4.2.4 Documents as specified in PO/PR/MR are minimum requirements.Supplier shall submit any other document/data required for completion of the job as per EIL/Owner instructions.

4.3 Style and Formatting

4.3.1 All Documents shall be in ENGLISH language and in M.K.S(Meter-Kilogram-Second) System of units.

4.3.2 Before forwarding the drawings and documents, contractor shallobtain the title block from EIL and ensure that the following information are properly mentioned in each drawing:

- Purchase Requisition Number
- Name of Equipment / Package
- Equipment / Package Tag No.
- Name of Project
- Client
- Drawing / Document Title
- Drawing / Document No.
- Drawing / Document Revision No. and Date

4.4 Review and Approval of Documents by Supplier

4.4.1 All, the Drawing/Documents shall be reviewed, checked, approved and duly signed/stamped by supplier before submission.Revision number shall be changed during submission of the revised supplier documents and all revisions shall be highlighted by clouds. Whenever the supplierrequires any sub-supplier drawings to be reviewed by EIL, the same shall be submitted by the supplier duly reviewed, approved and stamped by the supplier.Direct submission of sub-supplier's drawings without contractor's / suppliers' approval shall not be entertained.

4.5 Document Category

Following review codes shall be used for review of supplier Drawings/Documents:

Code 1 - No comments. Proceed with Manufacture / Fabrication / Construction as per the document.

Code 2 - Proceed with Manufacture / Fabrication / Construction as per commented document. Revised document required.

Code 3 - Document does not conform to basic requirements as marked.Resubmitfor review.

Code R - Document is retained for Records. Proceed with Manufacturing / fabrication as per Tender/ ContractRequirement.

Code V - Void, Document is returned as invalid.

Document is marked as Void under following conditions:

a) Wrong item drawing uploaded.
b) Superseded or obsolete submission.
c) Duplicate submission.
d) Out of sequence submission.
e) Mismatch in document name and title under which document uploaded.
f) Document not legible.
g) For PMC projects, document not signed and stamped by contractor and DEC

4.6 Methodology for Submission of Documents to EIL/Owner

4.6.1 Document Control Index (DCI)

Supplier shall create and submit Document Control Index (DCI) forreview based on PO/PR/MR along with schedule date of submission of each drawing/document on EIL Vendor Portal.The DCI shall be specific with regard to drawing/document no. and the exact title. Proper sequencing of the drawings/documents should be ensured in schedule date of submission.

4.6.2 Submission of Drawings/Documents / Data

Drawings/documents, data and DCI shall be uploaded on the EIL Vendor Portal as per approved DCI. The detailed guidelines for uploading documents on EIL VendorPortal are available on URL:**http://edocx.eil.co.in/vportal**

4.6.3 Statutory Approvals

Wherever approval by any statutory body is required to be taken by Supplier, the Supplier shall submit copy of approval by the authority to EIL.

4.6.4 Manufacturing Schedule

Supplier shall prepare milestone based(milestones such as document submission, sub ordering, manufacturing, Inspection, dispatches, etc.) manufacturing schedule for the order, to meet delivery as per FOA/PO terms. Supplier shall submit manufacturing schedule to concerned Regional Procurement Office (RPO) of EIL, with a copy to Head office monitoring team/Owner for review within 7 days from date of FOA/PO.Same shall be uploaded in the EPS portal of EILi.e.,https://www6.eil.co.in/epsinspection/supp

4.6.5 Schedule and Progress Reporting

Supplier shall submit Monthly Progress Report(MPR) on or before the 9th of every monthindicating following milestone-based progress details as minimum:

- Drawing submission and approval status and schedule for submission of revised drawing / fresh Drawing requiring approval as per approved DCI
- Sub-ordering plan/details for all major items indicating item description, sub-order number, Date of sub-ordering, sub-vendor name, Location, contractual delivery data and expected delivery dates at main vendor's shop and other critical details requiring timely receipt of sub-ordered items at shop.
- Shop manufacturing progress indicating major milestone progress, in case of missing any milestone date, catch up plan for the same and expected dispatch date from shop and expected delivery date at site.
- Area requiring special attention/concern and proposed action plan to resolve the same.

First Monthly Progress Report (MPR) shall be submitted within2 weeks from FOA/LOA.In case of exigencies, EIL/Owner can ask for report submission as required on weekly/fortnightly/ad-hoc basis depending upon supply status and supplier shall furnish such reports promptly without any price implication.Format for progress report shall be submitted by the Supplier during kick off meeting or within 2 weeks of receiving FOA/LOA, whichever is earlier.

4.7 Inspection and Testing

4.7.1 Quality Assurance Plan/Inspection and Test Plan

If Inspection and test plans (ITP)are attached with MR/PR same shall be followed along with additional tests requirement (if any) mentioned in MR/ PR. However for cases wherein EIL Standard ITPs not available/ have not been attached with MR/PR, Supplier shall submit within one week of receiving FOA/LOA, the Quality Assurance Plan for inspection & testing at various stages of production, quality control records for critical bought out items/ materials and site assembly & testing as may be applicable to the specific order and obtain approval from concerned Regional procurement Office of EIL/third party inspection agency, as applicable.

For Package equipment contracts, the supplier shall prepare a list of items/ equipment and their inspection categorization plan for all items included in the scope of supply immediately after receipt of order and obtains approval for the same from EIL. The items shall be categorized into different categories depending upon their criticality for the scope of inspection of TPIA and/or EIL.

4.7.2 Inspection Requirements:

Supplier shall perform internal inspection as per ITP/ approved QAP at their works based on approved documents/drawings. Upon satisfactory internal inspection, supplier shall raise inspection call through Inspection call Module of EPS (https://www6.eil.co.in/epsinspection) to concerned Regional Procurement Office (RPO) of EIL/ TPIA/ Owner with advance notice as per contractalong with Internal test reports. Where inspection is not in the scope of EIL and is carried out by nominated Third Party Inspection agency (TPIA), Inspection Release Note (IRN) issued by the nominated TPIA along with Manufacturer's Test Certificate (MTC) shall be uploaded in EIL EPS Portal (https://www6.eil.co.in/epsinspection).

All changes w.r.t. PR shall be recorded through agreed variations or Concessions & Deviations. Conflict, if any, between PR / Job specifications and approved drawings, shall be brought to the notice of EIL / owner bythe supplier/ contractor. Decision of EIL / owner will be binding on the supplier and to be complied without time and cost implications.

Identified bought out items/ raw material shall be procured under TPIA as per ITP.

4.7.3 Inspection Release Note (IRN)/ Inspection Certificate (IC)

IRN/ IC shall be issued by EIL Inspector/ third party inspection agency on successful inspection, review of test reports/ certificates as per specifications &ITP/ agreed quality plan (as applicable) and only after all the drawings/documents as per DCI are submitted and are accepted under review code-1or code R. Supplier shall ensure that necessary documents/manufacturing and test certificates are made available to EIL/TPIA as and when desired.

Note 1: Non fulfilling above requirement shall result into appropriate penalty or with- holding of payment as per conditions of PO/PR/MR.

Note 2: For items where IRN/IC is issued by TPIA, supplier to ensure that following as a minimum must be mentioned by TPIA in IRN/IC:

a) PR document number
b) List of drawings/documents with EIL approval code
c) Tests witnessed, documents reviewed

d) Compliance statement by TPIA that product meets the requirement as specified in EIL PR, standard specifications, Inspection Test Plan/QAP and approved documents.

4.8 Transportation Plan

Transportation Plan for Over Dimensional Consignments (ODC), if any, shall be submitted within 2 weeks of receiving FOA/LOA, for approval. Unless otherwise specified, consignments with parameters greater than following shall be considered as over dimensional.

Dimensions : 4 meters width x 4 meters height x 20 meters length

Weight : 32 MT (Metric Ton)

Dimensions and weight provided above are inclusive of all nozzles, attachments, transportation saddles etc.

Physical Rout survey for ODC movement shall be submitted to EIL within 8 weeks of receiving FOA / LOA.

4.9 Dispatch Details

Upon receipt of IRN/IC from EIL inspector/TPIA, supplier shall dispatch items within 2 days. Item wise dispatch details shall be uploaded in EIL's EPS module within 24 hours of any item dispatched from shop, indicating PR item no, Quantity dispatched, Transporter's name, LR Number/ LR date.

4.10 Vendorshall ensure timely uploading of Manufacturing Schedule, Monthly Progress Report,Inspection Certificate (IRN)issued by the TPIA (as applicable for PO where Inspection is under nominated Third Party Inspection Agency)and updation ofitem wise dispatch details in EPS portal of EIL (https://www6.eil.co.in/epsinspection).

4.11 Final Documentation

4.11.1 Supplier shall prepare final documents in line with VDR(Vendor Document Requirements) attached with PR/Tender. A copy of final document along with filled in Format for Completeness of Final Documentation (Format No. 3-78-0004) to be submitted to EIL Inspector/TPIA for review & approval within 2 weeks from dispatch. Upon receipt of EIL/TPIA endorsement on Completeness of Final Documents, supplier shall submit soft/hard copies of Final documents to EIL/Owner in requisite quantity as per PO/PR details, along with covering letter. A copy of covering letter to be submitted to the concerned Regional Procurement Office (RPO) of EIL/Owner.

4.11.2 As Built Drawings

Minor Shop changes made by Supplier after approval of drawings under 'Code 1' by EIL and deviations granted through online system, if any, shall be marked in hard copies of drawings which shall then be stamped 'As-built' by the supplier.These 'As-built' drawings shall be reviewed and stamped by EIL Inspector/TPIA.Supplier shall prepare scanned images files of all marked – up 'As – built' drawings. Simultaneously Supplier shall incorporate the shop changes in the native soft files of the drawings also.

4.11.3 Packing/Presentation of Final Documents

Final Documents shall be legible photocopies in A4, A3 size only.Drawings will be inserted in plastic pockets (both sides transparent, sheet thickness minimum 0.1 mm) with an extra strip of 12 mm wide for punching so that drawings are well placed.

Final Documentation shall be bound in Hard board Plastic folder(s) of size 265 mm x 315 mm (10½-inch x 12½-inch) and shall not be more that 75 mm thick. It may be of several volumes and each volume shall have a volume number, index of volumes and index of contents of that particular volume.Where number of volumes are more, 90mm thickness can be used.Each volume shall have top PVC sheet of minimum 0.15 mm thick duly fixed and pressed on folder cover and will have 2 lever clips.In case of imported items documents, 4 lever clip shall also be accepted.All four corners of folders shall be properly metal clamped.Indexing of contents with page numbering must be incorporated by supplier.Spiral/Spico bound documents shall not be acceptable.As mentioned above, books should be in hard board plastic folders with sheets punched and having 2/4 lever clips arrangement.

Each volume shall contain on cover a Title Block indicating package Equipment Tag No. & Name, PO/Purchase Requisition No., Name of Project and Name of Customer.Each volume will have hard front cover and a reinforced spine to fit thickness of book.These spines will also have the title printed on them.Title shall include also volume number (say 11 of 15) etc.

4.11.4 Submission of Soft Copies

Supplier shall submit to EIL, the scanned images files as well as the native files of drawings/documents, along with proper index.

In addition to hard copies, Supplier shall submit soft copies of all the final drawings and documents in pen drive or any other specified medium with proper identification tag, all text documents prepared on computer, scanned images of all important documents (not available as soft files), all relevant catalogues, manuals available as soft files (editable copies of drawings/text documents, while for catalogues/manuals/proprietary information and data, PDF files can be furnished). All soft files shall be appropriately named, systematically indexed, and duly bookmarked in PDF format to facilitate ease of reference and access.

All the above documents shall also be uploaded on the EILVendor Portal and if applicable on Client Server also.

4.11.5 Completeness of Final Documentation

Supplier shall get the completeness of final documentation verified by EIL/TPIA,as applicable, and attach the Format for Completeness of Final Documentation (Format No. 3-78-0004) duly signed by EIL Inspector or TPIA as applicable to the final document folder.

COMPLETENESS OF FINAL DOCUMENTATION

Name of Supplier/Contractor	:	
Customer	:	
Project	:	
EIL's Job No.	:	
Purchase Order No./ Contract No.	:	
Purchase Requisition No./ Tender No.	:	Rev. No.:
Name of the Work/ Equipment	:	
Tag. No.	:	
Supplier's/ Contractor's Works Order No.	:	

Certified that the Engineering Documents/ Manufacturing & Test Certificates submitted by the supplier (as per Index sheet mentioned in Annexure-1) are complete in accordance with the Vendor Data Requirements of Purchase Requisition / Tender.

Signature	: ……	Signature	: ……
Date	: ……	Date	: ……
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……
	Supplier/Contractor		EIL/TPIA

Annexure-1

Final Documentation Index Sheet			
PR/PO/Tender No.		Revision No.	
Serial No.	Document Title	Page/ Folder No.	No. of Pages

Signature	: ……	Signature	: ……
Date	: ……	Date	: ……
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……

Supplier / Contractor

EIL / TPIA

CONSTRUCTION SUPERVISION AND MANAGEMENT BY PACKAGE CONTRACTOR

COOLING TOWER PACKAGE FOR PP PROJECT, NRL

PROJECT	:	**POLYPROPYLENE (PP) UNIT PROJECT**
OWNER	:	**M/s NUMALIGARH REFINERY LTD.**
LOCATION	:	**NUMALIGARH, ASSAM**
JOB No.	:	**C0050**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	12.08.2025	ISSUED FOR BIDS	JK	AC	GGM (C)

CONSTRUCTION SUPERVISION AND MANAGEMENT

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Attachment-III	Standard Specification for Positive Material Identification (PMI) at Construction Sites	6-82-0002, Rev.5
Attachment-IV	Standard Specification for Colour Coding of Piping Materials	6-82-0003, Rev.3
Attachment-V	Standard Specification for erection of equipment and machinery	6-76-0001, Rev.4
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Attachment-VIII	Observation on Safety Aspect	C050-00-1U68-19-41-0001_F2

1.0 GENERAL

1.1 The CONTRACTOR shall construct Plant/Facilities in accordance with the requirements of the Technical Standards/ Specifications, with proven/good engineering practices and procedures. Such Facilities shall be safe, reliable and suitable for their intended purpose.

1.2 The CONTRACTOR shall provide all supervision, labour, construction equipments, tools & tackles, materials and consumables, temporary facilities, etc. and render all support services necessary for the construction. Provision of construction power and water shall be as per Special Conditions of Contract (SCC)/ General Conditions of Contract (GCC).

1.3 The CONTRACTOR shall plan, execute, manage and control all the construction activities for the facilities forming a part of this contract.

1.4 The CONTRACTOR shall arrange insurance coverage for all the personnel engaged by him for the work as per statutory rules, regulations and local laws.

1.5 The CONTRACTOR shall insure all the materials and equipments against fire, flood, earthquake, theft, etc. as per SCC/ GCC brought for the job till the Plant/Facilities are commissioned and handed over to the OWNER.

1.6 The CONTRACTOR to ensure mechanizing the construction activities to the maximum.

1.7 The CONTRACTOR is deemed to have full knowledge of the applicable laws and regulations, conditions of labour, local conditions, the SITE conditions, environmental aspects and shall comply with the requirements thereof.

1.8 The CONTRACTOR is required to organize and mobilize Construction Management Services in a systematic and sequential manner to ensure that the Plant installation is carried out in accordance with the approved engineering drawings, specifications, standards, QA/QC procedures etc. and its mechanical completion is achieved within targeted time schedule. Construction Management and Supervision is to be carried out by the CONTRACTOR himself by deploying persons on his rolls and this activity is not to be sub-contracted in any case.

For this purpose, the CONTRACTOR shall deploy a Construction Management Team headed by a qualified & experienced person at site. The Construction Management team shall include engineers/ specialists in QA/QC, Project Control (Planning, scheduling, monitoring), contracts, construction supervision, progress measurement/billing, safety, warehousing, purchasing etc. Key personnel including the Head should have sufficient qualification/experience and should not be changed without concurrence from OWNER/PMC.

Curriculum vitae of all key Construction Personnel shall be submitted to Owner/PMC at least 3 months before deployment. Owner/PMC reserve the right to interview these personnel before their mobilization.

1.9 The CONTRACTOR shall ensure delegation of adequate and sufficient powers (including financial) to the Head of his Construction Team for effective and smooth functioning of the construction management. HO support shall be provided to the Head of Construction Team at site during construction on all matters of project execution including the following:

- Field engineering.

- Vendor specialists required during construction.
- Rectification/replacement of defective supplies, if any, noticed during construction.
- Expediting replacement of imported items found short/damaged.
- Required documentation for the material inspection at site
- Compilation and submission of Field Inspection documents in requisite copies as per contract
- Documentation to meet Statutory requirements.

1.10 The construction supervision, co-ordination and management activities shall be carried out by the CONTRACTOR in accordance with the construction procedures developed and submitted by the CONTRACTOR and approved by OWNER/PMC. CONTRACTOR shall prepare construction schedules within the framework of overall contract schedule and submit to OWNER/PMC for approval. CONTRACTOR shall plan, execute, monitor and control construction activities as per the approved construction schedule.

CONTRACTOR shall depute a project team at site during construction phase under a project coordinator for providing above-mentioned support to the Head of Construction Team.

1.11 The Contractor shall procure materials like cement, reinforcement bars and structural steel from approved vendors only. The CONTRACTOR shall establish and maintain a material testing laboratory for carrying on field tests during execution of contracts under different disciplines by sub-contractor's, at no extra cost to OWNER. The entire test equipments deployed shall have valid test/calibration certificates traceable to relevant national/ international standards. Such material tests, for which testing facility at site is not established, shall be carried out by CONTRACTOR at testing laboratories approved by OWNER/ PMC at no extra cost. CONTRACTOR shall maintain the test records and the same shall be made available for review/ inspection of OWNER/ PMC. Further, OWNER/PMC reserve the right to witness/ inspect testing at the laboratory at no extra cost to OWNER/PMC.

1.12 Construction supervision and management functions to be performed by the CONTRACTOR shall include the following as key functions for effective execution, monitoring and control:

- Planning, scheduling, monitoring & reporting.
- Construction supervision, discipline wise.
- Quality assurance and quality control, discipline wise.
- Shipping, custom clearances, inland transportation
- Warehouse management and material control.
- Field engineering/Purchase.
- Health, Safety and Environment (HSE) Management
- Enforcement of statutory rules/ regulations and Labour Laws.
- Personnel/administration/Industrial Relations
- Billing and Invoicing

- Finance and Accounts
- Security

1.13 Whenever the hookup is to be done with the facilities under operation, efforts shall be made by the CONTRACTOR to complete the work and restore the system expeditiously. If required the work shall be continued round the clock.

