizontal Angle of view	55.4 deg(wide)- 3.5 deg (Tele) minimum
Focus	Auto with Manual Override
Iris Range	F1.6-F2.9
Iris Control	Auto with Manual Override
Back Light Compensation	Required
White Balance	Automatic with mode selection options
Electronic Shutter	1/50 to 1/10000 Auto
S/N Ratio	>50dB
Audio	Full Duplex or 2-way
Automatic Gain Compensation	Up to 18 dB
Power Supply	The camera power supply should be of the same make as that of camera and suitable for the model no. offered.
Gain Control	Auto/Off
Day/Night selection	Auto On-Off
IR cut-filter	Yes
Protocols	IPV4/IPV6,RTP, UDP, TCP, IP, HTTP, HTTPS, FTP, DHCP, IGMP V2/V3, ICMP, ARP, SMTP, SNMP,SNMP or equivalent.
Security	Password protection
Auto Resume after Power Failure	Yes
Multiple Streams	H.264 /H.264 & H.264/Motion JPEG
Operating resolution	Primary stream – 1920X1080 at 25/30 FPS & other minimum 720X576 at 25/30FPS
Analytics	Motion detection & Tamper alarm
PoE supply IEEE 802.3af compliant or better	Yes
Rate Control	VBR/CBR
Other Features	
	On screen Menu display, contour correction and contrast compensation control
	Automatic Picture Enhancement to give a balanced picture where there is too much/too little light
	Synchronization selection for line lock and free running
	Minimum 2 Alarm I/Ps & 1 alarm output
PTZ Specifications	
Pan	360 Deg Continuous
Tilt	90 deg
Manual Tilt Speed	0.1 deg/sec to 45 deg/sec
Manual Pan Speed	0.1 deg/sec to 80 deg/sec
Preset Positions	Minimum 256
Preset Pan Speed	280 deg/sec min
Preset Tilt Speed	160 deg/sec min

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>										
13.04.03	Camera Housing & Mount <p>a) All the cameras and accessories are to be housed in Weather Proof IP 65 environmental housing made of aluminum and Sun shroud. The housing, with heater and blower installed, shall provide protection for camera/lens assemblies in the ambient temperature range of - 0 deg. C to 50 deg. C.</p> <p>b) The camera mount, camera housing and camera power supply should be of the same make as that of camera and suitable for the model no. offered as specified by the manufacturer.</p> <p>c) Keyboard & Joystick</p> <p>Keyboard shall have full function used for system control and programming for selection of various Network switches, camera/database servers, camera functions including pan, tilt and zoom lens controls and shall be ergonomically designed.</p> <p>Joystick shall be provided for achieving all control functions.</p> <p>d) Work Station</p> <p>Operator work station & network switch station shall be in Control Room or as finalized during the detailed engineering.</p>													
13.05.00	CABLES :													
13.05.01	Cables shall be of FRLS PVC sheathed cables for use in CCTV and shall conform to latest edition of Indian/International standards. Fiber optic cables are to be provided (as applicable). The remaining cables can be as per CCTV supplier's standard. For details of Fiber Optic cables, refer subsection INST CABLE. All the cables and the hardware required for powering the system are also in the scope of Contractor. All cables required for interfacing alarm contact inputs (to be provided by employer) to CCTV system are also in scope of contractor.													
13.05.02	For estimation of cable quantities, erection hardware etc., the Contractor shall refer to General Layout Plant, Equipment Location Plans drawings & other relevant drawings to be finalized during detailed engineering. All the cables are to be provided by the Contractor on as required basis.													
14.00.00	PUBLIC ADDRESS SYSTEM (PAS) <p>The quantities mentioned below are minimum required and location of the call stations shall be decided at the time of detailed engineering:</p> <table><tr><td>S. No.</td><td>Item Description</td><td>Quantity (nos.)</td><td></td><td></td></tr><tr><td>1.</td><td>Call Stations</td><td></td><td></td><td></td></tr></table>				S. No.	Item Description	Quantity (nos.)			1.	Call Stations			