2.0 EXECUTION OF WORKS

The CONTRACTOR'S work during construction shall include but not be limited to the following:

i) Prepare and submit all the Plans, Procedures and documents to OWNER/PMC as specified in the contract.

ii) Establish requisite site organization staffed by competent and experienced specialists, supervisors and inspectors.

iii) Supervise, Coordinate and manage the activities performed at site by him and by his sub-contractors for execution of work and render all technical/specialist services.

iv) Plan and schedule the construction work, monitor and take timely corrective action when required to adhere to approved execution schedule.

v) Plan, allocate and mobilize required resources, manpower, and construction equipment/materials, commensurate with construction plan/schedule.

vi) Provide all temporary facilities required for Construction including drinking water, lighting, office space, electronic transmission of drawings & documents, printing facilities, rest rooms, crèches, first-aid, fire protection system, toilets, canteen facilities, labour hutments, transport facilities for the workers and staff.

vii) Prepare & implement Quality Control and Quality Assurance plan.

viii) Prepare & implement Health, Safety & Environment (HSE) plan.

ix) Report beforehand and take approval from OWNER/PMC regarding use of any equipment and/or material not conforming to the contract, drawings and specifications.

x) Execute and supervise all additional works and modification works as required or suggested by OWNER/PMC as a part of approved change orders.

xi) Erect and install the equipments and materials according to the approved specifications and procedures.

xii) Establish required Field Inspection and Testing Laboratories at site to carryout tests as specified in the standards/specifications of the contract.

xiii) To organize and obtain all applicable clearances/approvals from statutory bodies/authorities, as required by the laws of land for the work executed at site shall be the responsibility of the CONTRACTOR under the contract.

xiv) Obtain approval of OWNER/ PMC for Welding Procedure Specifications (WPS)/ Procedure Qualification Records (PQR) as required. Carry out inspection, non-destructive tests and analyze and certify acceptability of all welds and materials in

accordance with specified Technical Standards. Carry out inspection and testing of incoming materials as per agreed procedures.

xv) Organize and conduct Weekly Project Review meeting related to site construction activities.

xvi) Provide daily work progress reports and detailed weekly and monthly progress reports summarizing percentage completion of the work including status of drawings, materials and effects on approved schedule, areas of concern and corrective actions required thereof. CONTRACTOR shall also identify any foreseeable delays in any aspect of the WORK and take corrective actions to eliminate/minimize the effect on Overall Completion Schedule. All progress shall be quantified.

xvii) Take photographs and video recording of Project Construction Progress on regular basis and submit the same to OWNER/PMC on monthly basis along with the Monthly Progress Report.

xviii) Prepare and submit safety and labour relation procedures in line with all applicable codes, regulations and OWNER'S requirements.

xix) Supervise and monitor all safety and labour relation functions as per agreed procedures and applicable laws of the land and report to OWNER immediately for any violations and injuries.

xx) If any part of the facilities is completed and is under operation, while other parts of the facilities are under construction, or work is to be carried in running Plant , it is essential that rigid safety rules be prepared and maintained for all WORKS in accordance with the requirements of OWNER/PMC.

xxi) Maintaining all the records generated during project execution up-to-date and made available to OWNER/PMC whenever requested. These records shall be handed over to OWNER on completion of the work at no extra cost to OWNER.

xxii) Carryout warehouse management and material control in accordance with approved procedure.

xxiii) Take all necessary precautions and required actions to protect construction work and materials from damage by local weather conditions and ongoing construction activities in the vicinity, theft and pilferage etc. till handing over of the plant to OWNER.

xxiv) Undertake housekeeping including sweeping, clean up to maintain cleanliness, sanitation, removing excess materials, temporary facilities, scaffolding, etc. on regular basis till handed over to OWNER.

xxv) Prepare and submit to OWNER/PMC the following daily reports for construction activities covering the following:

a. Weather

b. Manpower deployment category wise

c. Construction Equipments

d. Work Progress

xxvi) Ensure the control of all works with regard to its impact on the surrounding environment.

xxvii) Ensure all hot works are performed outside hazardous areas and in compliance with OWNER'S Safety Permit System requirements wherever applicable.

xxviii) Arrange and coordinate the visits of suppliers representatives/specialists at site.

xxix) All material handling equipment, tools, tackles, hoisting and lifting equipments/ machineries should be subjected to required load test initially and then periodically, to ensure safe/stable operation.

xxx) Organize field engineering work, wherever required and ensure timely resolution of interface problems / site constraints in consultation with OWNER/PMC.

xxxi) Prepare and certify material reconciliation statement on completion of work to enable OWNER to take over the surplus materials, as applicable.

xxxii) Organize the codification and handing over of surplus materials (as applicable) and spares/ tools and tackles to the OWNER on completion of work.

xxxiii) Provide weekly/daily activity plan for site inspection.

xxxiv) Develop a phased mechanical completion program to facilitate sequential Pre-commissioning/Commissioning activities in a logical manner to meet the Overall Project Schedule.

xxxv) Remove / demolish all temporary structures/ establishments/ facilities created by the CONTRACTOR / his sub-contractors during the execution of the work and restore the site to its original condition.

xxxvi) Carry out tightening of flange joints by using hydraulic tensioner/ torque wrench as per specifications. CONTRACTOR shall ensure that stud bolts are ordered extra-long to facilitate tensioning.

xxxvii) Organize safety induction programme for their manpower before deployment on work and at regular intervals thereafter.

CONTRACTOR shall draw up a detailed activity list of pre shutdown activities and shutdown activities (wherever applicable) and submit the same for the approval of the OWNER/PMC. All endeavors shall be made to maximize the pre-fabrication before the planned shut down and to minimize the work during shutdown period. All such activities shall be identified and appropriately planned for temporary supports, scaffolding, clamping arrangements, enabling works, etc. so that the quantum of the work during the shutdown can be minimized.

3.0 EXECUTION PLANS

CONTRACTOR shall submit Construction Execution Plan to OWNER/PMC for review/approval during kick-off meeting. The Plan shall detail the execution methodology of the CONTRACTOR during construction phase of the PROJECT covering following aspects as minimum –

3.1 Construction Management Plan

CONTRACTOR shall submit Construction Management Plan to OWNER/PMC for approval during kick-off meeting. The Plan shall detail the management methodology to be applied during the construction phase of the PROJECT, along with a list of procedures to be utilized in undertaking the work.

All reference procedures and detail work plans referred to in this document must be submitted for review and approval by OWNER/PMC at least (4) four weeks in advance of actual commencement of the activity concerned.

3.2 Construction Execution Plan:

It shall include the following as minimum:

3.2.1 Contractor's manpower and man-hour histogram by major section and discipline and their manpower deployment schedule on monthly basis.

3.2.2 Major equipment mobilization plan on monthly basis with short description. CONTRACTOR to develop this plan with due consideration to maximize the mechanization of construction activities.

Other plans of CONTRACTOR and procedures to be submitted at least four (4) weeks prior to start of respective activity at site, include the following as a minimum:

a. Develop/ prepare pre-shut down/ shut down and post shut down plan including resource mobilization plan and submit to OWNER/PMC for approval (where applicable).

b. Develop/ prepare construction/erection plan/procedures and submit to OWNER/ PMC for approval.

c. Temporary facilities, etc.

d. Piling plan (if applicable)

e. Barricading Plan

f. Scaffolding plan

g. Excavation and underground work plan

h. Heavy transport and heavy lifting plan (Rigging Plan), If applicable

i. Pre-fabrication plan

j. Other activity plans e.g. piping, equipment and steel structure erection plan etc.

k. Monsoon counter measures and preparation

l. Emergency Evacuation Procedure

m. Storm Management Plan

n. Schemes to carry out works in inclement weather

Contractor shall ensure that lay down area (as applicable) given to him shall be utilized optimally.

3.3 Sub-Contracting Plan

A minimum of of the following activities shall be performed by the CONTRACTOR directly and shall not be subcontracted:

a) Project Management

b) Planning

c) Procurement

d) Construction Management

e) Commissioning

If CONTRACTOR proposes to engage sub-contractor(s) for the execution of some of the activities at site, a preliminary sub-contracting plan along with the identified scope of work for each sub-contract shall be furnished by the CONTRACTOR to the Owner/PMC at the time of bid submission. However, the credentials of proposed Sub-contractor(s)'s shall be submitted by the CONTRACTOR on award of work, which shall be evaluated by OWNER/PMC at SITE for acceptance. CONTRACTOR shall not be permitted to change the sub-contractor under any circumstances without prior approval of OWNER/PMC. Non-compliance of the above shall be strictly dealt within relevant provision(s) of the contract.

The sub-contracting plan shall cover

i) Sub-contracting philosophy

ii) List and scope of work of each subcontract

iii) Subcontract administration plan

iv) Organization chart of each sub-contractor.

The list and major scope of each subcontract shall not be changed from those of the CONTRACTOR'S plan unless specially approved by OWNER.

4.0 TEMPORARY FACILITIES

The CONTRACTOR shall arrange the following temporary facilities as the minimum (including for his sub-contractors also):

i) Exact location of temporary work area, access and general layout inside the area.

ii) Planning and description of the temporary facilities such as:

a. Identification of borrow earth area (if required)/excess earth dumping yards

b. Site office and Fabrication yards, Open storage area and Warehouse

c. Miscellaneous workshops including maintenance area for construction equipments.

d. Temporary roads including access road to Plant, fencing and gates

e. Security, watch & ward, security gates, etc.

f. Utility supply systems viz. Construction power with DG Sets, construction water, drinking water etc.

g. Area lighting

h. Firefighting equipment's

i. Drainage and Sanitation

j. Camp Accommodation

k. Field Testing Laboratory

l. Radiography Source Pit as per BARC Guidelines

m. Film processing and viewing labs

n. Communication facilities viz. Telephone, Fax, E-mail, electronic transmission of drawings. / Documents, etc.

o. Hutments, transport, Pantry and Canteen for staff and workers. Hutments/ labour colony shall not be allowed inside the petrochemical complex.

p. Vehicle parking area including construction equipments.

q. First aid arrangement/ medical and health care facilities

r. Gate pass for workmen/officials/ vehicles as per OWNER security system.

s. Work Permits as per Owner's prevailing system.

CONTRACTOR shall develop the temporary facilities layout for approval of OWNER/PMC.

5.0 CONSTRUCTION PLANNING, SCHEDULING, MONITORING & REPORTING

The CONTRACTOR shall be responsible for construction Planning, Scheduling, Monitoring and Reporting activities at site in line with the overall master schedule and details stipulated elsewhere in the bid.

6.0 QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

The CONTRACTOR shall be responsible for ensuring quality of construction (including materials) carried out by him/his approved sub-contractors in accordance with the requirements given in section for Quality Assurance / Quality Control (QA/QC) during construction including all documents referred therein.

7.0 WAREHOUSE MANAGEMENT & MATERIAL CONTROL

The CONTRACTOR shall construct/ build warehousing facilities (both covered and open) appropriate for storing materials required for the job. The facilities shall include proper lighting, fire protection system, office/rest rooms/toilets for warehouse personnel.

The CONTRACTOR shall obtain all statutory approvals from concerned authorities for all warehouse equipment, instruments etc. The CONTRACTOR shall comply with statutory regulations for storage of any material covered under Explosives rules.

The CONTRACTOR shall be responsible for carrying out the Warehouse Management and Material Control in accordance with the approved warehousing procedure and material control procedure, which is to be submitted by the CONTRACTOR during kick-off meeting. The activities shall include but not limited to:

- Transport Liaison, both for imported materials as well as materials procured indigenously, from the time of dispatch up to receipt at site.
- Transportation Plan (i) from source to site (ii) site to erection location.
- Receipt, Handling, Identification, Inspection (including confirmation by an Alloy Analyzer for Alloy Steel, Stainless Steel and other Exotic Materials) and Acceptance, Storage and Preservation of Materials, Codification of all materials including free issue materials to be supplied by OWNER.
- Filing of insurance Claims and follow up.
- Documentation for control and accounting of materials.

- Generation and upkeep of Traceability Records for materials.
- Materials Control & Issue.
- Inventory Checks.
- Field Requisition and Purchase.
- Spare & Tools including handing over of mandatory Spares/Tools to the OWNER as per the terms of the contract.
- Material Appropriation and Handing Over of all items to OWNER with Owner's codification system.
- Security.
- Taking up with suppliers on short supplied items and placing replacement orders for lost/damaged items.
- Intimating short/lost/damaged items received at site and further replacement action, as applicable.

CONTRACTOR shall generate and issue following reports:

- Fortnightly statement of consignments in transit.
- Daily report of material received.
- Material receipt status and inventory status w.r.t. material delivery schedule
- Material Inspection Report with respect to materials received at site
- Report on Over/Short/Reject/Damage (OSRD) receipts against each consignment on receipt at warehouse.
- Weekly status of consignments, Material Receipt Report (MRRs)
- Monthly status of field purchase.
- Monthly status of over, short, reject & damage (OSRD) settlement.
- Monthly status of piping material MTO V/s Actual receipt.
- Log Register of Rotating Equipments maintenance
- Daily Stock Position of Cement
- Any other report as desired by OWNER/PMC.

8.0 FIELD ENGINEERING

CONTRACTOR shall be responsible for controlling and issue of technical drawings and documents, preparation of field sketches, field modifications, checking/preparation of as-built drawings, etc. CONTRACTOR should have adequate facilities for incorporating field changes, preparation of As-built drawings, printing machines and Drawing & Document Control System.

9.0 FIELD TENDERING

CONTRACTOR shall be responsible for carrying out field tendering activities, as required from the site itself.

10.0 FIELD PURCHASE

CONTRACTOR shall be responsible for carrying out field purchase activities, as required.

Field Purchase items are restricted to those required for running and maintenance of the field offices, items required to expedite construction work and items found short, missing or damaged against the main order when received at the site. Any material purchased from field for usage in the plant should have proper inspection certificate and should be purchased from OWNER/PMC approved suppliers. If required by OWNER/ PMC, check testing of the material samples selected by OWNER/PMC shall be carried out by CONTRACTOR without any extra commercial implication.

11.0 HEALTH, SAFETY AND ENVIRONMENT (HSE) MANAGEMENT

The CONTRACTOR shall be responsible for Health, Safety and Environment (HSE) Management at construction site for the construction activities to be carried out by the him/his approved sub-contractors in accordance with the requirements mentioned in section for Health, Safety and Environment Management during construction.

12.0 HOUSE KEEPING

It is the responsibility of the CONTRACTOR to maintain general cleanliness and proper housekeeping at work site. CONTRACTOR shall organize disposal of excavated earth /garbage/ rubbish/scrap, etc. on day-to-day basis to identified disposal areas/safe areas and forward daily report for the same indicating the details of men and machinery deployed for the purpose; if asked by OWNER/PMC.

Wastage and serviceable/ unserviceable scrap generated during dismantling and regular works shall be segregated and dumped in designated locations in consultation with OWNER/PMC. Earth and landfill materials shall be dumped at locations identified by OWNER/PMC, otherwise outside the Project Site and the required fees charged by the local authorities shall be borne by the CONTRACTOR without any extra cost to OWNER.

13.0 INDUSTRIAL LABOUR RELATIONS

CONTRACTOR shall be responsible for industrial relation functions and implementation of labour laws at site. CONTRACTOR'S staff shall be suitably trained and experienced in Labour Relation functions so as to ensure a good relationship with labour and to prevent the occurrence of industrial disputes resulting in subsequent delays or work stoppages. In particular, CONTRACTOR shall maintain close liaison with OWNER/PMC.

CONTRACTOR shall maintain proper liaison with Statutory Authorities and local bodies and shall be responsible to implement and observe all statutory laws at site. CONTRACTOR must have in his staff; a well experienced Labour Relation Officer, preferably from local area.

CONTRACTOR shall maintain the records of wages paid in a wage register, PF, etc. as per statutory regulations.

CONTRACTOR shall report immediately to OWNER/PMC any problems including labour disputes, fight, and work stoppages. A written report shall be submitted to OWNER/PMC within 24 hours of the incident.

CONTRACTOR must submit a Labour Relation Plan including their sub-contractor(s) prior to the start of the work/within one month of award of the contract, whichever is earlier, mentioning as a minimum:

A detailed estimate of the number of labours, both indirect and direct, sorted by craft.

a. Outline recruiting plans for all manpower requirements.

b. Identify personnel involved with labour relations and outline procedures to mitigate labour disputes & problems.

c. Labour welfare plan

CONTRACTOR shall hold labour relations meeting twice a month with their work force as well as a separate meeting with the OWNER.

14.0 CONSTRUCTION EQUIPMENTS

The CONTRACTOR is required to organize and mobilize the construction equipments and other tools/tackles in a sequential manner and ensure that plant installation is carried out in a mechanized manner to the extent possible and its mechanical completion is achieved within targeted time schedule.

CONTRACTOR shall ensure deployment of the following construction equipment as a minimum as per requirement to the maximum extent –

i. Cranes of different capacities
ii. Tower crane, as required
iii. Batching Plant and Transit Mixture/supplier
iv. Concrete Boom Placer/ Concrete Pump, as required
v. Portable Alloy Analyzers with print out facility
vi. X-ray and Radiography sources
vii. Stress Relieving Equipments with Recording facility
viii. All weather fabrication sheds
ix. Blast cleaning and Painting Shop, as required
x. Welding machines
xi. DG sets
xii. Electrical and Instrumentation equipments/measuring devices etc.
xiii. Bevel Cutting Machines
xiv. Test Pumps
xv. Compressors
xvi. Gas and Mechanical cutting devices
xvii. Various inspection / measuring devices

In order to minimize fabrication at site, all (major) fabricated equipment like Columns/Towers, Vessels shall be transported preferably in single piece due to limitation of space at site. Deviation to this shall be specified at the bidding stage itself.

CONTRACTOR shall carry out the route survey for transportation of 'Over Dimensioned Consignments' including waterways from source of manufacture/supply to site well in advance of placement of order to ensure unhindered transportation of the same to construction site. CONTRACTOR shall arrange Cranes of suitable capacities to match with the erection requirements and inform the source and ownership of the same. Crane movement roads are to be clearly identified and marked on the plot plan before planning of such movement. Construction of hard stands for positioning of crane in the fabrication yard and at erection site/locations including approach roads to the hard stands from the plant roads shall be CONTRACTOR'S responsibility. The hard stands shall be suitable for the crane loads (self-load + equipment load) to facilitate erection works and to be tested for any settlement.

For the purpose of Equipment/Structural steel Erection, the CONTRACTOR shall deploy a Rigging team headed by a Rigging Foreman/Engineer reporting to concerned Area Engineer. Area Engineer should be well conversant with various erection techniques and shall be responsible for preparing erection schemes in accordance with the approved procedures and based on crane manuals and suiting to plant layout. Area Engineer shall have to foresee various other construction activities in the surroundings areas while planning erection schemes including safety aspects of man and machinery also.

CONTRACTOR shall prepare erection schedule in line with the overall project schedule of the Plant in phased manner with erection schemes of various equipments, vessels and submit to OWNER/PMC for approval, Monitoring and control of erection schedule and erection activities shall be carried out by the contractor as per the approved construction procedures.

For efficient working and maintenance of construction aids, CONTRACTOR shall establish and maintain crane yard / workshop equipped with regular maintenance facilities for various construction aids for carrying out routine field maintenance during performance of the contract. Temporary approach road and hard stands, wherever required for the movement of the Cranes and other vehicles for equipment erection and transportation of material shall be properly planned and made by the CONTRACTOR. Weekly/fortnightly maintenance shall be planned in such a way that the same does not hamper the erection schedule.

During performances of the work, contractor must ensure that structures, materials and equipments are adequately braced with Guys, Struts or any other means as deemed fit & approved by Owner/PMC. Such means shall be supplied and installed by the contractors as required till the erection works is satisfactorily completed. Such guys, shoring, bracing, strutting, planking supports etc. shall not interfere with the work of other agencies and shall not damage or cause distortion to works executed by other agencies. All lifting tools, tackles and cranes shall be tested periodically by statutory/ competent authorities for their load carrying capacity. Such relevant valid/test certificates shall be submitted to Owner/PMC for review before actual use of the tools, tackles and cranes.

CONTRACTOR shall submit the construction equipment deployment schedule. Daily construction equipment deployment report will also be submitted by the CONTRACTOR to Owner/PMC in the performa approved by Engineer In-Charge.

CONTRACTOR shall ensure the timely augmentation of the men, equipments and machinery depending upon the exigencies of the work to meet the overall project schedule and as per instructions of Owner/PMC.

15.0 CONSTRUCTION MANPOWER

The Contractor is required to organize and mobilize construction staff/ manpower in a sequential manner to ensure that the work is carried out in accordance with the construction schedule. Mobilization of construction staff should be such that the progress achieved in phased manner should match with the overall Project Schedule. Key Personnel i.e. Resident Construction Manager, Site In-charge, Lead QA/QC Engineer, Lead Planning Engineer, Safety officer, Discipline Engineer for execution of job shall be deployed meeting the qualification and experience requirement of Document No. 7-82-0003.

For this purpose, the CONTRACTOR shall clearly indicate in his construction methodology whether work shall be done departmentally or by engaging sub-contractor or the combination of both. CONTRACTOR shall prepare detailed methodology for the work to be carried out departmentally as well as through sub-contractors clearly, defining the scope and responsibility of CONTRACTOR and his sub-contractors.

The works of all sub-contractors shall be managed by the construction staff of the main CONTRACTOR who shall perform the duties of construction management and shall administer, coordinate, and inspect the works of the sub-contractor(s) and be responsible for the Quality and timely completion of respective works. The CONTRACTOR shall establish the pre-requisites for successful completion of sub-contractor (s) work. However, by deploying the sub-contractor (s), as approved by OWNER/PMC for any discipline, does not absolve the CONTRACTOR of his total responsibility under the subject contract.

The CONTRACTOR must note that in case of any sub-contractors' failure to execute the works as per standards/specifications/drawings and/or negligence & disobedience in carrying out any order or instruction of OWNER/PMC, the same shall be viewed very seriously and any action as deemed fit in accordance with provision(s) of the contract shall be taken by OWNER/PMC.

CONTRACTOR must submit the construction manpower deployment schedule along with the bid. Daily construction manpower deployment report shall also be submitted by the CONTRACTOR to OWNER/PMC on approved format. Any additional manpower of any category required to be deployed during the actual execution of the work to meet the Project time schedule and as instructed by OWNER/PMC, shall be mobilized by the CONTRACTOR within a reasonable time. Mobilization of such additional manpower by the CONTRACTOR shall not entitle him for any additional compensation at all.

All construction supervision, coordination and management activities shall be carried out by the CONTRACTOR in accordance with the construction procedures approved by OWNER/PMC. CONTRACTOR shall prepare construction schedules based on the Overall Project Schedule of the PLANT and submit the same to OWNER/PMC for approval. Monitoring and control of the construction activities shall be carried out as per the approved construction schedule & procedures.

During the execution of works at site, if the CONTRACTOR engages sub-contractor (s) for execution of works at site as per approval obtained from OWNER/PMC in line with contract provision(s) and in the event sub-contractor complains in writing to the OWNER with regard to the non-payment of their dues from the CONTRACTOR for the works executed by them (excluding final payments and payments due after termination of sub-contractors' services by the main CONTRACTOR), OWNER/PMC reserves the right to make such payment to the sub-contractors directly based on approved measurements with due notice to the CONTRACTOR. OWNER/PMC shall release such payments to

sub-contractor at the cost and risk of the CONTRACTOR in order to ensure smooth execution of work at site. All such payments made by OWNER/PMC to the sub-contractor(s) shall be deducted from the running account bills or any other payments due to the CONTRACTOR.

The above provisions shall also be applicable in case of construction materials procured at site by the CONTRACTOR from the suppliers.

16.0 INTERFACE WITH OTHER CONTRACTORS

CONTRACTOR shall ensure that his interface with other CONTRACTORS is smooth and cordial. In case of any dispute, OWNER/PMC decision shall be binding.

OWNER/PMC may arrange weekly/fortnightly/monthly interface meetings. The CONTRACTOR shall depute concerned personnel to attend these meetings.

Generally, the following interfaces may be present:

- CONTRACTOR shall allow movement of persons/ material/ equipment/ vehicles belonging to other CONTRACTORS or OWNER/PMC through the roads constructed by him.
- CONTRACTOR shall coordinate with 'neighboring' contractors for maintaining elevations/levels of various interconnecting services.
- CONTRACTOR shall not dump his earth, scrap or any material in other Contractors' area. He shall cooperate with OWNER/PMC in maintaining good housekeeping throughout the complex.
- CONTRACTOR shall ensure proper drainage and no water logging in his area/other areas.
- If requested by the OWNER/PMC, CONTRACTOR shall allow testing of materials of other Contractors in his laboratory, in case of emergency.
- CONTRACTOR shall clearly define in the interface meeting with other contractors their erection / construction interface at their Battery limits.

17.0 CHECKLIST FOR INSPECTION OF FLANGED JOINTS

Requirements specified in EIL standard specification for application of torque and hydraulic bolt tension for flange joints No. 6-76-0002 shall also be followed by the CONTRACTOR.

18.0 COLOUR CODING OF PIPING MATERIAL

Specification for colour coding of Stored Piping Material No. **6-82-0003** shall be uniformly followed for the entire facilities.

APPENDIX - A

QUALITY ASSURANCE

AND

QUALITY CONTROL

DURING CONSTRUCTION PHASE

TABLE OF CONTENTS

1.0 SCOPE

This document shall be applicable to all construction works to be executed by CONTRACTOR.

2.0 RESPONSIBILITY

It is Contractor's prime responsibility to arrange/produce the product conforming to contract specifications and inspect all equipment, materials and works at various stages of execution as per the approved QA Plans. In addition, they have to coordinate all efforts in this regard directly with the Owner/PMC and other involved agencies to give adequate confidence that the activities are performed as per agreed ITPs and necessary documentation is available. Contractor shall deploy an exclusive team of Quality control Engineers and Supervisors for ensuring the quality of works executed at site on day-to-day basis. Verification by Owner/PMC or his representative at any stage shall not relieve CONTRACTOR of his responsibility towards quality of the product.

The CONTRACTOR shall comply with all statutory rules & regulations in force during execution of work and interface with such authorities as required.

3.0 METHODOLOGY

The management of construction quality control is divided into the following categories: -

(1) Procurement of materials required for the construction work.

(2) Execution of work

(3) QA/QC Audits

3.1 PROCUREMENT OF MATERIALS REQUIRED FOR THE CONSTRUCTION WORK

The CONTRACTOR shall develop list(s) defining the items to be procured along with proposed Vendors for approval of the Owner/PMC. The list shall comprise of all items except vessels, equipments, pumps, electrical/ instrumentation panels etc. which may be available directly ready for installation or requiring small fabrication as per requirement. The vendor list shall be in line with the contract document. In case, no vendor list exists in the contract for a particular item, the CONTRACTOR shall propose a list of Vendors to Owner/PMC. CONTRACTOR has to satisfy himself with the capability of the vendor to deliver the product in time with quality before proposing him as a prospective vendor. CONTRACTOR shall submit the QA/QC plans for all major items and carry out their procurement in line with the approved plans. The categorization plan shall be submitted by contractor in line with the contract requirement/ bid package. The CONTRACTOR can either provide his own adequate qualified staff for inspection or employ a separate third- party inspection agency with prior approval to carry out these functions. Involvement of Owner/PMC in the quality control plan, if required, shall be defined during approval of the same.

3.2 EXECUTION OF WORK

(i) The QA plans for execution shall be developed by the CONTRACTOR. OWNER/ PMC's approval for the same shall be taken well before start of the work. The final Inspection & Test Plans (ITPs) and formats, based on the indicative ITPs (enclosed elsewhere in package), shall be developed by the CONTRACTOR as per contract specifications for approval by Owner/PMC. For

the activities which are identified as Witness or Hold Point, specific inspection call shall be raised by the CONTRACTOR with Owner/PMC in the requisite format well in advance.

The indicative ITPs enclosed in the bid package are for guidance to the CONTRACTOR and may not cover some of the activities to be performed during execution of works under the scope of this contract. The CONTRACTOR shall develop Inspection & Test Plans and Formats for all such activities also and submit the same to Owner/PMC for approval, before actually undertaking such activities

CONTRACTOR shall be completely responsible for management of approved quality plans and Owner/PMC involvement will be only of Surveillance in nature to randomly check the works at selective/critical junctures. Their role shall be to monitor that the CONTRACTOR is executing the quality plans as per the approved drawings, employing adequately qualified staff and other resources for various items of works. Any deviation to the specifications shall be brought to the notice of Owner/PMC in prescribed formats by CONTRACTOR for approval.

(ii) It is likely that the CONTRACTOR may engage sub-contractor(s)/vendors for performance of the work. CONTRACTOR shall be responsible for ensuring the implementation of approved QA plan, contract specifications and contract conditions through their sub-contractors to achieve the quality during all stages of construction. It shall be the responsibility of the CONTRACTOR to ensure proper coordination between his sub- contractor(s) and other agencies working at site.

The sub-contractor(s)/vendors selection shall be done after evaluation by the CONTRACTOR in line with contract requirements and shall be got approved by Owner/PMC before engaging them for the works.

(iii) Storage

All the materials procured shall be stored/stacked as per the standard norms and as recommended in various clauses of relevant codes and contract document. The storage of material shall be such as to avoid damage to life/properties (physical and chemical) of the materials. The storage shall not cause deterioration, rusting, mix-up etc. and hamper the other related works in any way. CONTRACTOR shall submit his detailed warehouse plan for Owner/PMC approval to manage the above in open/covered areas.

The materials susceptible to fire shall be kept away in a separate protected place.

In general, the materials shall be kept systematically in order of their class, batch number and identification number, so that they are accessible for the inspection by Owner/PMC whenever required and to avoid the mix up in those materials.

(iv) Use

The materials shall be stacked in such a way that the lot, which is procured first, will be consumed first. For materials which are having specific expiry date/ shelf life shall not be used beyond that date and shall be removed from site. Wherever there is any doubt about the change in properties of the materials, such materials shall be sent to reputed approved laboratory for testing and acceptance.

(v) Inspection

The CONTRACTOR shall be responsible for carrying out inspection of the materials brought at site and conducting tests/ checks (at site or in approved laboratories) at predefined frequencies as per contract. It is the responsibility of the CONTRACTOR to ensure that the materials used at site shall conform to relevant codes/ standards and Manufacturer Test Certificates are available for correlation as and when required. The CONTRACTOR shall maintain the records of all materials brought at site and tests conducted on them.

(vi) In process and final Inspection

CONTRACTOR shall be responsible to arrange verification of products during in-process and final inspection. Relevant checks and tests shall be arranged for the works performed and records maintained. Tolerances achieved with respect to contract specification and execution drawings for various activities/processes shall be ascertained and submitted to Owner/PMC for approval. Efforts shall be made to keep checks and controls in such a way that a non-conforming product is avoided. However, if in an isolated case, the tolerances are beyond the acceptable values given in the contract/execution drawings/codes, non-conformance resolution/Deviation permit need to be raised by the CONTRACTOR and got approved/resolved from Owner/PMC.

The CONTRACTOR shall arrange verification of ingredients used and validation of the software used at the batching plant(s). Owner/PMC reserve the right to inspect the working of batching plant including validation of the software used and calibration of measuring & monitoring devices any time. The CONTRACTOR shall ensure the quality of the concrete delivered by the transit mixers, as applicable and maintain verifiable records.

CONTRACTOR will carry out Inspection, Non-destructive Tests and analyze and certify acceptability of all welds, materials and works in accordance with specified technical standards/International standards and carryout inspection and testing of incoming materials as per agreed procedures.

(vii) Any Observation on quality aspects, Owner/PMC shall raise observation in attached OQA format which has to be acknowledged & compliance to be done by the contractor within the agreed time period.

(viii) The CONTRACTOR shall follow the requirements given for control of monitoring and measuring devices (Refer Document no. 7-82-0002).

3.3 QA/QC AUDITS

During the execution of the works, CONTRACTOR shall carry out periodical Quality Audits at least quarterly in all areas of work. These audits will be conducted by a team of specialists in the respective areas. The auditors shall not be directly involved in the jobs being audited.

The CONTRACTOR shall prepare an Audit Plan and Procedure and submit the same to Owner/PMC for approval.

A copy of the Audit Report containing the findings of the Audit team will be submitted to Owner/PMC. After completion of rectification/modifications/corrective actions on the issues indicated in Audit Report, Compliance Report shall be submitted by the CONTRACTOR to Owner/PMC for review.

Over and above the Contractor's Internal QA/QC Audits outlined above, Owner/PMC shall also reserve the right to conduct QA/QC audits at the frequency decided by them. CONTRACTOR shall participate and provide full support to the Audit Team and furnish all documents/reports/records as desired by the Audit Team. The CONTRACTOR shall take all actions required to comply with the findings of the Audit Report and issue regular Compliance Reports for the same to Owner/PMC till all the findings of the Audit Report are fully complied.

In case major Non conformities are observed during execution of the works Owner/PMC reserve the right to appoint an independent person/Third Party Agency to conduct QA/QC Systems Audit for full/part of the facilities being executed by the CONTRACTOR. This audit will be in addition to the audits described above and may be carried out intermittently/continuously for all or part of the facilities being executed by the CONTRACTOR. CONTRACTOR shall bear the total cost of such audits and shall participate & provide full support to the Audit Team and ensure compliance of the audit observations.

4.0 DOCUMENTATION AND RECORDS

All the necessary documentation & records shall be maintained by CONTRACTOR till completion of project and handed over to Owner/PMC in requisite copies as a part of completion documents. Wherever Owner/PMC personnel were directly involved particularly in witness and hold point, the copies of the records shall also be provided to personnel on completing inspection of those activities. The documentation & records shall include the following as a minimum but not limited to:

i) Approved Quality Assurance Plan
ii) Approved Inspection and Test Plans
iii) Inspection and test documents covering
    a) Manufacturer Test Certificate
    b) Material Receipt Report including Inspection Release Note, if applicable and Site Inspection and acceptance Report on quality and quantity of material
    c) Site test/laboratory test Report reviewed by CONTRACTOR for acceptance vis-à-vis to contract/code requirements for materials/including PMI report at warehouse.
    d) In process Verification reports of CONTRACTOR representative and OWNER/ PMC as applicable
    e) Final verification report including any test checks done for compliance
    f) As-built vis-à-vis to contract/drawings including tolerances
    g) As-built for erection
    h) Non-conformance resolution raised by CONTRACTOR/OWNER/ PMC
    i) Concession/Deviation approval by Owner/PMC
    j) Change order approval by Owner/PMC in case there is variation from contract
    k) QA/QC Audit Reports and compliance Reports thereof
    l) Mechanical Completion formats

APPENDIX-B

HEALTH, SAFETY AND

ENVIRONMENT (HSE) MANAGEMENT

DURING CONSTRUCTION

GENERAL REQUIREMENTS

1.0 Specification for Health, Safety and Environment (HSE) Management (Spec. No. 6-82-0001), is required to be followed by CONTRACTOR during Construction Phase at site.

2.0 CONTRACTOR shall have a documented HSE policy to cover commitment of the organization to ensure Health, Safety and Environment aspects in the line of operation.

3.0 It is the responsibility of the CONTRACTOR to ensure that safe construction procedures are complied with. CONTRACTOR will also ensure that adequate First Aid medical facilities are available for emergency purpose and that safety practices as per the approved safety procedure are followed by his sub-contractors also.

CONTRACTOR to ensure safety measures at the minimum like:

a) The use of safety gadgets, viz. safety goggles, helmets, safety shoes, full body harness, provision of safety net for construction at higher elevations and provision of toe boards in scaffolding platforms, etc.
b) All hot works must be performed by ensuring compliance to the requirements as specified by the Owner from time to time.
c) Barricading of crane movement areas / Radiography areas
d) Proper earthing of equipment's.
e) Proper shoring / strutting of Excavated Areas, as applicable.
f) Cylinders of inflammable gases to be stacked upright.

To assist in the development of an effective safety program, a safety checklist for various jobs shall be developed by the CONTRACTOR and the same shall be adhered to by the Contractor's Site-In-charge.

The responsibilities of the CONTRACTOR will include but not limited to:

- Coordination and supervision of the details of the job safety programmed.
- Initiation of accident reporting, investigation and follow-up actions.
- Preparation of periodic accident summaries.
- Periodic Accident Analysis Reports
- Tallying safety inspection of the job and submission of summary inspection report to OWNER/PMC.
- Obtaining work permits from the OWNER, wherever applicable.
- Check the fitness of cranes and other hoisting equipments on periodic basis/before all major lifts and submit to Owner/PMC valid/latest test certificates of tackles used for lifting.
- Submission of any other report required by Owner/ PMC.
- Conduct HSE Audit at predefined frequencies and assist OWNER/EIL/TPI during conductance of their HSE Audits.
- Ensure closure of NCs observed during the above audits.

4.0 Guidelines on Safety Practices during Construction and Contractor Safety prepared by Oil Industry Safety Directorate (OISD) Nos. OISD-GDN-192 & OISD-GDN-207 shall be followed by the contractor at site. Safety Recommended Practices for Electrical System (OISD-RP-147) shall be followed by the contractor at site. These are supplementary requirements in addition to specification for Health, Safety and Environment (HSE) Management (Spec. No. 6-82-0001) to be followed by the CONTRACTOR at site.

5.0 Any Observation on Safety aspects, EIL/PMC shall raise observation in attached OSA format, which has to be acknowledged & compliance to be done by the contractor within the agreed time period.

ATTACHMENT – I

वॉटर पैकेजिस के लिए
निरीक्षण एवं परीक्षण योजना
(आईटीपी)

INSPECTION & TEST PLAN (ITP) FOR WATER PACKAGES

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
2	08.04.2024	Revised & Updated	DK	AC	RKS	MN
1	19.03.2019	Revised & Updated	SKG	AP	AKK	RKT
0	26.02.2014	ISSUED AS STANDARD SPECIFICATION	SM	DJ	RKD	SC

Abbreviations:

A/G	:	Above Ground
AC	:	Alternating Current
AFC	:	Approved For Construction
AS	:	Alloy Steel i.e. Cr-Mo steels like A335 Gr P11, P5, P9,P22,etc
AVR	:	Automatic Voltage Regulator
BB	:	Blue Blue
BDV	:	Break Down Voltage
BM	:	Bench Mark
CB	:	Circuit Breaker
CF	:	Ceramic Fibre
CFB	:	Ceramic Fibre Blankets
CI	:	Cast Iron
CPT	:	Cone Penetration Test
CS	:	Carbon Steel
CSO	:	Car Seal Open
CT	:	Current Transformer
DC	:	Direct Current
DCS	:	Digital Control System
DPT	:	Dye Penetration Testing
EHT	:	Extra High Tension
EIL	:	Engineers India Limited
EMCC	:	Emergency Motor Control Centre
FD	:	Free Draught
FTB	:	Field Terminal Block
GAD	:	General Arrangement Drawings
GI	:	Galvanised Iron
HIC	:	Hydrogen Induced Cracking
HV	:	High Voltage
I/S	:	Inner Side
IBR	:	Indian Boiler Regulations
ID	:	Induced Draught
IR	:	Insulation Resistance
IRC	:	Indian Road Congress
ITP	:	Inspection & Test Plan
JB	:	Junction Box
LCP	:	Local Control Panel
LO/ LC	:	Lock Open/ Lock Close
LT	:	Low Tension
LTCS	:	Low Temperature Carbon Steel
LV	:	Low Voltage
MCC	:	Motor Control Centre
MPT	:	Magnetic Particle Testing
MRIR	:	Material Receipt Inspection Report
MS	:	Mild Steel
MV	:	Medium Voltage
NACE	:	National Association of Corrosion Engineers
NDT	:	Non Destructive Testing
NGR	:	Neutral Grounding Resistance
NRV	:	Non Return Valve
O/S	:	Outer Side
ODC	:	Over Dimension Consignment
OLTC	:	On Load Tap Changer
OTI	:	Oil Temperature Indicator
P&ID	:	Piping & Instrumentation Drawings
PCC	:	Power Control Centre

PI	:	Polarization Index
PLC	:	Programmable Logic Controller
PMC	:	Project Management Consultant
PMG	:	Permanent Magnet Generator
PMI	:	Positive Material Identification
PMS	:	Piping Material Specification
PQR	:	Procedure Qualification Record
PVC	:	Poly Vinyl Chloride
PWHT	:	Post Weld Heat Treatment
QA/QC	:	Quality Assurance/ Quality Control
RCC	:	Reinforced Cement Concrete
R_{CT}	:	Resistance of Current Transformer
RF	:	Reinforcement
RR	:	Red Red
RT	:	Radiographic Testing
SPT	:	Standard Penetration Test
SS	:	Stainless Steel like A312 TP 304, 316, 321, 304L, 316L, 316Mo, etc
SSCC	:	Sulphide Stress Corrosion Cracking
SWGR	:	Switch Gear
TSR	:	Tray Support Ring
U/G	:	Under Ground
UDFC	:	Under Down Flow Clearance
WBM	:	Water Bound Macadam
WMM	:	Wet Mix Macadam
WPS	:	Welding Procedure Specification
WTI	:	Winding Temperature Indicator
YY	:	Yellow Yellow

Construction Standards Committee

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Sh. Udayan Chakravarty, CGM (Piping)
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Sh. Pankaj Kumar Rai, DGM (Construction)
Sh. Dhananjay, AGM (Construction)

CONTENTS

GENERAL NOTE

The enclosed ITP's shall be followed for the works to be performed by the contractor. The provisions indicated for stage wise inspection by EIL/Owner (For specific activities), may be modified in line with EIL scope of services as per the contract between EIL and Owner. Activities for which ITP's are not provided in this specification, contractor to develop and get the same approved by EIL/Owner well before start of the work. In general role of EIL has been specified in the document. The role of owner to be specified during preparation of site specific ITPs.

Contractor to submit job procedures for the jobs for which ITP's are attached & job specific reporting formats with the aid of enclosed sample reporting formats to EIL/Owner for approval, before commencement of the activity. If the contractor has to deviate from the given ITP for a valid reason, he shall obtain prior written approval of EIL/Owner. Contractor to carry out 100% examination of all activities.

LEGEND

HP : **Hold Point ;**

A point which requires witnessing/inspection/verification and acceptance by Owner/EIL before any further processing is permitted.
The Contractor shall not process the activity/item beyond a Hold Point without written approval by Owner/EIL except where prior written permission for further processing is available.

W : **Witness Point ;**

An activity which requires witnessing/inspection/verification by Owner/EIL when the activity is performed.
After proper notification has been provided (notification modalities and period shall be finalized before hand), the Contractor is not obliged to hold further processing if Owner/EIL is not available to witness the activity or does not provide comments before the date notified. Basis of acceptance shall be as per relevant technical specification.

Rw : **Review** of Contractor's documentation.