S. No.	Item Description	Quantity (nos.)												
1.	Call Stations													
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		(i)	Outdoor wall/column mounting type with amplifier	10			
		(ii)	Indoor desk top mounting type with amplifier	10			
	2.	Master Control Unit (MCU)		1			
	3.	Amplifier					
		Standalone amplifier		1			
	4.	Loudspeakers					
		(i)	Outdoor Industrial Horn type	10			
		(ii)	Indoor wall mounted Cone type	10			
	5.	Portable call stations with network connection port					
		(i)	Network connection ports	10	-	-	
		(ii)	Portable call station with minimum 2 meters connecting cable	2	-	-	
	6.	Cables					
		(i)	All Interconnecting cables including power cables	On as required basis within the Contractor's quoted lump sum price			
	7.	G.I. conduit for					
		(i)	Interconnecting cables	On as required basis within the Contractor's quoted lump sum price			
	8.	Acoustic hood (nos.)		5	-	-	
	9.	Server		Minimum one redundant server			
	10.	PC Station		one located at CR			
	11.	Network Switches		On as required basis within Contractor's quoted lump sum Price.			
	12.	Layer-III Switch/Router		On as required basis within Contractor's quoted lump sum Price.			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		<div>एनटीपीसी NTPC</div>	
	13.	Software(s) for PA system	On as required basis within Contractor's quoted lump sum Price.	
		NOTES		
	1.	Any other equipment, accessories and facilities required for the completeness of this system shall be furnished by Contractor on as required basis within the quoted price.		
	2.	Refer S.No.6, the cable shall be laid in existing cable trays. If cable is unarmoured, the same shall be laid in G.I. conduits.		
	3.	* These loudspeakers shall be connected to Standalone Amplifiers.		
14.01.00	General Requirements			
14.01.01	The intent of the specification is to define the functional & design requirements for the Public address system. The Contractor shall be responsible for selection, design, engineering, manufacturing, testing at manufacturer's works/ site, erection, installation and commissioning of public Address system meeting the intent and functional requirement of specifications.			
14.01.02	The Bidder's scope shall also include successful demonstration of performance testing specified herein complete in all respects. All the items, including public Address system erection hardware, racks, cables, cable trays, conduits, etc. as required, for the proper installation (conforming to IS:1881, IS:1882) to make the IP based PA system complete and functional are under Contractor's scope on as required basis. All equipment, accessories and facilities required for completeness of this system shall be furnished by the Contractor within the quoted lump sum price, whether these are specifically mentioned herein or not.			
14.01.03	The equipment furnished under this section shall meet the requirements of all-applicable codes and standards as specified in Part-C, Section-VI or their equivalent international codes and standards.			
14.01.04	The Public Address System (PAS) offered by the Bidder shall be from reputed manufacturer who should have designed, manufactured, tested and commissioned a distributed amplifier type industrial Public Address systems as specified in thermal power plants or large industrial installation as on the date of bid opening.			
14.01.05	The system shall be adequately protected from signal and power line noise and meet the Surge Withstand Capability (SWC) requirements of ANSI C37.90 A/IEEE standard 472-1989 or equivalent. Equipment shall be self-protecting against transients in the input ac supply			
14.01.06	The Bidder shall guarantee satisfactory performance of the equipment under stipulated variations of voltage and frequency. The design and manufacture shall be such that equipment/components of same type and rating shall be interchangeable.			
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14.01.07	In addition to the facilities to be provided by the Bidder as mentioned in relevant clauses of this section the Bidder shall make his own arrangements for any other requirements that are necessary to put the system in service.			
14.02.00	POWER SUPPLY ARRANGEMENT			
14.02.01	The PA system along with all its system components i.e. network switches, servers, media converters, PC stations etc. shall be powered from UPS system. Contractor shall also provide local power distribution boxes on as required basis for sub-distribution of UPS supply.			
14.02.02	For call stations & amplifiers, mini UPS of suitable rating are to be provided by the Contractor within his quoted lump sum price. Contractor shall also provide local power distribution boxes as required for sub-distribution of supply from mini-UPS to call stations & amplifiers. The location of mini-UPS & power distribution scheme shall be finalized during detail engineering.			
14.02.03	If the offered equipment is operating at voltage level other than what has been specified, the Contractor shall provide all required hardware, within lump sum quoted price to make the offered system compatible with specified power supply arrangement.			
14.03.00	SYSTEM DESCRIPTION			
	DESIGN AND TECHNICAL REQUIREMENTS			
14.03.01	The PA system shall be designed as standalone IP based network architecture. The system shall be based on centralized control together with distributed nodes permitting speech broadcasts and pre-recorded messages /alarm tones etc. The PA system shall be designed such that no single failure shall disrupt the availability of complete system. A redundant server catering to all zones of the plant shall be located at CER.			
14.03.02	The carrier system shall be based on Voice Over IP, extended to provide IP communication across the complete PA system. The call stations and standalone amplifiers shall be individually IP addressable. Any conversion of the analog field call station to IP mode by separate attachment of the intelligent module/ unit shall not be acceptable. Each call station should be able to selectively call another call station without manual intervention of any other equipment. The design shall be such as to provide highly intelligible full duplex voice communication even in areas of high background noise (up to 80 db).			
14.03.03	PA System Management Software: Configuration of the system shall be achieved by user Friendly GUI based software for maximum flexibility, easy re-configuration, maintenance & future expansion. This software should be configured on each PC station, located at Unit CER which enables an operator to implement speed commissioning and also carry out routine diagnostic checks / fault finding functions of PA system components. It should be possible to make adjustments when the system is installed without resulting in modification to the system wiring. It shall be possible to download/ store the configuration parameters & scheme from the server without taking the system out of service. Levels of system access and privileges shall be maintained through security passwords etc. The software shall be able to work with the latest windows version. All software utilized shall be latest and upgraded version.			
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14.03.04	Built in Diagnostic features: The Bidder shall provide all hardware/software in order to have a comprehensive built in diagnostic test feature covering the complete PA system components including call stations & amplifiers, standalone amplifiers along with associated loudspeakers, servers, network components i.e. network switches and interconnecting cables, power supplies etc. so that at all times, the status of the complete system can be monitored. Active fault reporting concerning all aspects of PA system shall be extended to PC Stations which shall record the system malfunction messages with time & date stamp.			
14.03.05	Recording functionality for calls to and from master call station in each zone shall be provided. System shall ensure that once recorded, audio cannot be altered.			
14.03.06	The system shall be able to accept potential free contacts from other systems (like fire alarm system, security system and access control system etc.) for predefined actions (like fire or security alarm announcement on call stations (configurable) etc.) For implementation of the same, 10 nos. potential free contacts for common plant area shall be provided by Employer for interfacing with PA system. The exact details shall be finalized during detail engineering.			
14.04.00	Communication within a zone			
14.04.01	The PA system shall allow party calls i.e. between one call station to another and also Group/ conference calls i.e. simultaneous conversation amongst multiple call stations. Party calls and group/conference calls shall be in full duplex mode.			
14.04.02	Each call station shall be able to broadcast a message to all the associated call stations or selected call stations in a zone. The priority of call mode or broadcast mode or Emergency priority settings shall be configurable for each call Station.			
14.04.03	Portable type call stations with network compatible ports shall be used at certain location where operational personnel are not present normally. Necessary network connection, power supplies etc., shall be provided at these locations. The locations (distributed across different zones) shall be finalized during detailed engineering.			
14.04.04	Unless requested, announcements/communication within a zone shall not be audible in other zones.			
14.05.00	CALL STATION			
14.05.01	Call Stations shall be of the following types: (a) Outdoor Wall/column mounting type.(Type – A) (b) Indoor desk-top mounting type. (Type – B)			
14.05.02	Each Call Station shall have LCD indicator, 10 digit dial pad & 2 special keys, Pre-amplifier & power amplifier, Indication for 'Power Supply On' and 'Network Connection Healthy' as a minimum.			