S : **Surveillance** Inspection by Owner/ EIL.
Monitoring or making observations to verify whether or not material/items or services conform to specified requirements. Surveillance activities may include audit, inspections, witness of testing, review of quality documentation & records, personnel qualifications, etc.

WC : **100%** Examination by Contractor.

Responsibility for execution of the inspection/testing is with the Contractor; Owner/EIL only verifies examination or testing done by the Contractor at important stages

ITP NO. : 4102

SOIL INVESTIGATION

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Positioning of test location	WC	S
2.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw
	b) Field calibration, if any	WC	S
3.	Boring & sampling	WC	S
4.	In-situ testing (SPT, CPT, Plate load test, Soil Resistivity, Block vibration test, etc.)	WC	S/Rw
5.	Lab testing (as applicable)	WC	S / Rw
6.	Monitoring of water level	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

ITP NO. : 4104

EXCAVATION

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
1.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw	Rw	Rw
	b) Field calibration, if any	WC	S	S	-
2.	Layout checking	WC	S	-	-
3.	Taking initial levels	WC	S	-	-
4.	Slopes of excavation, benching, overburden, shoring & strutting (in case of deep excavation)	WC	S	S	-
5.	Check for sub-soil water, dewatering requirements as per specifications.	WC	S	S	S
6.	Bottom level of excavation and compaction	WC	S	S	S
7.	Stacking of different type of soils separately	WC	S	-	-
8.	Making trial pits manually to check UG Utilities before carrying out Mechanical Excavation (If applicable)	WC	S	S	S
9.	List of obstacles encountered (cables, pipes, conduits, etc)	WC	S	S	-
10.	Barricading of excavated pits for safety & protection from rain	WC	S	S	S
	FOR HARD ROCK				
1	Obtaining license from district authorities for undertaking blasting operations	WC	Rw	Rw	Rw
2	Storing of explosive materials as per explosive rules	WC	S	S	S
3	Prominent display of red flags around the area to be blasted	WC	S	S	S
4	Check the dimensions of bore holes	WC	S	S	S
5	Stacking of hard rock for useable/non useable including handing over to owner	WC	S	S	S
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

CAT A : Equipment foundations, Plant buildings, Technological structure, etc.
CAT B : Non Plant buildings, pipe racks, pipe culverts, bridges, etc.
CAT C : Boundary walls, wing walls, manholes, drains, etc

ITP NO. : 4105

BACK FILLING

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
1.	Selection of materials/selected earth	WC	S	S	S
2.	Check for treatment of soil, if any	WC	S	S	-
3.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw	Rw	Rw
	b) Field calibration, if any	WC	S	S	-
4.	Filling in specified layers, consolidating, watering.	WC	S	-	-
5.	Compaction tests for layers	WC	Rw	Rw	Rw
6.	Filling to required levels	WC	S	-	-
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

CAT A : Equipment foundations, Plant buildings, Technological structure, etc.

CAT B : Non Plant buildings, pipe racks, pipe culverts, bridges, etc.

CATC : Boundary walls, wing walls, manholes, drains, etc

ITP NO. : 4106

UNDERGROUND PIPING (RCC/ CI)

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Checking of material	WC	NOTE 1	NOTE 1
2.	Adequate slope, benching in excavation for safety purposes (if required)	WC	S	
3.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw	Rw
	b) Field calibration, if any	WC	Rw	Rw
4.	Layout, line & level	WC	S	-
5.	Laying & jointing, grouting at manholes/chambers	WC	S	-
6.	Check for supports/ firm bed/ sub soil water level	WC	S	-
7.	Testing for leakages by blocking pipe ends	WC	W	W
8.	Hydro-testing and other tests, Removal of blockages, Cleaning & flushing of system	WC	W	W
9.	Backfilling in layers	WC	Rw	Rw
10.	Check for MS rungs in proper position, inlet/outlet pipe levels in manholes	WC	S	-
11.	Preparation of "As-built drawings"	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT B: Main plant buildings, Utilities , offsites etc.

CATC: Non plant buildings, technological buildings admn. Buildings, Gate house, security rooms, etc

ITP NO. : 4107

WBM ROADS

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw	Rw
	b) Field calibration, if any	WC	S	-
2.	Layout checking including Road crossings and taking initial levels	WC	S	S
3.	Approval of source & checking/testing of materials (wherever required)	WC	NOTE 1	NOTE 1
4.	Filling (if any), compaction, providing cambers in sub-base including levels	WC	S	S
5.	Spreading metal to required thickness, line & levels, dry rolling including spreading of screening material	WC	-	-
6.	Check for camber and levels over metaling	WC	S	S
7.	Spreading murrum/ sand, watering and rolling	WC	S	-
8.	Checking thickness after each layer and rectification thereof (if any)	WC	S	S
9.	Checking quantity of aggregate by excavation of trial pits as per IRC Code	WC	S	S
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT B: Roads subjected to heavy loading, connected to main highway, main plant roads

CATC: Balance Roads

ITP no: 4108

WMM Roads

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT A	CAT B
1.	a.) Review of calibration certificates of instruments/testing equipment's.	WC	Rw	Rw
	b) Field calibration, if any.	WC	S	W
2.	Design Mix to Fix the Proportion of ingredients	WC	HP	HP
3.	Layout Checking including Road Crossing & taking initial levels.	WC	S	W
4.	Approval of source & checking /testing of materials (wherever required)	WC	NOTE 1	NOTE 1
5	Filling (if any), compaction, providing chambers in sub-base including levels.	WC	Rw	Rw
6	Spreading metal to required thickness, line & levels, dry rolling including spreading of screening material.	WC	S	-
7	Check for camber levels.	WC	S	S
8	Spreading, watering & rolling.	WC	S	-
9.	Checking thickness after each layer and rectification thereof (if any).	WC	S	S
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE :1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A - Roads subjected to heavy loading connected to main High way, main plant roads etc.

CAT B - Balance roads

ITP NO. : 4109

BLACK TOPPING PREMIX CARPETING – PC, BITUMINOUS CONCRETE (BC) & BITUMINOUS MACADAM (BM) / DENSE BITUMINOUS MACADAM (DBM)

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Approval of source of materials (aggregate, bitumen etc.)	WC	Note 1
2.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw
	b) Field calibration, if any	WC	S
3.	Surface preparation & check for camber/level	WC	-
4.	Checking/ testing of material wherever required	WC	S
5.	Tack coat application	WC	-
6.	Laying of Premix carpeting/ BM including rolling	WC	S
7.	Application of Seal coat	WC	-
8.	Check for camber and levels	WC	S
9.	Check for bitumen temperature and consumption	WC	S
10.	Thickness check (random)of Premix carpet/ BM	WC	S
11.	Removal of surplus earth	WC	-
12.	Berm preparation	WC	-
13.	Final Inspection	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO. : 4110

MICRO GRADING

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw
	b) Field calibration, if any	WC	-
2.	Taking initial levels	WC	S
3.	Clearing/ Removal of extra soil, debris, etc. from site by transportation	WC	-
4.	Taking final levels	WC	S
5.	Verification of gradient of ground	WC	-
6.	Finishing of ground surface by hand compactor/ Roller (As applicable)	WC	S
7.	Final inspection	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

ITP NO. : 4140

FOR UNDERGROUND PIPING (CARBON STEEL) (Sheet 1 of 6)

SL. NO	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
A.	**PRIOR TO FABRICATION**			
1	Incoming materials	WC	NOTE 1	NOTE 1
2.	Welding Filler Material Approval/Qualification			
	i) Review of Manufacturer's Test Certificates/ other documents	WC	Rw	Rw
	ii) Testing, if any	WC	Rw	Rw
3.	WPS/PQR			
	i) Review of proposed Procedure	WC	Rw	Rw
	ii) Testing	WC	W	W
	iii) Approval of Final WPS/PQR	WC	HP	HP
4.	Welder Performance Qualification Test	WC	W	W
4a.	Certification & approval of welders	WC	Rw	Rw
5.	NDT Procedure Qualification			
	i) Review of proposed Procedure	WC	Rw	Rw
	ii) Testing	WC	Rw	Rw
	iii) Approval of NDT procedure	WC	HP	HP
6.	Preparation of sketches from General Arrangement drawings	WC	Rw	-
7.	Joint numbering	WC	Rw	-
8.	Approval of colour coding scheme	WC	Rw	-
9.	Monitoring of colour coding on pipes & fittings	WC	S	-
B.	**FABRICATION (SHOP & FIELD)**			
1.	Material as per piping class (check w.r.t. approved colour coding procedure)	WC	S	
	i) Fit-up check ii) Dimensional check	WC WC	S S	Rw Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: -6-82-1010.

CAT B: All pressure lines, Fire Water line, Cooling Water line, etc.
CAT C: Balance Works

ITP NO. : 4140

FOR UNDERGROUND PIPING (CARBON STEEL) (Sheet 2 of 6)

SL. NO	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
2.	Pre-heat (if any)	WC	S	-
3	Check for purity of purging/shielding Gas (if any)	WC	S	-
4.	Purging (if any)	WC	—	-
5.	Shielding rate (if any)	WC	S	-
6.	Baking of Electrodes	WC	S	-
7.	Inter-pass cleaning & Temperature check.	WC	S	-
8.	Visual check of completed welds	WC	S	-
9.	PT/MT	WC	S	-
10.	Radiography marking (for Random Radiography)	WC	S	S
11.	Radiography Interpretation	WC	Rw	Rw
C.	**HYDROSTATIC/ PNEUMATIC TESTING**			
1.	Procedure Review	WC	Rw	Rw
2.	Correctness of Testing arrangements	WC	S	-
3.	Calibration of Pressure Gauges	WC	S	-
4.	R.F. Pad testing, if any	WC	S	-
5.	Scrutiny of test packs for Mechanical & NDT Clearance (Refer **Annexure-1**)	WC	HP	HP
6.	Air/Water Flushing (preliminary)	WC	S	S
6a.	Addition of corrosion inhibitors, if required – Approval of make & quality	WC	S	S

CAT B: All pressure lines, Fire Water line, Cooling Water line, etc.
CAT C: Balance Works

ITP NO. : 4140

FOR UNDERGROUND PIPING (CARBON STEEL) (Sheet 3 of 6)

SL. NO	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
7.	Pneumatic/ Hydrostatic testing	WC	S	S
8.	Draining of water & Air drying	WC	S	S
D.	**LAYING**			
1.	Trench excavation and levels	WC	S	-
2.	Cleaning of pipe surface	WC	S	-
3	Approval of wrapping/coating material manufacturers	WC	Note 1	Note 1
4.	Approval of agency for wrapping & coating	WC	Rw	Rw
5.	Sample test of coating materials in approved laboratory	WC	Rw	Rw
6.	Procedure qualification for wrapping & coating	WC	HP	HP
7.	Application of primer	WC	S	S
8.	Coal tar temperature	WC	S	-
9.	Coating & wrapping	WC	S	S
10.	Check Thickness of coating (if applicable)	WC	S	-
11.	Calibration of Holiday tester	WC	Rw	Rw
12.	Holiday testing	WC	W	S
13.	Peel test	WC	S	S

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT B: All pressure lines, Fire Water line, Cooling Water line, etc.
CAT C: Balance Works

ITP NO. : 4140

FOR UNDERGROUND PIPING (CARBON STEEL) (Sheet 4 of 6)

SL. NO	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
14.	Lifting arrangement	WC	S	-
15.	Lowering (levels & orientation of branches)	WC	S	-
16.	Checking of wrapping & coating for damages during lowering, their repair, Holiday Testing, etc.	WC	S	S
17.	Back filling & compaction	WC	S	-
18.	Location, Brickwork, plaster of valve pit	WC	-	-
19.	Top cover & Finish of valve pit	WC	S	S
E.	**SYSTEM COMPLETION**			
1.	Tie in joints (Refer **Annexure-2**)	WC	Annex-2	Annex-2
2.	Scrutiny of test packs for system testing (Refer **Annexure-1**)	WC	Annex-1	Annex-1
3.	System testing	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

CAT B: All pressure lines, Fire Water line, Cooling Water line, etc.
CAT C: Balance Works

ITP NO. : 4140

FOR UNDERGROUND PIPING (CARBON STEEL) **(Sheet 5 of 6)**

ANNEXURE – 1

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
A.	**MECHANICAL COMPLETION RECORD (U/G Piping)**			
1.	Clearance for flushing & testing	WC	Rw	Rw
1a.	Mechanical clearance			
	- Conformity with drawing	WC	Rw	Rw
	- Material as per Specification	WC	Rw	Rw
1b.	Welding & NDT clearance			
	- Material as per Specification	WC	Rw	Rw
	- Fit-up check record	WC	Rw	Rw
	- Visual check of completed welds	WC	Rw	-
	- PT/MT	WC	Rw	Rw
	- Radiography	WC	Rw	Rw
	- PWHT & hardness	WC	Rw	Rw
	- RF pad testing	WC	Rw	Rw
2.	Flushing & Pressure testing	WC	W	W
3.	Coating & wrapping			
	- Surface preparation	WC	Rw	-
	- Primer application	WC	Rw	Rw
	- Coating, wrapping & peel test	WC	Rw	-
	- Holiday check	WC	Rw	Rw
4.	Laying			
	- Trench leveling	WC	Rw	Rw
	- Lowering & checking for damages in wrapping & coating, their repair, Holiday testing, etc.	WC	Rw	Rw
	- Backfilling	WC	Rw	Rw

CAT B: All pressure lines, Fire Water line, Cooling Water line, etc.

CAT C: Balance works

ITP NO. : 4140

FOR UNDERGROUND PIPING (CARBON STEEL) **(Sheet 6 of 6)**

ANNEXURE – 2

TIE-IN

SL. NO.	ACTIVITY	CONTRACTOR	EIL
A.	Fit Up	WC	S
B.	Root Run Dp	WC	S
C.	Final Run Dp	WC	S
D.	Radiograph Review	WC	Rw
E.	PWHT Hardness	WC	Rw
F.	Rf Pad Testing	WC	W
G.	Cleaning & Priming	WC	S
H.	Coating, Wrapping	WC	S
I.	Peel Test	WC	S
J.	Holiday Testing	WC	W
K.	Checking For Any Damage In Wrapping & Coating After Lowering, Their Repair Holiday Testing, Etc.	WC	S
L	Back Filling	WC	S

ITP NO : 4141

PLAIN CEMENT CONCRETE

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw	Rw
	b) Field calibration, if any	WC	S/Rw	Rw
2.	Checking of layout and materials, compaction of sub -grade	WC	S	-
3.	Mix proportion	WC	S	-
4.	Check for shuttering, dewatering if any.	WC	-	-
5.	Concreting with proper compaction	WC	-	-
6.	Checking of top level of PCC	WC	Rw	-
7.	Curing	WC	-	-
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

CAT B : for filled-up area
CAT C : for cutting area

REINFORCED CEMENT CONCRETE (SUBSTRUCTURE)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CATC
1	Approval of source of materials	WC	HP	HP	Rw
2.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw	Rw	Rw
	b) Field calibration, if any	WC	S	S	S
3.	Checking of layout & condition of PCC/ leveling course	WC	S	S	-
4.	Incoming material checking	WC	NOTE 1	NOTE 1	NOTE 1
5.	Design of mix &establishment of strength at site by trial mix	WC	HP	HP	HP
6.	Check for line & level of shuttering including its condition, quality and rigidity.	WC	S	S	-
7.	Check for sub-soil water & dewatering arrangement, if any	WC	S	S	-
8.	Reinforcement & covers to reinforcement	WC	S	S	S
9.	Inserts, Anchor bolts and pipe sleeves, pockets, dowels, etc.	WC	S	S	S
10.	Pour Card	WC	W	W	Rw
11.	Check for obstacles encountered (Electrical conduits, pipe lines, etc.)	WC	S	S	-
12.	Concreting, testing, compaction & finishing	WC	W	S/Rw	Rw
13.	Casting of cubes	WC	S	S	S
14.	Curing	WC	S	S	-
15.	Testing of cubes- 7 days	WC	S/Rw	S/Rw	S/Rw
16.	Testing of cubes- 28 days	WC	W	W	W
17.	Removal of shuttering	WC	S	-	-
18.	Check for water tightness, rendering, if any	WC	S	S	S
19.	Preparation of As-built drawings	WC	Rw	Rw	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Critical foundations of equipments i.e compressors, reactors, columns, stacks, foundations subjected to dynamic loading and any other foundation with RCC Quantity > 250 Cum in single pour ,etc.

CAT B: Unit Pipe racks, plant buildings and other equipment foundations not covered in category A, etc

CAT C: Non critical pipe racks (branch pipe, offsite pipe rack, etc) non plant buildings ,pipe sleepers, manhole, catch pit and balance works.

ITP NO : 4143

REINFORCED CEMENT CONCRETE (SUPER STRUCTURE)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CATA	CATB	CAT C
1	Approval of source of materials	WC	HP	HP	Rw
2.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw	Rw	Rw
	b) Field calibration, if any	WC	Rw	Rw	Rw
3.	Checking of layout	WC	S	S	-
4.	Incoming material inspection	WC	Note 1	Note 1	Note 1
5.	Design of mix &establishment of strength at site by trial mix	WC	HP	HP	HP
6.	Check for line & level of shuttering and scaffolding/ vertical bracing including hoisting arrangements.	WC	S	S	-
7.	Reinforcement & covers to reinforcement	WC	S	S	S
8.	Inserts, bolts, pipe sleeves, MS rungs, concealed electrical conduits, fan hooks, dowels, etc. including welding if any	WC	S	S	-
9.	Pockets/ openings	WC	S	S	-
10.	Expansion joints, if any	WC	S	S	-
11.	Check for water stops, slopes, stoppers, if any	WC	S	S	-
12.	Pour Card	WC	W	W	Rw
13.	Concreting, testing, compaction & finishing	WC	S	S	S
14.	Casting of cubes	WC	S	S	S
15.	Curing	WC	S	S	-
16.	Testing of cubes- 7 days	WC	S/Rw	S/Rw	S/Rw
17.	Testing of cubes- 28 days	WC	W	W	W
18.	Removal of formwork/ staging	WC	S	-	-
19.	Verification of dimensions viz AFC drawings and tolerances	WC	S	S	S
20.	Check for water tightness, rendering, if any	WC	S	S	-
21.	Preparation of As built drawing .	WC	Rw	Rw	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Super structure of foundations for Critical equipments ie compressors, reactors, columns, stacks, foundations subjected to dynamic loading and super structure of any other foundation with RCC Quantity > 250 Cum in single pour , Slabs of plant and non plant buildings, etc.

CAT B: Unit Pipe racks, plant buildings and super structure of other equipment not covered in category A, etc

CAT C: Non critical pipe racks(branch pipe, offsite pipe rack, etc) non plant buildings ,pipe sleepers, manhole, catch pit and balance works.

ITP NO : 4145

RCC PAVEMENT/FLOORING

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Approval of source of materials	WC	Rw
2.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw
	b) Field calibration, if any	WC	S
3.	Layout checking/ excavation of all new foundations	WC	-
4.	Incoming material inspection	WC	NOTE 1
5.	Design of mix &establishment of strength at site by trial mix	WC	HP
6.	Check for proper back filling/compaction/ completion of sub - Structure works	WC	S
7.	Check for edges of shuttering, alternate panels	WC	-
8.	Check for slopes, thickness of flooring	WC	S
9.	Shuttering, reinforcement (as applicable)	WC	-
10.	Check for expansion joints/ Construction joints	WC	S
11.	Check for concealed pipe embedment, earthing, if any	WC	-
12.	Check for dividing strips, as applicable	WC	S
13.	Concreting, finishing, etc	WC	S
14.	Checking for line, levels, slopes, joints, thickness of flooring viz. AFC drawings	WC	S
15.	Curing	WC	S
16.	Grinding & polishing, as applicable	WC	S
17.	Testing of concrete cubes (as applicable) i- Testing of cubes- 7 day ii- Testing of cubes- 28 days	 WC WC	 S/ Rw W
18.	Preparation of "As Built Drawings"	WC	Rw
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO : 4146

BRICK MASONARY

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw	Rw
	b) Field calibration, if any	WC	Rw	Rw
2.	Incoming material inspection	WC	Note 1	Note 1
3.	Cleaning of surface	WC	-	-
4.	Wetting/soaking of bricks	WC	S	S
5.	Cement mortar proportion	WC	S	S
6.	Staging & scaffolding	WC	-	-
7.	Hacking of adjacent concrete surface	WC	S	S
8.	Check for bond/closers, thickness of joints .	WC	S	-
9.	Line, level & plumb	WC	S	S
10.	Raking out joints, keys in brick work, if any	WC	S	S
11.	Check for placement of Reinforcement bars in case of partition brick work	WC	S	S
12.	Embedment of fixtures	WC	S	S
13.	Curing	WC	-	-
14.	Preparation of 'As Built' Drawings	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT B: Load bearing walls
CAT C: Balance works

ITP NO : 4147

STRUCTURAL STEEL WORKS

S. NO	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CATC
A	**PRE – FABRICATION ACTIVITIES**				
1.	a) Review of calibration certificates of instruments/ testing equipments	WC	Rw	Rw	Rw
	b) Field calibration, if any	WC	S	S	Rw
2.	Incoming material inspection	WC	Note 1	Note 1	Note 1
3.	Welding Filler material approval/ qualification				
	a) Manufacturing test certificates/ documents	WC	Rw	Rw	Rw
	b) Testing, if any	WC	S	S	S
4.	WPS/ PQR	WC	HP	HP	HP
5.	Welders performance qualification	WC	Rw	Rw	Rw
6.	Layout checking	WC	S	-	-
7.	Welding equipment and accessories	WC	S	-	-
8.	Preparation and approval of Fabrication drawings	WC	Rw	Rw	-
B	**FABRICATION ACTIVITIES**				
1	Checking of Materials as per design drawing	WC	Rw	Rw	Rw
2	Check straightness and non-warping of members	WC	S	S	-
3	Dimensional and fit-up checks including provision of slopes for deflection wherever required	WC	S	S	-
4	Visual check for welding	WC	S	S	-
5	Grinding including surface preparation for painting and application of primer	WC	S	S	-
6	Checking paint as per specs, shelf-life, etc.	WC	S	S	-
7	Application of specified paint, painting thickness, etc.	WC	S	S	-
C	**FIELD ERECTION ACTIVITIES**				
1	Lifting arrangements including test certificates of lifting tackles	WC	S	S	S
2	Correctness of location	WC	S	-	-
3	Orientation of bracing, lugs	WC	S	-	-
4	Alignment & levels	WC	S	-	-
5	Field welding (if any)	WC	S	S	-
6	Grouting	WC	S	S	--
7	Finishing coat of paint, thickness of paint etc.	WC	S	S	S
8	Preparation of As-built drawings	WC	Rw	Rw	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Steel structures pertaining to equipments ie compressors, reactors, columns, stacks, Technological structures.

CAT B: Steel structures pertaining to Unit Pipe racks, and other equipments not covered in category A, etc.

CAT C: Steel structures of Non critical pipe racks (branch pipe, offsite pipe rack, etc) plant buildings and non plant buildings ,pipe sleepers, manhole, catch pit ,walkways, platforms at grade levels, etc

ITP NO : 4148

PILING WORKS

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CATC
1	Approval of source of materials	WC	Rw	Rw	Rw
2	Layout and ground level	WC	S	S	-
3	Incoming material inspection	WC	Note 1	Note 1	Note 1
4	Design of mix &establishment of strength at site by trial mix	WC	HP	HP	HP
5	Driving of piles & check for set point	WC	S	S	-
6	Check for depth of bore and lowering of cage measuring	WC	S	-	-
7	Pour Card	WC	HP	HP	Rw
8	Concreting, testing	WC	W	S	S
9	Casting of Cubes/ Testing i- Testing of cubes- 7 days ii- Testing of cubes- 28 days	 WC WC	 S/Rw W	 S/Rw W	 S/Rw W
10	Check for cut off level of concreting & quantity of concrete poured	WC	S	-	-
11	Lifting of casing pipe	WC	S	S	-
12	Pile load tests (lateral/vertical/cyclic/pull out)	WC	W	Rw	Rw
13	Submission of pile load test report	WC	Rw	Rw	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Critical foundations of equipments ie compressors, reactors, columns, stacks, foundations subjected to dynamic loading and any other foundation with RCC Quantity > 250 Cum in single pour ,Technological structures etc.

CAT B: Unit Pipe racks, plant buildings and other equipment foundations not covered in category A, etc

CAT C: Non critical pipe racks(branch pipe, offsite pipe rack, etc) non plant buildings ,pipe sleepers, manhole, catch pit ,etc

ITP NO : 4171

ANTITERMITE TREATMENT

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Approval of applicator agency	WC	HP
2.	Incoming material inspection & spraying devices including personal protective equipments like facemask, gloves, shoes, etc.	WC	Note 1
3.	Preparation of surface for taking dosage of emulsion by ramming of each layer of soil by roding the earth at specified intervals	WC	-
4.	Backfilling and compaction in specified layers along with application of emulsifier along the sides of masonry & RCC structures	WC	S
5.	Compaction of top surface for taking dosage of emulsifier by roding the earth at specified intervals for the entire floor area before concreting	WC	-
6.	Check for consumption of emulsifier utilized	WC	S
7.	Shelf life of anti-termite chemical	WC	S
8.	Guarantee Certificate for performance	WC	Rw
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

ITP NO : 4172

PLASTERING

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Check for completeness of all hidden jobs like piping, conduiting, etc.	WC	-	-
2..	Check for grading of sand, Mix proportion	WC	S	S
3.	Mortar Cube casting & its testing	WC	S	S
4.	Use of Chicken mesh of given gauge at junction of concrete & masonry.	WC	S	S
5.	Sample preparation for finish and its approval	WC	W	S
6.	Neeru application on plaster (as applicable)	WC	S	-
7.	Hacking and cleaning the surface, removing loose particles, wetting the surface	WC	S	S
8.	Leaving plaster rough where tiles are to be fixed	WC	-	-
9.	Checking of plaster thickness, plumb & even surface	WC	S	-
10.	Check for grooves, openings, rounding off the corners, hollowness in plaster	WC	S	S
11.	Checking for use of waterproofing compound , Mix proportion(as applicable)	WC	S	S
12.	Curing	WC	S	-
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	-

CAT B: Area requiring special finish (e.g. pebble dash finish etc.)
CAT C: Balance works.

ITP NO. : 4173

DOORS, ROLLING SHUTTERS, WINDOWS AND VENTILATORS

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Incoming material inspection	WC	Note 1	Note 1
2.	Check for sections & dimensions	WC	S	-
3.	Line, level & plumb	WC	-	-
4.	Section joinery details	WC	Rw	-
5.	Check for orientation/ opening direction	WC	S	S
6.	Grouting with lugs/ dash fasteners	WC	-	
7.	Check for fixtures & fittings	WC	S	S
8	Check for thickness & type of glazing	WC	-	-
9.	Check for rubber gasket, anodizing (as applicable)	WC	-	-
10	Brand/ shade of paints, no. of coats including surface preparation (as applicable)	WC	S	Rw
11.	Check for fire rated certificate for fire doors/ windows/ partitions	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT B: Main plant buildings
CAT C: Balance works

ITP NO. : 4174

PAINTING (BUILDING WORKS)

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Completion of surface preparation	WC	S	S
2.	Incoming material inspection	WC	Note 1	Note 1
3.	Confirmation of colour, shade & brand	WC	S	S
4.	Check for base surface preparation (Putty/ POP, Primer, rendering etc.)	WC	S	-
5.	Check for number of coats and thickness	WC	S	S
6.	Final check for touch up, repairs etc.	WC	S	-
7.	Curing, if any	WC	S	S
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT B: Main plant buildings
CAT C: Balance works

ITP NO. : 4175

SANITARY FITTINGS

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Incoming material inspection	WC	Note 1	Note 1
2.	Checking of sample (as applicable)	WC	S	-
3.	Check completeness of finishing works w.r.t: line, level & position	WC	S	-
4.	Check proper fixing of the sanitary fittings to give aesthetic appeal	WC	S	-
5.	Check for leakage/ testing at given pressure	WC	S	S
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

CAT B: Main plant buildings
CAT C: Balance works

ITP NO. : 4176

WATER PROOFING (ROOF)

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Surface preparation for screeding/ water proof plastering	WC	S
2.	Mix proportion, thickness of screeding/ plastering & slope towards rain water pipes	WC	S
3.	Formation of groove at specified height on parapet wall/ pedestal/ columns etc.	WC	S
4.	Incoming material inspection, no. of coats, application procedure and consumption.	WC	S/Note 1
5.	Lapping (along the length & in transverse direction) of waterproofing membrane.	WC	S
6.	Termination of material in groove on vertical plane	WC	S
7.	Check for hollowness, bubbles in water proofing, if any	WC	S
8.	Conducting a sample of water proofing test by flooding the area for specified interval (as applicable)	WC	S
9.	Check for protective layer of PCC over waterproofing with chicken wire mesh, groove cutting, sealant filling.	WC	S
10.	Cleaning of surface	WC	-
11.	Submission of Guarantee in the requisite Performa	WC	Rw
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

ITP NO : 4177

FALSE FLOORING AND FALSE CEILING

SL. NO.	ACTIVITY	CONTRACTOR	EIL
	FALSE FLOORING		
1.	Manufacturers Test Certificate	WC	Rw
2.	Incoming material inspection	WC	Note 1
3.	Cleaning base floor	WC	S
4.	Painting base floor with Polyurethane based paint (as specified)	WC	S
5.	Check for cutouts in floor, anchor fasteners in floor, studs spacing etc.	WC	S
6.	Proper line, level & layout	WC	S
	FALSE CEILING		
1.	Manufacturers Test Certificate	WC	Rw
2.	Incoming material inspection	WC	Note 1
3.	Surface preparation of panel boards	WC	-
4.	Proper line, level & cut-outs	WC	S
5.	Finishing of panel boards	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

ITP NO. : 4178

UNDER DECK INSULATION

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Incoming material checking including density	WC	Note 1
2.	Checking of adhesive, fasteners for anchorage	WC	S
3.	Fixing of scaffolding, ladders, platforms	WC	S
4.	Fixing of under-deck insulation with adhesive	WC	S
5.	Use of chicken wire mesh while fixing the insulation sheet.	WC	S
6.	Fixing of dash fasteners at defined spacing	WC	-
7.	Finishing	WC	S
	INSPECTION & TEST DOCUMENTS		

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO. : 4179

ROOFING ACCESSORIES

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Incoming material inspection	WC	HP/Note 1	HP/Note 1
2.	Check for mitring, overhang, laps, etc.	WC	S	-
3.	Slopes line, level of sheets, barge boards, ridges & gutters, overhang of sheets	WC	S	-
4.	Checking for profile, coating, shade of sheet.	WC	S	-
4.	Bolting by drilling only, length of bolts, nos., anodizing and type of washers	WC	S	-
5.	Check for slopes of rain gutters, down take pipes, north lighting curves/ supports for gutters	WC	S	-
6.	Check for wind ties installation of required dimensions	WC	S	-
7.	Check for leakage/ passing of light	WC	S	-
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For incoming material inspection please refer ITP no: 6-82-1010.

2) Fixing arrangement need to be reviewed with respect to contract specifications.

CAT B: Important structures (e.g. Compressor House, Warehouse and Pump House etc.)
CAT C: Balance works.

ITP NO. : 4199

LIGHTING WORKS (BUILDINGS)

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Prepare detailed conduit layout diagram as per the approved electrical drawing	WC	W
2.	Provide PVC/ GI sleeves in columns/beams at identified locations to facilitate laying of conduit on later date.	WC	S
3.	Ensure conduit & accessories material is inspected at site before using	WC	Note - 1
4.	Ensure that the conduit is laid in line with execution drawings & provide pull-wires as per requirement.	WC	S
5.	Check correctness of drop/JB locations	WC	S
6.	Check threaded joints are proper	WC	S
7.	Ensure all JB/Fan box are properly stuffed with jute	WC	S
8.	Ensure conduits are properly tied to reinforcement bars to prevent floating during concrete	WC	S
9.	Ensure proper supporting of conduit lengths wherever required	WC	S
10.	Ensure adequate chasing depth for conduit portion coming inside brick walls	WC	S
11.	Check workmanship towards joints and presence of any foreign material inside the conduits	WC	S
12.	Ensure wiring material is inspected at site before use	WC	Note - 1
13.	Ensure correctness of lighting wire size and no. of wires as per the drawing in each conduit portion	WC	S
14.	Preparation of "As Built" drgs.	WC	Rw
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO : 4210

ABOVE GROUND PIPING

(sheet 1of 11)

SL. NO	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CATC
A.	PRIOR TO FABRICATION				
1.	Incoming Material	WC	Note -1		
2.	Welding Filler Material Approval/Qualification a) Review of Manufacturer's Test Certificates/Documents & Sampling	WC*	HP*	Rw*	Rw*
	b) Laboratory Testing, if any	WC	Rw	Rw	Rw
3.	WPS/PQR				
	a) Review of proposed procedure	WC	HP	Rw	Rw
	b) Welding of Test Coupons and subsequent testing	WC	W	W	S
	c) Approval of final WPS/PQR	WC	HP	HP	HP
4.	Welder performance Qualification	WC	Rw	Rw	Rw
5.	Certification & approval of welders.	WC	HP	W	~~W~~ S
6.	NDT Procedure Qualification				
	i) Review of proposed procedure	WC	Rw	Rw	Rw
	ii) Witnessing of Proposed Procedure Testing	WC	W	W	S
	iii) Approval of Qualified Procedure	WC	HP	W	W
7.	Review of Joint numbering in Isometrics (Big & Small bore)/Sketches	WC	W	Rw	--
8.	Material traceability & Transfer of Heat Nos.	WC	HP	S	--

* **a)** *Notwithstanding any other tests/documentation required for qualification/approval of filler metals:*

i) For Alloy Steel & Stainless Steel welding filler metals, chemical analysis to be carried out for every batch.

ii) For Low Temperature Services piping, Impact testing to be carried out for every batch of the filler metal, to be witnessed by PMC/owner.

b) *For NACE filler metals, corrosion tests like HIC, SSCC, etc. to be carried out for every batch. However, HIC/SSCC tests done earlier & duly endorsed by a reputed third party, will be acceptable.*

ITP NO : 4210

ABOVE GROUND PIPING

(sheet 2 of 11)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CATC
B.	FABRICATION /ERECTION				
1.	Material as per piping class (check w.r.t. approved colour coding procedure), Fit-up check and Traceability check .	WC	W	S	--
2.	Pre-heat (if any)	WC	S	--	--
3.	Certificate of purity of purging/shielding Gas (if any)	WC	S	--	--
4.	Purging rate (if any) and arrangement	WC	S	--	--
5.	Shielding rate (if any)	WC	S	--	--
6.	Baking of Electrodes	WC	S	--	--
7.	Inter-pass cleaning & Temperature check.	WC	S	--	--
8.	Visual Examination of completed welds	WC	W	S	S
9.	a) Monitoring of PWHT Cycle	WC	S	--	--
	b) Review of Time – Temperature graph	WC	Rw	Rw	--
10.	Hardness Check	WC	S	--	--
11.	a) PT/MT (Branch Joints)	WC	W	S	--
	b)PT /MT (Others)	WC	W	S	--
12.	a)Identification of Joints for Radiography (for Random Radiography only)	WC	S	--	--
	b) Check shot for radiography	WC	HP	HP	HP
13.	Review of Radiographs interpreted by the Contractor	WC	HP	W	Rw
14	Lifting arrangement (for critical piping only)	WC	Rw	Rw	Rw
15	Test certificates for lifting tackles	WC	Rw	Rw	Rw
16	Location and orientation of Branch connections	WC	Rw	Rw	-
17	Provision of Inst. Tappings	WC	W	W	-
18	Provision of vents and drains	WC	Rw	Rw	-
19	Correctness of type of supports, Anchors, Guides	WC	W	W	S
20	Correctness of gaskets/ fasteners	WC	W	S	S
21	Correctness of valves (NRV, Gate, Globe, control Valves etc), steam traps and their direction of flow.	WC	HP	W	S
22	Provision of cold pull, if any.	WC	W	W	-

ITP NO : 4210

ABOVE GROUND PIPING

(sheet 3 of 11)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CATB	CATC
C	**PROOF TESTING**				
1.	Procedure Review (Refer Annexure -2)	WC	Rw	Rw	Rw
2.	Correctness of Testing arrangements. (Refer Annex-2)	WC	S	--	--
3.	Scrutiny of test packs for Mechanical & NDT Clearance	WC	S	S	--
4.	Positive Material Identification as per specification after completion of installation.	WC	Rw	--	--
5.	Preparation of Punch list .(Refer Annex-3)	WC	W	W	--
6.	Review of Punch List prepared by Contractor	WC	Rw	Rw	--
7.	Liquidation of check list, if applicable.(Refer Annex-3)	WC	HP	HP	--
8.	a) Review of Calibration certificates of pressure Gauges	WC	Rw	Rw	--
	b) Field Calibration, if any	WC	S	--	--
9.	Air/Water Flushing (preliminary)	WC	S	S	--
10.	Visual inspection of all weld joints for leak during Pneumatic/ Hydrotesting	WC	W	W	--
11.	Draining of Water & Air Drying (Refer Annex-2)	WC	S	S	--
12.	Removal of temporary blinds/supports.(Refer Annex-2)	WC	W	S	--
13.	Boxing up including reinstallation of flappers of check valves	WC	S	--	--
14.	Review of Records of fasteners & gaskets	WC	Rw	Rw	Rw
15.	Torque tightening/ tensioning of flange joints, wherever applicable	WC	W	S	--
16.	Modification of Tested lines.(Refer Annexure - 4))	WC	Rw	Rw	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010.

2) Pre-commissioning activities such as chemical cleaning, card board blasting, system testing are not covered by these ITP's. The contractor shall develop ITP's for such activities and obtain Owner/ PMC/ Licensor's approval.

CAT A: All services involving hydrogen and hydrogen bearing fluid., all piping above and including 600# rating, all SS, AS,NACE,LTCS ,clad Inconel, piping ,SHP/HP Steam piping.

CAT B: All CS piping for process lines up to 600 # (excluding) , all Steam lines under purview of IBR and excluding category A, Jacketed piping.

CAT C: Piping for "D" class fluid, Non IBR portion of condensate & steam lines

(sheet 4 of 11)

ANNEX – 1

Checklist for Mechanical Clearance - A/G Piping

Project : _____	Report No : _____
Plant/Unit : _____	Date : _____
Contractor : _____	Area : _____
Loop No : _____	INCH MTR : _____

Line No (Isometric No.)	Rev.	GAD No.	Rev.	P&ID No.	Rev.