14.05.03	The outdoor wall/column mounting type call station shall be dust-tight and weather proof, with appropriate protection against direct rain, ingress of dust and moisture conforming to			
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	<p>IP-65 degree of protection as per IS/IEC:60947-1, outdoor wall/column mounting type. The indoor desk-top mounting type call station shall have a degree of protection of at least IP-32. All call stations and their components shall be capable of continued satisfactory operation at an ambient temperature at 55 Deg C.</p>		
14.05.04	<p>The indoor desk-top mounting type call station shall be suitable for flush mounting on control desk Suitable accessories for the same shall be provided by Contractor.</p>		
14.05.05	<p>Call stations transmitter/microphone shall be dynamic noise cancelling type and anti-side tone control facility shall be inbuilt.</p>		
14.05.06	<p>All call stations shall have a compact, robust, rust resistant, shock resistant body made of high impact polycarbonate/ Stainless Steel or equivalent. The outdoor call station shall be inside an enclosure with transparent glass door which can be opened through number padlock only.</p>		
14.05.07	<p>The wall/column mounting call stations shall be tamper-proof, using internal anchoring bolts and peculiar (e.g. triangular head, counter-sunk) screws which can be loosened only with special keys. Constructions where the entire electronic part shall be modular type and can be removed from the call station enclosure for easy maintenance.</p>		
14.05.08	<p>The call stations in the noisy areas like Engine hall, etc. shall be housed in Acoustic hoods. An industrial type free standing, floor mounting hood shall be used for providing the above requirement. The design noise level within the hood shall be limited to a maximum of 60dB SIL.</p>		
14.05.09	<p>The indoor desk mounting type call stations shall preferably be PoE powered and the same shall be IEEE 802.a.f compliant.</p>		
14.06.00	AMPLIFIERS		
14.06.01	<p>Amplifiers shall be solid state, class-D, push-pull type, in built with the call station fully conforming to IS: 10426 or equivalent international standard.</p>		
14.06.02	<p>Amplifier shall have 0-100% volume control facility for coarse and fine setting, Input sensitivity control, Receiver volume control, Bass cut filter and Anti-side tone control feature</p>		
14.06.03	<p>Standalone Amplifier</p>		
	<p>Amplifiers of suitable rating as mentioned in Part-A of specifications shall be provided for general announcement. Multiple loudspeakers spread across a zone shall be used along with a standalone amplifier. This amplifier shall be IP based and health monitoring of the associated loudspeakers shall be provided.</p>		
14.07.00	LOUDSPEAKERS		
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14.07.01	Indoor loudspeaker shall be cone type housed in sturdy metal cabinet suitable for wall/column mounting. The mounting bracket shall be treated with acoustic under-coats to prevent resonance. They shall have IP-52 degree of protection as per IS/ IEC:60947-1.		
14.07.02	Outdoor loudspeaker shall be industrial horn type and of pressure die cast aluminum or equivalent industrial grade material construction. The mounting bracket shall be with adjustable base suitable for vertical and horizontal orientation. They shall have IP-65 degree of protection as per IS/ IEC:60947-1.		
14.08.00	SERVER		
14.08.01	The server shall be based on state of art VOIP technology. The server should support protocols including SIP or equivalent, TCP, IPV4/ IPV6, Codec G.722, SNMP, RTP, NTP etc. Suitable built in IP security such as firewall, SSH, HTTPS etc. shall be provided in server. The server should be able to support the required number of call stations with future provision as defined in Part-A of the specifications. The required no. of all hardware/software licenses to meet the Employer specifications shall be supplied by the Contractor.		
14.08.02	The server shall be capable of self-recovery in case of any fault/ network break down. It shall be rack mounted type.		
14.08.03	The server shall be able to support minimum 4 channels for GSM communication with PA system. Suitable interface for the same shall be provided by Contractor.		
14.08.04	All programming tools & software that are required to program/ reprogram the system shall also be provided along with the server.		
14.09.00	MASTER CONTROL UNIT		
	The Master Control Unit shall facilitate interzone communication amongst different zones. It shall have minimum 40 direct access keys with LED indication, which shall be configured as per requirement, a goose neck type Microphone and a hand receiver unit attached to it. Emergency announcement facility like fire alarms etc., shall be done from master control unit automatically.		
14.10.00	NETWORK SWITCH		
	All the network switches shall be of high quality and shall be sized to meet the functional requirements as specified. The location of network switches shall be decided during detail engineering and shall be subject to approval of Employer.		
14.11.00	PC STATION		
	PC station shall be provided for overall viewing and monitoring of PA system functionality in plant area. It shall be provided with PA system management software as mentioned elsewhere. For hardware specification please refer specification of Operator work stations given in sub-section-PLC.		
14.12.00	CABLES AND JUNCTION BOXES		
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14.12.01	The bidder shall supply the all required cables for PA system on as required basis. Colour of the outer sheath shall be YELLOW. All cables of PA system shall be armoured, if unarmoured, the same shall necessarily be laid in GI conduits.																												
14.12.02	Cables shall be of FRLS PVC sheathed cables for use in PA system and shall conform to latest edition of Indian/International standards.																												
14.12.03	Twisted multipair, multistrand with at least one spare pair, minimum 0.5 mm2 cross section, annealed copper (shielded and armoured) shall be provided for Loud speakers.																												