	Items to be checked		Accept Contractor	Remarks
1.	**Installation checked as per Isometric w.r.t.** CONFIGURATION : Route, plumb, elevation, Clearance for thermal expansion/ insulation BRANCH : Location, angle, orientation, type, RF pad, etc. STEAM TRAP : Direction			
2.	**Installation checked as per GAD w.r.t.** CONFIGURATION : Route, clearance for thermal expansion/insulation			
3.	Installation checked as per P&ID			
4.	Isometrics completed for (**enclosed**):			
	a. Joint Numbering (Shop & Field Welds)			
	b. Spool Numbering			
	c. As-built routing & dimensions			
5.	**Valves**(Check Rating, Gaskets, Flow Direction, Sheet No., Tag No., Spindle direction, CSO LO/LC, Damage, etc)	Nos		
	Gate Valves			
	Globe Valves			
	Check Valves			
	Control Valves Tag Nos.:			
	Safety Valves Tag Nos.:			
	Any other valves :			
6.	**Strainers** : Check for clearance, flow direction, elements			

FORMAT NO: _____ (Sht 1/4)

(sheet 5 of 11)

Checklist for Mechanical Clearance - A/G Piping

	Item to check	Accept Contractor	Remarks
7.	**Flanged Joints**		
	Total Nos.		
	Check for type of flange		
	Check for Rating		
	Check for Alignment, (proper gap & parallelity		
	Check for Correct Studs & nuts – dia., length, Material, uniform protrusion of studs, anti seize compound		
	Check for correct gasket (type, size, spec., thickness, etc.)		
	Torque values used for tightening		
8.	Seal Welding of Screwed Connections (if Required)		
9.	Vents/Drains as per Dwg and Provision of additional high point Vents and/or low point Drains, if reqd.		
10.	Reinforcement pads as per piping class		
11.	**Orifice Flanges :**		
	Check for Tag No., tapping orientation, tap valve, jack screw, straight run length of upstream & downstream		
12.	**Local Gauges :** Check for accessibility		
13.	Slope (When Applicable)		
14.	**Supports**		
	a) Guides, Cross Guides, Trunnion, etc.		
	i) Check for correct type, material & dimension		
	ii) Check welding		
	iii) Check for vent hole on pads (if applicable)		
	iv) Check offset for thermal expansion		
	v) Check clearance of guide		
	vi) Check U bolt for slide support		
	b) Spring Support		
	c) Verify tag no. and check details as per data sheet/spring set		
	d) Check for locking arrangement and any damage during transit, etc.		
	e) Check for completeness of installation as per drg. Including welding of mounting cleat/ bracket		
	iv) Check for locking during installation and pressure test		
	c) Bracket Support & Inserts with Anchor Fasteners :		
	i) Check for members dimensions and materials		
	ii) Check for welding		
	iii) Check for bolting		
	iv) Check for appearance/ damage		

FORMAT NO: _____ (Sht 2/4)

(sheet 6 of 11)

Checklist for Mechanical Clearance - A/G Piping

	Item to check	Accept Contractor	Remarks
15.	**Vents/ Drains :**		
	- As per drg.		
	- Orientation of valve handles		
	- Clearance for hose		
	- Requirement of additional vents/ drains (highest/lowest pt.)		
16.	**Earthings :**		
	a) Check for location		
	b) Check for dimension of lug welding		
17.	**Joists History sheets enclosed for :**		
17.1	Material Traceability as per Procedure No:_____ (refer enclosed suggested Format)		
17.2	Fit ups checked		
17.3	NDT Complete (Radiography, MT, PT)		
17.4	Stress Relieving & Hardness check complete		
17.5	Positive Material Identification **(PMI)**		
	Checked for Removal/Blinding-off of:		
	a. Control, Safety and Check Valves		
	b. In-Line Instruments		
	c. Rupture Discs		
	d. Equipment Nozzles		
	e. Others		
18.	Supports and Weld/Flanged/Screwed connections free from		
	insulation or other coverage`		
19.	Checked Installation of (Indicate Location in Drawings)		
	a. Temporary Blinds/Spades		
	b. Temporary Strainers		
	c. Temporary Dummy-Spools		
	d. Temporary Gaskets		
	e. Others		
20.	**Expansion Bellows** -		
	a) Checks prior to installations		
	- Physical damages		
	- Transit locks are intact		
	- Dimensions as per drgs.		
	b) Check during installation		
	- Parallelity of mating flanges		
	- Face to face dimension of mating flanges		
	- Concentricity of mating flanges		
	- No stress on expansion bellows		
	- Record		

FORMAT NO: _____ (Sht 3/4)

(sheet 7 of 11)

Checklist for Mechanical Clearance - A/G Piping

	Item to check	Accept Contractor	Remarks
	c) Isolation during pressure tests		
	- Bellow mfg. recommendations on isolation of bellow during pr. Test to be followed		
	- If recommended expn. Bellow to be dropped during pr. Test.		
21.	Cleanliness Internally and Externally		
22.	Rotating Equipment Final Alignment Checked with piping		
23.	Removal of unwanted construction supports		
24.	Instrument tapings provided as per Drawing		
25.	**Physical-Walk-Through – The – Line,** checked for gross irregularities including physical damages, unwanted tacks, arc strikes, spatters and space for thermal expansion.		

Other :

Remarks

Reviewed by Contractor (minimum one level higher than checker)

Name : Designation :

Date :

EIL

Sign :

Date :

Name : Designation :

FORMAT NO: _____ (Sht 4/4)

(sheet 8 of 11)

ANNEX – 2

Piping Hydro Test Release Record – A/G Piping

Project : _____	Report No : _____
Plan : _____	Date : _____
Contractor : _____	Area : _____
Loop No : _____	REF P & ID No. : _____
	INCH MTR : _____
	From _____ To _____

S. No.	Line No. (s)		Isometric No. (s)	P&ID No. (s)	

Test Medium :		Test Duration :	Design/Test Pressure :
Test Pressure Gauge No.	Range	Calibration Certificate No.:	Gauge Calibration Date:

Items to check		Accept		Witness
		Contractor	EIL	
	Field Installation Checklist Prior to Hydrotest Signed			
	Punch list Prepared	Yes ☐	No ☐	
	Pre – Hydrotest Punch items Cleared			
	Accessibility to Inspection/Witness Locations			
	Capacity of pressurizing pump checked			
	Cordon off area for high pressure testing, as required			
	Pre-hydrotest flushing carried out			
	IBR/Others test Witnessing Required Yes No			
System Released for Pressure Testing :				

Contractor :	**EIL:**
Sign : Name :	Sign : Name :
Date :	Date :
Designation :	Designation:

FORMAT NO: _____ (Sht 1/2)

(sheet 9 of 11)

Piping Hydro Test Record – A/G Piping

ACTIVITY	Date	Time
Water Filling and Venting started at		
Water Filling Completed		
Vents Closed		
Isolation of Pressurizing pump		
Test completed at :		
- Water drained		
- Air		
- Temp Blinds Removed		
- Checked for reinstallation of a. Control & Safety vales b. On line Instruments c. Rupture disks d. Deblinding e. Others		
- Cold setting of spring supports carried out		
- **Test Result**	☐ Acceptable	☐ Not Acceptable

Contractor :	**EIL** :
Sign :	Sign:
Date :	Date:
Name : Designation	Name: Designation:

FORMAT NO: _____ (Sht 2/2)

(sheet 10 of 11)

ANNEX – 3

Punchlist

Project : _____	Report No : _____
Plan : _____	Date : _____
Contractor : _____	Area : _____
Loop No : _____	REF P & ID No. : _____

Description : _____

Ref Document : _____

Punch Item No.	Priority	Description of Punch Items	Location	Prepared By	Action By	Due date	Completion Acceptance

Priority: 1. Needed for pressure test 2. Needed for commissioning 3. Needed for start up 4. Needed for plant acceptance

Contractor :	**EIL** :
Sign :	Sign :
Date :	Date :
Name : Designation :	Name : Designation :

FORMAT NO: _____ **Sh. 1/1**

(sheet 11 of 11)

ANNEXURE-IV

Indicative format for Authorizing/Recording of Modification of Piping Joints after Mechanical clearance /NDT Clearance/ Hydro Testing /Pneumatic Testing of pressure Test Packages/Loops in piping jobs.

Job No. :	Unit No.:	Report No:	Date:
Owner/Client : PMC : Contractor :		Pressure Test Package No.: System Name/No. : Previous Hydrotest Date :	

Drawing No	:	
Line No.	:	
Joint Nos. to be modified (attach sketch)	:	
Size & type of joint	:	
New Joint Nos.	:	
Deleted Joint Nos.	:	
Modification Joint Nos.	:	
Reason for Modification	:	

A) Proposed checks/NDT / Testing after Modification

1. Fit up and Traceability. :	☐				
2. PMI Checks :	☐	Mark '√' in box as necessary			
3. MPI Test :	☐	PT (root/final) :	☐	RT :	☐
4. PWHT/Hardness : Required. :	☐	Not Required. :	☐		
5. Hydrotesting :	☐	Pneumatic Test :	☐		

Authorized Signatory (note-1)

Name	
Signature	
Date	

B) Proposal Accepted by EIL (note-2)

	Area Co-ordinator	Welding/ NDT Incharge
Name		
Signature		
Date		

Clearance/Acceptance after modifications (All Supporting Documents enclosed)

Mechanical clearance : Contractor Mech.	☐	Signature.	EIL Mech.	☐	Signature.
NDT Clearance : Contractor QA/QC.	☐	Signature.	EIL Welding/NDT	☐	Signature.
Testing Acceptance : Contractor Mech.	☐	Signature.	EIL Mech.	☐	Signature.

Final acceptance after Modification

	Contractor	EIL
Name		
Signature		
Date		

Note: 1. Authorized signatory (*): RCM/ Site In charge of execution agency

2. RCM/SIC of EIL may seek opinion of Engineering, prior to acceptance of proposal from LSTK contractor as necessary.

ITP NO : 4250

EQUIPMENT ERECTION (STATIC)

(sheet 1of 3)

SL. NO	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
	EQUIPMENT ERECTION (STATIC)				
1.	BEFORE ERECTION				
a.	Review of foundation acceptance report	WC	HP	Rw	Rw
b.	Incoming material	WC	Note-1	Note-1	Note-1
c.	Readiness for erection				
	i) Centre line marking on equipment and foundation	WC	S	--	--
	ii) Level of foundation (shims/ packing with marking to be prepared & kept ready)	WC	S	--	--
	iii) Correctness of no. & size of Foundation bolts	WC	S	--	--
	iv) Hole dia and no. of holes in base/ structure of equipment columns	WC	S	--	--
	v) Matching equipment base bolt holes with actual foundation bolt layout	WC	S	--	--
	vi) Marking orientation	WC	S	--	--
	vii) Checking the threads of bolts & nuts	WC	S	--	--
	viii) Chipping & roughening of foundation	WC	S	--	--
d.	Outside cleaning, coating/wrapping, painting (for underground equipment only)	WC	HP	W	--

ITP NO : 4250

EQUIPMENT ERECTION (STATIC)

(sheet 2 of 3)

SL. NO	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
2.	**ERECTION SCHEMES FOR CRITICAL EQPTS**				
	a.Review of rigging procedure	WC	HP		--
3.	**SAFETY TEST**				
	a .Load test of cranes, lifting beams, slings and shackles, length and dia. of sling & condition of wire rope by competent authority	WC	Rw	Rw	Rw
4.	**DURING ERECTION**				
	a. Orientation to be checked	WC	S	--	--
	b. Placement of packing as per AFC drg	WC	S	--	--
	c. Placement of Main & trailing crane as per approved rigging procedure	WC	S	--	--
	d. Orientation of equipment as per AFC drg	WC	S	--	--
5.	**AFTER ERECTION**				
	a. Tightening of Bolts and Providing washers	WC	S	--	--
	b. Leveling and Alignment of equipments	WC	W	W	--
	c. Corresponding requirement elevation & distance between nozzles in special cases	WC	S	--	--
	d. Cleaning of Sleeves before grouting	WC	S	--	--
	e. Grouting	WC	S	--	--
	i) Acceptance of Specified grouting materials	WC	HP	Rw	Rw
	ii) Placement of grouting	WC	S	--	--
	iii) Curing of grout	WC	S	--	--
	f. Final tightening of bolts	WC	S	--	--

ITP NO : 4250

EQUIPMENT ERECTION (STATIC)

(sheet 3 of 3)

SL. NO	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
6.	**PACKED EQUIPMENTS**				
	1. Before Installation				
	a. Identify the material, check thickness, dimensions, no. and angle of fingers of packing rings	WC	S	--	--
	2. During Installation				
	a. Degreasing and cleaning of packing material	WC	S	--	--
	b. Check packing support plate	WC	S	--	--
	c. Check for stacked or dumped packing as per specifications	WC	S	--	--
	d. Check for nesting	WC	S	--	--
	e. Check that packings are touching bed limiter	WC	S	--	--
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A Process columns & Reactors (including internals), Mounded Bullets, ODC's or Any special type of equipment (Project specific)

CAT B Vessels & exchangers above 5 T, Hoppers /bins, Incinerators, combustion chamber, Boilers and all other equipments not covered in "Cat A" and "Cat C"

CAT C Filters, Demister, Seal pots, All vessels/exchangers Up to 5T

ITP NO : 4260

EQUIPMENT ERECTION ROTARY

(sheet 1of 3)

SL. NO.	ACTIVITY	CONTRACTOR*	EIL		
			CAT A	CAT B	CAT C
1.	**PRE – ERECTION ACTIVITIES**				
	a. Review of foundation acceptance report	WC	HP	Rw	Rw
	b. Material Supply				
	- Owner's supply including templates, if any	WC	Rw	Rw	--
	- Contractor's supply & check testing, if any	WC	Note-1	Note-1	Note-1
	c. Readiness for erection				
	i. Level of foundation (shims/packing with markings to be prepared & kept ready)	WC	W	--	--
	ii. Marking/Centre line of foundation & equipment	WC	W	--	--
	iii. No./dia./length of anchor bolts, depth of pockets, verticality of pockets	WC	W	--	--
	iv. Chipping, roughing & cleaning of pockets/top of foundation	WC	HP	W	Rw
	v. Acceptance of grouting materials as per specifications/ Manufacturer's recommendations	WC	HP	Rw	Rw
2.	**LIFTING TACKLES**				
	a. Certificate from competent authority	WC	Rw	--	--
	b. Load test of Cranes/Lifting beams/slings/ shackles/ Wire ropes, etc. for weight of equipments to be handled	WC	Rw	--	--
3.	**VISUAL INSPECTION OF EQPT. TAG/IDENTIFICATION NO.**				
	a. For any damage	WC	S	--	--
	b. Free shaft rotation	WC	S	--	--
4.	Drilling & Tapping, holes in the base plate of eqpt. (if reqd.)	WC	S	--	--
5.	Approval of Rigging procedure	WC	HP	Rw	Rw

* Inspection by Vendor/Manufacturer for all critical equipments

ITP NO : 4260

EQUIPMENT ERECTION ROTARY

(sheet 2of 3)

SL. NO.	ACTIVITY	CONTRACTOR*	EIL		
			CAT A	CAT B	CAT C
6.	DURING ERECTION				
	a. Level/elevation of base frame	WC	S	--	--
	b. Checking of foundation bolts (for location, threading, greasing, etc.)	WC	S	--	--
	c. Checking orientation of equipment	WC	S	--	--
	d. Placement of Crane(s), if applicable	WC	S	--	--
	e. Elevation/level of equipment and placement of shims/packings as per AFC drawings	WC	S	--	--
	f. Distance between couplings	WC	S	--	--
	g. Rough alignment of equipment	WC	S	--	--
	h. Availability of Vendor's engineer at site (For critical equipments	WC	S	--	--
	i. Cleaning of pockets/ grouting of foundation bolts' pockets/base frame	WC	W	--	--
	j. Erection of auxiliary equipment/ Accessories	WC	S	--	--
	k. Final alignment of equipment	WC	S	--	--
	- Without piping	WC	W	W	--
	- With piping (After tightening the flange bolts)	WC	HP	W	--
	l. All protection & safety guards installation	WC	S	--	--

ITP NO : 4260

EQUIPMENT ERECTION ROTARY

(sheet 3 of 3)

SL. NO.	ACTIVITY	CONTRACTOR*	EIL		
			CAT A	CAT B	CAT C
7.	**POST ERECTION ACTIVITIES**				
	a. Curing of grout	WC	S	--	--
	b. Auxiliary connections to be mounted on eqpts as per drawing	WC	S	--	--
	c. Final tightening of bolts	WC	S	--	--
	d. Chemical cleaning of equipment parts/ connected piping	WC	S	--	--
	e. Boxing up of equipment & connected piping	WC	S	--	--
	f. Log book maintenance (For rotating of shaft and any other activity to be performed as per vendor's recommendations)	WC	S	--	--
	g. No load run of motors	WC	W	W	Rw
	h. Re-coupling of motor & reconfirmation of alignment	WC	HP	W	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	S	--	--

* Inspection by Vendor/Manufacturer for all critical equipments

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A : Compressors, Pumps (ratings>15 KW), Turbines & Diesel Engines, Rotary Driers or Any special type of equipment (Project specific)

CAT B : All types of pumps excluding category A & C, Fans & Blowers Conveyors & Material handling Equipments

CAT C : Metering & Dosing Pumps, etc.

ITP NO : 4270

INSTALLATION/ERECTION & TESTING OF CRANES (EOT/HOT)

SL.			EIL		
			CAT A	CAT B	CAT C
1.	BEFORE ERECTION				
	a. Execution scheme of equipment foundation	WC	Rw		
	b. Materials supply	WC	Note-1	Note-1	Note-1
	c. Readiness for erection	WC	W	--	--
	i. Structural steel girder span centre to centre & elevation difference	WC	W	--	--
	ii. Check centre to centre distance of rails, gaps, elevations, crab wheels distances	WC	W	--	--
	iii. Check buffer stops	WC	W	--	--
2	a. Erection and assembly of components like LT, Crane Girders, Crab, Platforms, etc.	WC	S	--	--
	b. Review of hoist ropes and assembly of hook blocks	WC	S	--	--
3.	a. Electrical installation, testing & no load test of motors	WC	S	--	--
	b. Coupling of motors to drivers	WC	S	--	--
4	NO LOAD TEST				
	a. Winding & unwinding test	WC	W	--	--
	b. Traversing test	WC	W	--	--
	c. Traveling test	WC	W	--	--
5.	LOAD TEST				
	a. Winding & unwinding test	WC	HP	W	Rw
	b. Traversing test	WC	HP	W	Rw
	c. Traveling test	WC	HP	W	Rw
	d. Load & over load testing	WC	HP	W	Rw
	e. Deflection of girder	WC	HP	W	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Special purpose M/C viz. Pot tending M/c
CAT B: All EOT cranes with capacity 10T and above
CATC : All EOT /HOT cranes with capacity below 10T

ITP NO : 4280

STORAGE TANKS

(sheet 1 of 5)

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT A	CAT B
A.	**PRIOR TO FABRICATION**			
1.	Review Acceptance Report of the tanks foundation	WC	HP	Rw
2.	Incoming Material	WC	Note-1	Note-1
3.	Welding Filler Material Approval/Qualification			
	a) Review of Manufacturer's Test Certificate/Documents	WC*	Rw	Rw
	b) Laboratory testing, if any			
	i) Carbon Steel	WC	W	--
	ii) Alloy Steel/Stainless Steel	WC	W	--
	iii) Low Temperature Services	WC	W	--
4.	WPS/PQR			
	a) Review of proposed procedure	WC	Rw	Rw
	b) Testing			
	i) Carbon Steel	WC	Rw	Rw
	ii) Alloy Steel/Stainless Steel	WC	W	W
	c) Approval of Final WPS/PQR	WC	W	W
5.	a) Welder performance Qualification Test	WC	W	S
	b) Certification & approval of welders	WC	W	S
6.	NDT Procedure Qualification			
	i) Review of proposed procedure	WC	Rw	Rw
	ii) Witnessing of the proposed procedure testing	WC	W	S
	iii) Approval of Qualified Procedure	WC	W	W
7.	Review of Joint numbering in drawings	WC	Rw	Rw
8.	Review fabrication, erection, testing Procedures for job	WC	Rw	Rw
B.	**FABRICATION/ERECTION BOTTOM**			
1.	Blast cleaning & painting of underside of bottom plates	WC	HP	S

* *Notwithstanding any other tests/documentation required for qualification/approval of filler metals :*

i)For Alloy Steel & Stainless Steel welding filler metals, chemical analysis to be carried out for every batch.

ii)For Low Temperature application, Impact testing to be carried out for every batch of the filler metal, to be witnessed by PMC/Owner.

iii)For NACE filler metals, corrosion tests like HIC, SSCC, etc. to be carried out for every batch. However, HIC/SSCC tests done earlier & duly witnessed by a reputed third party, will be acceptable.