14.13.00	TECHNICAL PARTICULARS Public Address Systems shall conform to the following technical parameters. <table><tr><th>Items</th><th>Technical Particulars</th></tr><tr><td>(i) Amplifiers</td><td></td></tr><tr><td> (a) Band width (± 3 db)</td><td>100-16000 Hz</td></tr><tr><td> (b) THD</td><td>< 0.5% at 1 KHz at rated output</td></tr><tr><td> (c) Signal to Noise Ratio</td><td>Min. 80dB</td></tr><tr><td>(ii) Microphones</td><td></td></tr><tr><td> (a) Band width (±3 db)</td><td>Codec G.722, 200-7000Hz</td></tr><tr><td> (b) Type</td><td>Omnidirectional & Dynamic noise cancelling type</td></tr><tr><td>(iii) Loudspeakers</td><td></td></tr><tr><td> (a) Outdoor</td><td>wall/column mounted Horn Type</td></tr><tr><td> (i) Capacity</td><td>105 dB for broadcast, 95dB for call mode, 15 W (RMS)</td></tr><tr><td> (b) Indoor</td><td>wall/column mounted Cone Type</td></tr><tr><td> (i) Capacity</td><td>85dB , 4W (RMS)</td></tr></table>			Items	Technical Particulars	(i) Amplifiers		(a) Band width (± 3 db)	100-16000 Hz	(b) THD	< 0.5% at 1 KHz at rated output	(c) Signal to Noise Ratio	Min. 80dB	(ii) Microphones		(a) Band width (±3 db)	Codec G.722, 200-7000Hz	(b) Type	Omnidirectional & Dynamic noise cancelling type	(iii) Loudspeakers		(a) Outdoor	wall/column mounted Horn Type	(i) Capacity	105 dB for broadcast, 95dB for call mode, 15 W (RMS)	(b) Indoor	wall/column mounted Cone Type	(i) Capacity	85dB , 4W (RMS)
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15.00.00	WALKIE TALKIE 5 Nos. of industrial grade Walkie Talkie sets shall be provided by the Contractor along with all required licenses from government authorities.																												
16.00.00	C&I LABORATORY Contractor has to set up a laboratory as per process requirement with minimum quantity and type of instruments indicated as below:																												
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	<table><thead><tr><th>Sl. No.</th><th>Description of Equipment</th><th>Total Quantity Common for plant</th></tr></thead><tbody><tr><td>1.0</td><td>Electronic Test Bench</td><td>1</td></tr><tr><td>2.0</td><td>Pneumatic Test Bench</td><td>1</td></tr><tr><td>3.0</td><td>Dead Weight Tester</td><td>1</td></tr><tr><td>4.0</td><td>Vacuum Tester</td><td>1</td></tr><tr><td>5.0</td><td>Vacuum Pump</td><td>1</td></tr><tr><td rowspan="3">6.0</td><td>Manometers</td><td></td></tr><tr><td>(i) Test Manometer</td><td>2</td></tr><tr><td>(ii) U-Tube Manometer</td><td>2</td></tr><tr><td rowspan="2">7.0</td><td>Standard quality pressure Gauges of following ranges:</td><td></td></tr><tr><td>(-) 1-0 (bar), 0-1 kg/sq.cm, 0-1.6 kg/sq.cm, 0-2.5 kg/sq.cm, 0-4 kg/sq.cm, 0-6 kg/sq.cm, 0-10 kg/sq.cm, 0-25 kg/sq.cm, 0-40 kg/sq.cm, 0-60 kg/sq.cm, 0-100 kg/sq.cm, 0-250 kg/sq.cm, 0-400 kg/sq.cm, 0-600 kg/cm2</td><td>2 no of each range</td></tr><tr><td>8.0</td><td>Air Set</td><td>4</td></tr><tr><td rowspan="2">9.0</td><td>Portable Electro-pneumatic Calibrator (Accuracy 0.05%)</td><td></td></tr><tr><td>Range 0-2 Kg/sq.cm, Range 0-20 Kg/sq.cm</td><td>2 sets of each range</td></tr><tr><td rowspan="3">10.0</td><td>Laboratory Grade Temperature Dry Block Calibrator</td><td></td></tr><tr><td>High Range</td><td>1</td></tr><tr><td>Low Range</td><td>1</td></tr><tr><td>11.0</td><td>Thermocouple Test Furnace</td><td>1</td></tr><tr><td>12.0</td><td>Barometer</td><td>1</td></tr><tr><td>13.0</td><td>Digital Thermometer</td><td>4</td></tr><tr><td>14.0</td><td>Stop Watches</td><td>3</td></tr><tr><td>15.0</td><td>Precision Instrument Radial Drilling Machine with all Standard Tools</td><td>1</td></tr><tr><td>16.0</td><td>Standard toolbox for instrument maintenance work</td><td>3 sets</td></tr><tr><td>17.0</td><td>Digital Thermometer/Hygrometer</td><td>2</td></tr></tbody></table>	Sl. No.	Description of Equipment	Total Quantity Common for plant	1.0	Electronic Test Bench	1	2.0	Pneumatic Test Bench	1	3.0	Dead Weight Tester	1	4.0	Vacuum Tester	1	5.0	Vacuum Pump	1	6.0	Manometers		(i) Test Manometer	2	(ii) U-Tube Manometer	2	7.0	Standard quality pressure Gauges of following ranges:		(-) 1-0 (bar), 0-1 kg/sq.cm, 0-1.6 kg/sq.cm, 0-2.5 kg/sq.cm, 0-4 kg/sq.cm, 0-6 kg/sq.cm, 0-10 kg/sq.cm, 0-25 kg/sq.cm, 0-40 kg/sq.cm, 0-60 kg/sq.cm, 0-100 kg/sq.cm, 0-250 kg/sq.cm, 0-400 kg/sq.cm, 0-600 kg/cm2	2 no of each range	8.0	Air Set	4	9.0	Portable Electro-pneumatic Calibrator (Accuracy 0.05%)		Range 0-2 Kg/sq.cm, Range 0-20 Kg/sq.cm	2 sets of each range	10.0	Laboratory Grade Temperature Dry Block Calibrator		High Range	1	Low Range	1	11.0	Thermocouple Test Furnace	1	12.0	Barometer	1	13.0	Digital Thermometer	4	14.0	Stop Watches	3	15.0	Precision Instrument Radial Drilling Machine with all Standard Tools	1	16.0	Standard toolbox for instrument maintenance work	3 sets	17.0	Digital Thermometer/Hygrometer	2		
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	18.0	Soldering/de-soldering station with all accessories	2
	19.0	Portable Digital Tachometer	2
	20.0	Multimeter	
	(i)	Digital Multimeter 5½ digits	2
	(ii)	Digital Multimeter 6½ digits	2
	(iii)	Portable Digital Multimeter 4½ digits	3
	(iv)	Portable Digital Multimeter 3½ digits	3
	21.0	Portable Current/mV calibrator	2
	22.0	Resistance Thermometer Bridge	2
	23.0	Decade Resistance Box	2
	24.0	Decade Capacitance Box	2
	25.0	Decade Inductance Box	2
	26.0	Variac (Single Phase)	2
	27.0	Rheostat/Potentiometers of following ratings	
		Amp.	Resistance in ohms
		12	3
		15	1.8
		2	47
		2	100
		1	470
	28.0	Test Resistance Temperature Detector and Test Thermocouple	2 each
	29.0	Portable thermocouple/RTD Calibrator/simulator	2
	30.0	Portable Multi-function counters	1
	31.0	Digital Storage Oscilloscope	2
	32.0	Portable Power Pack	2
	33.0	Portable Vibration Meter	2
	34.0	Portable Vibration Analyzer	1
	35.0	RCL meter	1
	36.0	pH Simulator	1
	37.0	Logic Probe	2
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	38.0	Function Generator	2
	39.0	Portable Infrared Thermometer	1
	40.0	Clip-on AC Power Meter	1
	41.0	Portable Flue Gas Analyzer	2
	42.0	Portable High Speed Trend Recorder	1
	43.0	LAN/Coaxial cable meter/tester	1
	44.0	Digital Insulation Tester	2
	45.0	Bench Magnifier	1
	46.0	Industrial vacuum cleaner	1
	47.0	Drawing Scanner (A3 Size)	1
	48.0	PCs	2
	49.0	Portable Ultrasonic flow meter	1
	50.0	Ground resistance tester	1
	51.0	Fiber Optic testing tool set	2
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