ITP NO : 4280

STORAGE TANKS

(sheet 2 of 5)

SL. NO	ACTIVITY	CONTRACTOR	EIL	
			CAT A	CATB
2.	Plate lay out, overlap and fit up	WC	S	--
3.	Sequence of welding	WC	S	--
4.	Size and positioning of backing plate for annular plates	WC	S	--
5.	Baking of electrodes	WC	S	--
6.	Inter-pass cleaning	WC	S	--
7.	Visual check of welding	WC	W	S
8	PT/MT/NDT of annular plate butt welds and bottom plate butt welds (As applicable)	WC	W	S
9.	Vacuum box test for bottom plate welding	WC	W	S
	SHELL			
1.	Shell course alignments and fit-up of vertical and circumferential joints before welding	WC	W	S
2.	a) Check Shell diameter, circularity, perpendicularity, straight edge before welding.	WC	W	S
	b) Check Shell diameter, circularity, perpendicularity straight edge after welding,	WC	W	S
3	Visual check of welding and Back chipping	WC	S	-
4.	Inner side welding visual check	WC	S	-
5.	Location, size, alignment and fit-up of nozzles & other openings	WC	W	S
6.	R.F. Pads fit-up/welding	WC	S	-
7	PWHT of shell, RF pads, Nozzles, manholes, etc. (As applicable)	WC	S	S
8.	Radiography marking (for Random radiography only)	WC	W	W
9.	Curb angle and Wind girders fit-up/welding	WC	S	Rw

ITP NO : 4280

STORAGE TANKS

(sheet 3 of 5)

SL. NO	ACTIVITY	CONTRACTOR	EIL	
			CAT A	CATB
10.	PT/MT of nozzles, wind girders and other attachments (as applicable)	WC	W	S
11.	RF pads pneumatic test	WC	W	W
12.	Shell to bottom fit up	WC	W	S
13.	Shell to bottom I/S welding root run visual/Oil chalk test	WC	W	S
14.	Shell to bottom O/S welding visual and DPT	WC	W	S
15.	Fabrication and erection of stair ways	WC	S	--
16.	Cleats welding for insulation	WC	S	--
17.	Review of radiographs interpreted by the contractors	WC	HP	Rw
	FIXED ROOF			
1.	Blast cleaning and painting Roof Structure, underside of Roof plates	WC	W	S
2.	Location and Welding of Roof supports	WC	S	--
3.	Alignment and welding of Roof structures	WC	S	--
4.	Plate layout, overlap and fit-up	WC	S	--
5.	Visual check of roof welds	WC	S	--
6.	Location, size and alignment of roof nozzles, man-holes vents, etc.	WC	W	S
7.	PWHT (as applicable)			
	i) Procedure Review	WC	HP	Rw
	ii) PWHT cycle monitoring	WC	S	--
	iii) Time-Temp Chart Review	WC	Rw	Rw
8.	RF pads fit-up & Welding	WC	S	--
9.	RF pad pneumatic testing	WC	W	S
10.	PT/MT of Nozzles, vents & other attachments	WC	W	S
11.	Welding of Roof plate with shell/ curb angle	WC	S	--

ITP NO : 4280

STORAGE TANKS

(sheet 4 of 5)

SL. NO	ACTIVITY	CONTRACTOR	EIL	
			CAT A	CATB
	FLOATING ROOF			
1.	Temporary staging spacing and levels	WC	S	--
2.	Plate layout, overlap, fit-up/welding	WC	S	--
3.	Availability of approved calculations for design of buoys	WC	Rw	--
4.	Buoys fabrications	WC	S	--
5.	Vacuum testing of roof-plate welds	WC	W	--
6.	Location of sleeve supports	WC	S	--
7.	Pad plate welding with roof and sleeve support	WC	S	--
8.	Fixing and welding of Buoys	WC	S	--
9.	Initial -- lift	WC	S	--
10.	Supports fixing through sleeves	WC	S	--
11.	Seal welding of support sleeves from beneath after dewatering	WC	S	--
12.	Air test of Buoys Pontoon welding	WC	S	--
13.	Location, fixing and welding of man holes, drains etc	WC	W	--
14.	Shell to pontoon clearance	WC	HP	--
15.	Seal fixing	WC	HP	--
16.	Floating Roof Testing, as required e.g. flooding etc	WC	HP	--

ITP NO : 4280

STORAGE TANKS

(sheet 5 of 5)

SL. NO	ACTIVITY	CONTRACTOR	EIL	
			CAT A	CATB
C.	**TESTING**			
1.	Correctness of testing arrangements especially size of blind flanges/vents/drains/ temporary piping	WC	S	--
2.	Mechanical / Inspection clearances	WC	HP	HP
3.	Earthing of ladder & shell	WC	W	W
4.	Settlement readings during water filling	WC	W	Rw
5.	Hammer test	WC	W	W
6.	Air pressure test	WC	W	W
7.	Vacuum test	WC	W	W
8.	Roof collapsibility test in case of floating roof tanks	WC	W	W
9.	Calibration of tanks from Statutory authorities	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE :
1) For Incoming material Inspection please refer ITP No: 6-82-1010
2) For cleaning & painting, please refer ITP No. 2501
3) For Insulation, please refer ITP No. 2505

CAT A: All Site fabricated steel storage tanks for process fluid /Hydrocarbon, floating roof, tanks having capacity 600cum or 10m dia and 8 m height.

CAT B: Site fabricated steel storage tanks for Raw water, Fire water, waste water, DM water, etc. and all tanks not covered under "CAT A"

ITP NO : 4301

PAINTING WORKS

SL. NO.	ACTIVITY	CONTRACTOR	EIL
A.	BEFORE FABRICATION		
1.	a) Approved supplier, product and supplier's materials test certificate	WC	Note 1
	b) Check manufacturing date, expiry period and shelf life	WC	Note 1
2.	a) Physical condition of materials; original manufacturers packing/ containers	WC	Note 1
	b) Confirm identification/ Transfer of identification of materials before painting	WC	Note 1
3.	a) Adequacy of blasting machine capacity for blast cleaning	WC	--
	b) Type and quality of abrasive being used for blast cleaning	WC	--
	c) Adequacy of Airless spray equipment, air spray equipment and paint brushes	WC	--
4.	Performance test of paint applicator and blast cleaning operator	WC	S
5.	Check quality of dry air for blast cleaning and spray application	WC	--
6.	Inspection of blast cleaning operation		
	- Inspect for surface cleanliness by visual stds. of ISO 8501	WC	--
	- Measurement of surface profile by Micrometer/ Elkometer/ Stylus instrument	WC	--
7.	Wet film thickness and over coating interval for each coat of paint during application	WC	--
8.	Dry film thickness after final coat	WC	S
9.	Inspection of final curing/ drying, adhesion, hardness, surface finish, sagging, hiding and pinhole detection	WC	--
10.	Painting identification band/ code, etc.	WC	--
11.	Acceptance prior to shifting to fabrication shop, if applicable	WC	Rw

Note :1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO : 4301

PAINTING WORKS

SL. NO.	ACTIVITY	CONTRACTOR	EIL
B.	AFTER INSTALLATION		
1.	a) Approved supplier product : Suppliers materials test certificate	WC	Note 1
	b) Manufacturing date, expiry period and shelf life	WC	Note 1
2.	Physical condition of materials; original manufacturers packing/ containers	WC	Note 1
3.	Confirm completion of		
	a) Hydrostatic testing of piping	WC	--
	b) Mechanical clearance of structure & equipments	WC	--
4.	a) Adequacy of surface preparation tools and tackles	WC	--
	b) Check the quality of surface preparation	WC	--
5.	a) Performance test for paint applicator for spray application	WC	Rw
	b) Adequacy of airless spray equipment and air spray equipment and paint brushes and quality of dry air for paint application	WC	--
6.	Wet film thickness and over coating interval for each coat of application	WC	--
7.	Dry film thickness after final coat	WC	S
8.	Identification of colour bands, direction marking	WC	--
9.	Identification of colour bands, direction marking	WC	--
10.	Final Acceptance	WC	W
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

Note :1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO : 4402

SHOP FABRICATION FIELD INSTN. WORKS

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Incoming material Inspection	WC	NOTE 1
2.	Qualification of WPS, Welders and welding electrodes	WC	Rw/W
3.	Usage of approved welding consumables	WC	S
4.	Job Procedures being followed	WC	Rw
5.	NDT	WC	Rw
6.	PWHT & Hardness test	WC	S
7.	Shop testing	WC	S
8.	Painting & Storage	WC	Note-2
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection documents	WC	Rw

Note: 1) For Incoming material Inspection please refer ITP no: 6-82-1010
2) For cleaning & painting, please refer ITP No. 2501

ITP NO : 4403

CALIBRATION OF INSTRUMENTS

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Availability of approved standard calibrated testing equipments	WC	HP
2.	Validity of calibration equipments	WC	HP
3.	Dust free environment	WC	S
4.	Availability of approved data sheets, calibration procedures, standards, vendor's manuals	WC	Rw
5.	Usage of appropriate tools and tackles	WC	S
6.	Usage of qualified/ trained personnel	WC	S
7.	Mounting of instruments, instrument tag & model	WC	S
8.	Checking of instrument ranges, supply & output for proper connections	WC	S
9.	Calibration of local gauges	WC	Rw
10.	Calibration of electronic instruments/ control valves	WC	S
11.	Calibration of safety valves, shut down valves and trip switches	WC	S
12.	Calibration of special instruments/ float type instruments	WC	S
13.	Ensuring procedure & record	WC	Rw
14.	Plugging of free entries	WC	S
15.	Stamping of calibration date on instruments	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection documents	WC	Rw

ITP NO : 4404

FABRICATION AND ERECTION OF CABLE DUCTS

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Incoming material Inspection	WC	Note 1
2.	Usage of proper tools and tackles	WC	S
3.	Use of approved consumables	WC	S
4.	Correctness of dimensions of duct	WC	S
5.	Welding as per standards/ specifications	WC	S
6.	Installation & alignment of support as per structural drawings and documents	WC	S
7.	Painting of cable duct and support	WC	Note-2
8.	Grinding of sharp edges before erection	WC	S
9.	Alignment of cable duct	WC	S
10.	Covering of duct after completion of cable laying/ dressing	WC	S
11.	Usage of appropriate clamp & fasteners	WC	S
12.	Installation of guide supports	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Document	WC	Rw

Note :1) For Incoming material Inspection please refer ITP no: 6-82-1010
2) For cleaning & painting, please refer ITP No. 2501

ITP NO : 4405

FABRICATION, ERECTION OF CABLE TRAYS, ANGLE TRAYS FOR CABLE AND TUBE LAYING.

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Correct size and routing of tray/ angle	WC	S
2.	Supports as per standards/ specifications	WC	S
3.	Removal of sharp edges and sharp bends	WC	--
4.	Fastening/ welding of trays/ angles	WC	S
5.	Check for fouling with piping & structures	WC	S
6.	Check for any obstruction/ free access for maintenance	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Document	WC	Rw

ITP NO : 4406

FABRICATION, INSTALLATION OF INSTRUMENT SUPPORT/ STANCHIONS, PANEL SUPPORTS, CANOPIES, JB SUPPORTS

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Incoming material Inspection	WC	Note 1
2.	Usage of proper tools and tackles	WC	--
3.	Availability of approved junction box layout and instrument location plan	WC	Rw
4.	Correctness of dimensions, height, etc	WC	S
5.	Approved welder, consumables, standards	WC	Rw
6.	Check for installation, hole to hole dimension & alignment/ fit-up	WC	--
7.	Removal of sharp edges	WC	--
8.	Painting	WC	Note-2
9.	Easy access for maintenance	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Document	WC	Rw

Note :1) For Incoming material Inspection please refer ITP no: 6-82-1010
2) For cleaning & painting, please refer ITP No. 2501

ITP NO : 4407

INSTALLATION OF FIELD INSTRUMENTS

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Availability of approved location plans, piping GADs, P&ID, vendor's manual, etc.	WC	Rw
2.	Installation of proper support/ instrument stanchion, canopy	WC	S
3.	Instrument tag as per P&ID and model & make as per instrument data sheet	WC	S
4.	Alignment of the instruments	WC	S
5.	Mounting of accessories as per instrument data sheet	WC	S
6.	Visibility & maintenance clearance	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Document	WC	Rw

ITP NO : 4408

INSTALLATION OF IMPULSE TUBING

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
1.	Direction of flow, tapping orientation, standard , piping material	WC	W	S	S
2.	Upstream & downstream straight runs	WC	S	S	S
3.	Usage of appropriate tools & tackles	WC	S	S	-
4.	Removal of burrs & sharp edges on tube bends	WC	-	-	-
5.	Smooth bends/ free draining	WC	S	S	-
6.	Ferrule punching	WC	S	S	S
7.	Supports as per standards/ specifications	WC	S	S	S
8.	Direction of valves/ valve manifolds	WC	S	S	S
9.	Usage of approved sealant, etc	WC	Rw	Rw	-
10.	Hydrostatic/ pneumatic testing	WC	W	S	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Document	WC	Rw		

CAT A: All services involving hydrogen and hydrogen bearing fluid All piping above and including 600# rating All SS, AS,NACE,LTCS impulse piping

CAT B: All CS impulse piping for process lines up to 600 # (excluding)

CAT C: Piping for "D" class fluid, Non IBR portion of condensate & steam lines

ITP NO : 4409

CABLE LAYING, GLANDING AND TERMINATION

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Correctness of cable type as per schedule	WC	Note 1
2.	Measurement & routing	WC	--
3.	Check cable for continuity, insulation resistance, megger values	WC	Rw
4.	Identification tags/ tag plates and proper dressing & clamping	WC	S
5.	Separation of signal/ thermocouple and power cables	WC	S
6.	Proper glands as per area classification, size of cable, JB entry, etc	WC	S
7.	Identification/ ferrule and dressing inside junction boxes and instrument	WC	S
8.	Crimpable type lugs and proper crimping	WC	--
9.	Telephone wire connection inside JB	WC	--
10.	Shield wire dressing/ sleeving and termination	WC	--
11.	Insulation of shield wire on instrument end	WC	--
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Document	WC	Rw

Note :1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO : 4410

INSTALLATION OF JUNCTION BOXES, LOCAL CONTROL PANEL

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Incoming material Inspection	WC	Note 1
2.	Check suitability as per specified hazardous area classification	WC	Rw
3.	Correct cable entries	WC	--
4.	Alignment & fasteners	WC	--
5.	Tightening of fasteners	WC	--
6.	Tightening & numbering of terminal blocks	WC	--
7.	Availability of telephone sockets (for JB's) & earthing point	WC	--
8.	Earthing of JB/ LCP	WC	S
9.	Plugging of free entries with correct plugs	WC	S
10.	Wiring of various hardwares in LCP as per approved wiring drawings	WC	S
11.	Protection of JB and LCP	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Document	WC	Rw

Note :1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO : 4411

FABRICATION & ERECTION OF AIR LINES AND TUBING OF PNEUMATIC LINES

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Availability of AFC drawings for air / pneumatic distribution line	WC	Rw
2.	Usage of correct size, thread, etc. Jigs/ die sets for threading of pipes	WC	--
3.	Proper packing material/ sealant used at thread joints	WC	--
4.	Providing three piece union at each loop for easy maintenance	WC	--
5.	Drain & vent assemblies	WC	--
6.	Tightening of joints	WC	--
7.	Supporting and clamping	WC	S
8.	Test air lines as per standards/ specifications and record	WC	S
9.	Check for inlet, outlet, signal, test and drain connection on the instrument	WC	S
10.	Correct supply as per data sheets	WC	--
11.	Flush lines before connection	WC	S
12.	Punching of ferrules	WC	--
13.	Tagging at both ends of tubes	WC	S
14.	Test as per standards/ specifications and record	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Document	WC	Rw

ITP NO : 4412

INSTALLATION OF LEVEL SWITCHES, LEVEL GAUGES AND FLOAT TYPE

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Check Tapings provided at vessels/stand pipes are matching with centre to centre distance on respective instruments & connection size ratings are matching with instruments.	WC	-
2.	Check tapings provided at vessels/stand pipes are matching with process requirements/P&IDs	WC	-
3.	Incoming material Inspection	WC	Note 1
4.	Deployment of approved welding man-power, usage of approved consumables & procedures	WC	-
5.	Alignment of flanges, visibility of gauges and orientation of instrument	WC	S
6.	Verticality of the instrument	WC	S
7.	Installation of float, displacer, instrument accessories as per data sheet/vendor's instruction manuals	WC	S
8.	QA/QC clearance for welding & testing	WC	W
9.	Tightness of guide wires (as applicable)	WC	S
10.	Usage of correct size, rating & type of gasket and stud/ nuts as per PMS	WC	S
11.	Tightness of studs/ nuts	WC	S
12.	Check for requirements of Heat Testing/ Insulation/ Illumination for instruments	WC	Rw
13.	Final inspection	WC	W
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

Note :1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO : 4413

INSTALLATION OF TEST THERMOWELLS, TEMPERATURE GAUGES AND TEMPERATURE ELEMENTS

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Correctness of range, rating, immersion length (U length) as per P&ID/ Instrument data sheets	WC	Note-1
2.	Check for tapping size, orientation, location as per P&ID	WC	S
3.	Usage of correct size, rating & type of gasket and stud/nuts as per PMS	WC	Note-1
4.	Installation of temperature element head & assemblies	WC	S
5.	Tightness of studs/ nuts	WC	-
6.	Visibility & orientation of gauges	WC	--
7.	Plugging of free entries with correct size plugs	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

Note :1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO : 4414

LOOP CHECKING

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Completeness of installation as per standards & specifications	WC	Rw
2.	Liquidation of punch list as per ITP	WC	W
3.	Availability of standard calibrated equipment	WC	Rw
4.	Coordination with DCS vendor	WC	S
5.	Loop checking		
	a) From instrument to junction box	WC	S
	b) From instrument box to control room	WC	S
6.	Recalibrate/ fine tune instruments for accurate response	WC	--
7.	Check for inter locks and response of final control element	WC	W
8.	Ensure proper response and record	WC	Rw
9.	Loop acceptance	WC	W
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

ITP NO : 4415

INSTALLATION OF IMPULSE PIPING

(Sheet 1 of 11)

SL. NO	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
A.	**PRIOR TO FABRICATION**				
1.	Incoming Material				
	a) Documents (MRIR etc.): Review & acceptance	WC	NOTE 1	NOTE 1	NOTE 1
	b) Physical verification	WC	NOTE 1	NOTE 1	NOTE 1
2.	Welding Filler Material Approval/Qualification				
	a) Review of Manufacturer's Test Certificates/Documents & Sampling	WC*	HP*	Rw*	Rw*
	b) Laboratory Testing, if any	WC	W	Rw	Rw
3.	WPS/PQR				
	a) Review of proposed procedure	WC	HP	Rw	Rw
	b) Welding of Test Coupons and subsequent testing	WC	W	Rw	Rw
	c) Approval of final WPS/PQR	WC	HP	Rw	Rw
4.	a) Welder performance Qualification	WC	W	Rw	--
	b) Certification & approval of welders.	WC	HP	Rw	--
5.	NDT Procedure Qualification				
	i) Review of proposed procedure	WC	HP	Rw	--
	ii) Witnessing of Proposed Procedure Testing	WC	W	Rw	--
	iii) Approval of Qualified Procedure	WC	HP	Rw	--
6.	Review of Joint numbering Procedure, numbering in Isometrics (Big & Small bore)/Sketches	WC	W	Rw	--
7.	Material traceability & Transfer of Heat Nos. (Material Traceability not required for utility services)	WC	S	S	--

* Notwithstanding any other tests/documentation required for qualification/approval of filler metals :

i) For Alloy Steel & Stainless Steel welding filler metals, chemical analysis to be carried out for every batch.

ii) For low temp. services piping, Impact testing to be carried out for every batch of the filler metal, to be witnessed by Owner/ EIL.

For NACE filler metals, corrosion tests like HIC, SSCC, etc. to be carried out for every batch. However, HIC/SSCC tests done earlier & duly witnessed by a reputed third party, will be acceptable.

ITP NO : 4415

INSTALLATION OF IMPULSE PIPING

(Sheet 2 of 11)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CATB	CATC
	FABRICATION (SHOP & FIELD)				
1.	Material as per piping class (check w.r.t. approved colour coding procedure), Fit-up check and Traceability check	WC	S	--	--
2.	Pre-heat (if any)	WC	S	--	--
3.	Certificate of purity of purging/shielding Gas (if any)	WC	S	--	--
4.	Purging rate (if any) and arrangement	WC	S	--	--
5.	Shielding rate (if any)	WC	S	--	--
6.	Baking of Electrodes	WC	S	--	--
7.	Inter-pass cleaning & Temperature check	WC	S	--	--
8.	Visual Examination of completed welds	WC	S	S	--
9.	a) Monitoring of PWHT Cycle	WC	S	--	--
	b) Review of Time – Temperature graph	WC	Rw	Rw	Rw
	c) Hardness Check	WC	S	--	--
10.	PT/MT	WC	S	S	--
11.	Identification of Joints for Radiography (for Random Radiography only)	WC	S	--	--
12.	Review of Radiographs interpreted by the Contractor	WC	HP	W	Rw

ITP NO : 4415

INSTALLATION OF IMPULSE PIPING

(Sheet 3 of 11)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CATA	CAT B	CATC
C	**PROOF TESTING (See enclosed checklist in Annex-1)**				
1.	Procedure Review	WC	HP	Rw	Rw
2.	Preparation of Punch list (**Ref. Annex-3**)	WC	S	--	--
3.	Liquidation of check list, if applicable	WC	HP	W	--
4.	Correctness of Testing arrangements	WC	S	--	--
5.	Scrutiny of test packs for Mechanical & NDT Clearance	WC	HP	W	Rw
6.	Positive Material Identification as per specification after completion of installation	WC	S	Rw	--
7.	a) Review of Calibration certificates of pressure Gauges	WC	Rw	Rw	Rw
	b) Field Calibration, if any	WC	S	--	--
8.	Air/Water Flushing (preliminary)	WC	S	--	--
9.	Visual inspection of all weld joints for leak during Pneumatic/ Hydrostatic testing **(See Annex-2)**	WC	HP	W	--
10.	Draining of Water & Air Drying	WC	S	--	--
11.	Removal of temporary blinds/supports	WC	S	--	--

ITP NO : 4415

INSTALLATION OF IMPULSE PIPING

(Sheet 4 of 11)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CATB	CATC
12.	Boxing up including reinstallation of flappers of check valves	WC	S	--	--
13.	Review of Records of fasteners & gaskets	WC	Rw	Rw	Rw
14.	Torque tightening/ tensioning of flange joints, wherever applicable	WC	S	S	--
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

For liquidation of Punch list, see **Annex - 3**

Note : 1) For Incoming material Inspection please refer ITP no: 6-82-1010
2) Pre-commissioning activities such as chemical cleaning, card board blasting, system testing are not covered by these ITP's. The Contractor shall develop ITP's for such activities and obtain Owner/ EIL/ Licensor's approval.

CAT A: All services involving hydrogen and hydrogen bearing fluid All piping above and including 600# rating All SS, AS,NACE,LTCS impulse piping

CAT B: All CS impulse piping for process lines up to 600 # (excluding)

CAT C: Piping for "D" class fluid, Non IBR portion of condensate & steam lines

(Sheet 5 of 11)

ANNEX – 1

Checklist for Mechanical Clearance - IMPULSE Piping

Project : _____	Report No : _____
Plant/Unit : _____	Date : _____
Contractor : _____	Area : _____
Loop No : _____	INCH MTR : _____

Line No (Isometric No.)	Rev.	GAD No.	Rev.	P&ID No.	Rev.

	Items to be checked		Accept Contractor	Remarks
1.	**Installation checked as per Isometric w.r.t.** CONFIGURATION : Route, plumb, elevation, Clearance for thermal expansion/ insulation BRANCH : Location, angle, orientation, type, RF pad, etc. STEAM TRAP : Direction			
2.	Installation checked as per P&ID			
3.	Isometrics completed for (**enclosed**):			
	a. Joint Numbering (Shop & Field Welds)			
	b. Spool Numbering			
	c. As-built routing & dimensions			
4.	**Valves**(Check Rating, Gaskets, Flow Direction, Sheet No., Tag No., Spindle direction, CSO LO/LC, Damage, etc)	Nos		
	Gate Valves			
	Globe Valves			
	Check Valves			
	Control Valves Tag Nos.:			
	Safety Valves Tag Nos.:			
	Any other valves :			
5.	**Strainers** : Check for clearance, flow direction, elements			

FORMAT NO: _____ **(Sht 1/4)**

(Sheet 6 of 11)

Checklist for Mechanical Clearance - IMPULSE Piping

	Item to check	Accept Contractor	Remarks
6.	**Flanged Joints**		
	Total Nos.		
	Check for type of flange		
	Check for Rating		
	Check for Alignment, (proper gap & parallelity		
	Check for Correct Studs & nuts – dia., length, Material, uniform protrusion of studs, anti seize compound		
	Check for correct gasket (type, size, spec., thickness, etc.)		
	Torque values used for tightening		
7.	Seal Welding of Screwed Connections (if Required)		
8.	Vents/Drains as per Dwg and Provision of additional high point Vents and/or low point Drains, if reqd.		
9.	**Orifice Flanges :**		
	Check for Tag No., tapping orientation, tap valve, jack screw, straight run length of upstream & downstream		
10.	**Local Gauges :** Check for accessibility		
11.	Supports as per drg. and specifications		

FORMAT NO: _____ (Sht 2/4)

(Sheet 7 of 11)

Checklist for Mechanical Clearance - IMPULSE Piping

	Item to check	Accept Contractor	Remarks
12.	**Vents/ Drains :**		
	- As per drg.		
	- Orientation of valve handles		
	- Clearance for hose		
	- Requirement of additional vents/ drains (highest/lowest pt.)		
13.	**Earthings :**		
	a) Check for location		
	b) Check for dimension of lug welding		
14.	**Joists History sheets enclosed for :**		
14.1	Material Traceability as per Procedure No:_____ (refer enclosed suggested Format)		
14.2	Fit ups checked		
14.3	NDT Complete (Radiography, MT, PT)		
14.4	Stress Relieving & Hardness check complete		
14.5	Positive Material Identification **(PMI)**		
	Checked for Removal/Blinding-off of:		
	a. Control, Safety and Check Valves		
	b. In-Line Instruments		
	c. Rupture Discs		
	d. Equipment Nozzles		
	e. Others		
15.	Supports and Weld/Flanged/Screwed connections free from		
	insulation or other coverage`		
16.	Checked Installation of (Indicate Location in Drawings)		
	a. Temporary Blinds/Spades		
	b. Temporary Strainers		
	c. Temporary Dummy-Spools		
	d. Temporary Gaskets		
	e. Others		

FORMAT NO: _____ (Sht 3/4)

(Sheet 8 of 11)

Checklist for Mechanical Clearance - IMPULSE Piping

	Item to check	Accept Contractor	Remarks
17.	Cleanliness Internally and Externally		
18.	Removal of unwanted construction supports		
19.	Instrument tapings provided as per Drawing		
20.	**Physical-Walk-Through – The – Line,** checked for gross irregularities including physical damages, unwanted tacks, arc strikes, spatters and space for thermal expansion.		
Other :			
Remarks			
Reviewed by Contractor (one level higher than checker)			
Name :	Designation :		
Date :			
EIL			
Sign :			
Date :			
Name :	Designation :		

FORMAT NO: _____ (Sht 4/4)

(Sheet 9 of 11)

ANNEX – 2

Piping Hydro Test Release Record – IMPULSE Piping

Project : _____	Report No : _____
Plan : _____	Date : _____
Contractor : _____	Area : _____
Loop No.: _____	REF P & ID No. : _____
	INCH MTR : _____
	From _____ To _____

	Line No. (s)		Isometric No. (s)	P&ID No. (s)	

Test Medium :		Test Duration :	Design/Test Pressure :
Test Pressure Gauge No.	Range	Calibration Certificate No.:	Gauge Calibration Date:

Items to check		Accept	Witness	
		Contractor	EIL	
	Field Installation Checklist Prior to Hydrotest Signed			
	Punch list Prepared	Yes ☐	No ☐	
	Pre – Hydrotest Punch items Cleared			
	Accessibility to Inspection/Witness Locations			
	Capacity of pressurizing pump checked			
	Cordon off area for high pressure testing, as required			
	Pre-hydrotest flushing carried out			
	Statutory Authorities/Others test Witnessing Required	Yes	No	
System Released for Pressure Testing :				

Contractor :	**EIL:**
Sign : Name :	Sign : Name :
Date :	Date :
Designation :	Designation:

FORMAT NO: _____ (Sht 1/2)

(Sheet 10 of 11)

Piping Hydro Test Record – IMPULSE Piping

ACTIVITY	Date	Time
Water Filling and Venting started at		
Water Filling Completed		
Vents Closed		
Isolation of Pressurizing pump		
Test completed at :		
- Water drained		
- Air		
- Temp Blinds Removed		
- Checked for reinstallation of f. Control & Safety vales g. On line Instruments h. Rupture disks i. Deblinding j. Others		
- Cold setting of spring supports carried out		
- **Test Result**	☐ Acceptable	☐ Not Acceptable

Contractor :	**EIL:**
Sign :	Sign:
Date :	Date:
Name : Designation	Name: Designation:

FORMAT NO: _____ (Sht 2/2)

(Sheet 11 of 11)

ANNEX - 3

PUNCHLIST

Project : _____	Report No : _____
Plan : _____	Date : _____
Contractor : _____	Area : _____
Loop No : _____	REF P & ID No. : _____

Description : _____

Ref Document : _____

_____

Punch Item No.	Prio-rity	Description of Punch Items	Location	Prepared By	Action By	Due date	Completion Acceptance

Priority: 1. Needed for pressure test 2. Needed for commissioning 3. Needed for start up 4.Needed for plant acceptance

Contractor :	**EIL** :
Sign :	Sign :
Date :	Date :
Name : Designation :	Name : Designation :

FORMAT NO: _____ **(Sht 1/1)**

ITP NO : 4431

INSPECTION & PANEL ERECTION-CONTROL ROOM

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Receipt of materials/ panels as per purchase requisition, inspection release note, bill of materials, etc	WC	Note 1
2.	Storage of materials at site	WC	S
3.	Shifting of panels into the control room without damage	WC	S
4.	Check for Hole to hole dimensions of the base frames with the as built drawings of the panels	WC	S
5.	Check alignment, fastening, welding & painting of the base frame.	WC	S
6.	Erection of panels as per approved layout drawing, after completion of all welding works	WC	S
7.	Tagging/identification of panels	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

Note: 1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO : 4432

FABRICATION & ERECTION OF CABLE TRAYS-CONTROL ROOM

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Availability of latest revision of approved tray layout drawings	WC	Rw
2.	Welding & painting of supports before erection of panels	WC	--
3.	Fastening and joining of cable trays	WC	--
4.	Removal of sharp edges	WC	--
5.	Covering of cable trays for unarmoured and system cable trays	WC	S
6.	Separate cable trays for power and signal cables with sufficient distance apart	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

ITP NO : 4433

LAYING, GLANDING & TERMINATION OF INTERCONNECTION CABLES, PREFABRICATED CABLES, SYSTEM CABLES, POWER CABLES AND FIELD CABLES –CONTROL ROOM

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Correct size & type of cables as per cable schedule	WC	Note 1
2.	Testing of cable before laying as per specification (continuity, megger, etc.), as applicable	WC	--
3.	Check for exact distance and cables cutting accordingly	WC	--
4.	Tag on cables as per specification	WC	--
5.	Availability of proper cable gland size, type of specified thread	WC	--
6.	Tightening of check nut (after termination)	WC	--
7.	Cable continuity & insulation resistance, as applicable	WC	Rw
8.	Dressing of cables inside PVC Duct and covering of PVC Duct after complete cabling.	WC	--
9.	Ferruling of cables	WC	--
10.	Usage of sleeved crimpable type lugs	WC	--
11.	Crimping of lugs	WC	--
12.	Tightness of cables in the terminal block	WC	--
13.	Numbering of terminal blocks	WC	--
14.	Continuity of fuses in terminal blocks	WC	--
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

Note :1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO : 4434

POWER 'ON' OF PANELS AND PRE-COMMISSIONING OF THE SYSTEM-CONTROL ROOM

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Check for earth pit resistance	WC	Rw
2.	Earth connection to system earth, panel earth etc	WC	S
3.	Ensure proper interconnectivity of panel earth bus	WC	S
4.	Incoming power supply and termination of the power cables	WC	S
5.	Power 'ON' the system and observe system booting and self diagnostic check.	WC	W
6.	Reload the softwares, if necessary	WC	S
7.	Check for alarms by switching 'ON'/'OFF' the sub systems	WC	S
8.	Start simulation of individual loops from respective 'Field Terminal Blocks' (FTBs)	WC	S
9.	Observe the response and tune the controllers	WC	S
10.	Interlocks as per P&ID	WC	S
11.	Record the input & outputs	WC	Rw
12.	Trend reports, logging reports/shift reports & alarm, sequence and functioning of all peripheral units.	WC	Rw
13.	Back-up operation of PLC cards, system memory & power supply switch over	WC	W
14.	Lighting and ventilation fan operation	WC	S
15.	Functioning of complicated loop	WC	W
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

ITP NO : 4435

FOR FIELD LOOP CHECKING AND 'SYSTEM ACCEPTANCE TEST'- CONTROL ROOM

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Coordination with field contractor for loop checking.	WC	S
2.	Availability of record as per loop checking sheet duly signed	WC	W
3.	Operation of sub systems and peripheral systems	WC	S
4.	'Back-up' system operations	WC	W
5.	Ensure feedback/commands from/to electrical system	WC	S
6.	System acceptance	WC	HP
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

ITP NO. : 4501

FOR INSTALLATION/ ERECTION & TESTING OF TRANSFORMER

(sheet 1 of 3)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
1.	Incoming Material inspection at site	WC	Note-1	Note-1	Note-1
2.	Check foundation, its cleanliness, level and centre lines, Anchor bolts/insert plates, their position & straightness, flatness of contacting surface for transformer skid. In case of Rail mounted type, check centre line and levels of rails.	WC	S	S	S
3.	Check the Transformer no. and rating as per drawings and purged gas/ air pressure & oil leakage, physical damage etc.	WC	S	--	--
4.	Check availability of all accessories and Transformer oil	WC	S	--	--
5.	Check sequence of installation e.g. main tank first + radiators + accessories + internal check as per installation flow chart.	WC	S	--	--
6.	Ensure the cleanliness of connecting part e.g. flange parts and maintenance of duly tight blank flanges until commencement of assembly	WC	S	--	--
7.	Check bushing cracks, chips or presence of paint or dirt. Bushing should be cleaned as per vendor's instruction. Check explosion vent assembly & healthiness of diaphragm	WC	S	--	--
8.	Ensure the internal check by vendors' Engineer/supervisor and submission of report to Owner/ EIL duly signed by him and by the contractor	WC	Rw	--	--
9.	After completing assembly of all parts, filling of tank and OLTC with transformer oil, operation of OLTC (prior to filling the Transformer oil, each drum must be tested against di-electric strength for minimum as per specifications)	WC	S	--	--

ITP NO. : 4501

FOR INSTALLATION/ ERECTION & TESTING OF TRANSFORMER (contd.)

(sheet 2 of 3)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
10.	Check & ensure bus duct connection at both ends including torque checking of bolt.	WC	S	S	S
11.	Ensure cable connection at the cable & box, their colour coding & tightness. Use of spring and flat washers on the appropriate faces to be confirmed) and cleanliness of lapping surfaces. For multiple cable connection, check for correctness of RR, YY, BB grouping	WC	S	--	--
12.	If specified, fill the cable end box with tested transformer oil and ensure oil levels	WC	S	--	--
13.	Check the use of proper size conductors/ cables for HV/LV, neutral connection and their connection to NGR or earth grid/ earth point	WC	S	--	--
14.	Check equipment earthing, connections, tightness and earth resistance value on each earth pit	WC	S	--	--
15.	Ensure earthing of tertiary winding if applicable	WC	S	--	--
16.	Check leakage and oil level	WC	S	--	--
17.	Check oil filtration before energisation on & check BDV of oil(as applicable)	WC	S	--	--
18.	Check proper installation of Dessicants (reactivate the silica gel to blue; oil traps to be filled up)	WC	S	--	--
19.	Measure winding resistance at each tap	WC	S	--	--
20.	a) Test insulation resistance & PI	WC	S	--	--
	b) Ensure heat run/ dehydration of transformer	WC	W	S	--
	c) Check final IR value after dehydration and temp. Vs IR curve to ensure drying	WC	S	S	--
21.	Test vector group polarity, magnetizing current, magnetic balancing	WC	W		--

ITP NO. : 4501

FOR INSTALLATION/ ERECTION & TESTING OF TRANSFORMER

(sheet 3 of 3)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
22.	Test transformation ratio at each tap points (injecting 3 phase, 415 V at primary)	WC	W	S	--
23.	Ensure laying, termination & connection of all control &Signal cables as per cable schedule	WC	S	--	--
24.	Check Bucholtz's relay operation by air injection for both transformer & OLTC, MOG for alarm and trip contacts' function	WC	W	S	--
25.	Check setting of Fan control (auto & manual), OTI, WTI - alarm and trip	WC	S	S	--
26.	Check tap changer control/ operation- both auto & manual – without energizing the transformer. Ensure master/ followers' correct functioning	WC	S	--	--
27.	Final residual check to confirm removal of all temporary supports/ spacers, tags, accumulation of air in Buchhelz relay, oil, if any, etc., which might have been used as protection/ and identification during transportation and erection	WC	S	--	--
28.	Check operation of cooling system	WC	S	--	--
29.	Stability check,(Restricted (64R)/standby Earthfault(51G)/Transformer differential(87T),(as applicable)	WC	W	--	--
30.	Check CT Ratio & Polarity	WC	W	S	--
31.	Check Transformer protection relay settings as per Relay Setting chart	WC	W	S	--
32.	Mechanical Acceptance Test/Energisation protocol of transformer	WC	HP	HP	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: Power & Distribution Transformers,

CAT B: Lighting transformers

CAT C : Miscellaneous transformers like isolation transformers, etc.

ITP NO. : 4505

FOR INSTALLATION/ ERECTION & TESTING OF MOTOR

(sheet 1 of 2)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
1.	Incoming material inspection	WC	Note-1	Note-1	Note-1
2.	Check for foundation, it's level & centre line markings, ensure the depth of anchor grouting pockets and straightness of anchor bolts. Foundation should be thoroughly cleaned before placement of motor	WC	Rw	Rw	Rw
3.	Check motor name plate, identify the equipment referring to vendor's shop floor test certificate and construction drawing	WC	S	S	--
4.	Check type of motor as per area classification drgs duly approved by the Competent Authority	WC	S	S	S
5.	Check for installation of motor, its leveling, alignment and coupling with driven equipment (before coupling magnetic centering must be ensured)	WC	Rw	Rw	Rw
6.	Ensure fixing of all accessories, temperature indicators, cooling system, lubricating pumps, etc.	WC	S	--	--
7.	Ensure pedestal insulation	WC	S		--
8.	Check lubrication of bearings, their suitability and level. For lubricants, vendor instructions and specifications to be followed	WC	W	S	--
9.	Ensure sealing of all exposed outlets during erection/ assembly	WC	S	--	--
10.	Ensure air-gap as per vendor instruction (for big machines assembled at site)	WC	S	--	--
11.	Ensure all spacers and blockings used for transportation and erection have been removed	WC	S	--	Rw
12.	Check proper earthing of the motor and earth connection	WC	S	S	S

ITP NO. : 4505

FOR INSTALLATION/ ERECTION & TESTING OF MOTOR

(sheet 2 of 2)

SL. NO.	ACTIVITY	CONTRACTOR	EIL		
			CAT A	CAT B	CAT C
12	a. Check IR and PI for the motor and IR for auxiliary circuits like heaters and Thermal detectors, excitor (for synchronous motor), etc.	WC	W	S	--
	b. In case of low IR/ PI, Improve IR value as per spec/ suitable method as per vendors' recommendation.	WC	W	S	--
13.	Measure winding Resistance (if specified in spec)	WC	S	S	--
14.	Inspect space heater and control cable connections. Ensure the tightness of connection, proper glanding & earthing of armour, correct phase sequence of supply cable as per mark and closing the covers of terminal boxes.	WC	S	--	--
15.	Check for de-coupling of motor for no-load run and ensure re-coupling of the motor after verification of original alignment.	WC	W	S	--
16.	Set the temperature indicators (alarm/ trip) and vibration monitors (if any)	WC	S	--	--
17.	Check motor protection relay settings as per Relay Setting diagram	WC	W	W	--
18.	Check provision of CTs in power/ neutrals as per requirement of specifications. Visually check name plates of CT's and ensure their ratio, accuracy class and proper grounding as per approved drawings. Test their polarity ratio and stability. Do the cable termination at CT terminal boxes.	WC	W	W	Rw
19.	Check operation of synchronizing panel for synchronous motor.	WC	S	--	--
20	Perform no load run of motor - record vibration, Temp rise, current, speed, Starting current/No load current etc.	WC	W	W	--
21.	Mechanical Acceptance Test/Energisation Protocol	WC	HP	HP	Rw
	INSPECTION & TEST DOCUMENTS				
	Review Test and Inspection Documents	WC	Rw	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: HV& MV motors above 110 KW, all MV motors in hazardous area

CAT B: MV motors up to 110 KW in non hazardous area

CATC : Others .

ITP NO. : 4515

FOR INSTALLATION/ ERECTION & TESTING OF SWITCH GEARS/ PCC/ MCC/ EMCC/VFD's/ASB/LIGHTING PANELS

(Sheet 1 of 2)

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT A	CAT B
1.	Incoming material Inspection	WC	Note-1	Note-1
2.	Check the layout of base channels/frames and ensure the correct provisions for grouting/welding and cable entry openings.	WC	S	-
3.	Ensure level and centre lines are within the prescribed limits and they match with the requirements of incoming Bus-ducts, if any	WC	S	-
4.	Ensure proper grouting/welding of the base channels/frames	WC	S	-
5.	Ensure proper handling of panels	WC	S	-
6.	Check sequence wise (starting from centre or Bus-duct panel) installation, final leveling and bolting up	WC	S	-
7.	Check main bus bar connection at all shipping sections and shrouding at all tap-off points	WC	S	-
8.	Check inter panel wiring after fixing of loose accessories and wiring	WC	S	-
9.	Ensure the level of flooring for smooth opening of panel doors and drawing out & in operation of Breaker Trolleys	WC	S	-
10.	Check interchangeabilities of circuit breakers, MCC Feeder Modules	WC	S	-
11.	Check equipment earthing & continuity of earth bus	WC	S	S
12.	Ensure thorough cleaning, removal of temporary spacers, supports, any foreign materials and dusting the panels	WC	S	-
13.	Verify the correctness, in accordance with the drawings, of all type of relays, test blocks, control switches, meters & instruments, motor starters, fuses, space heaters, etc.	WC	Rw	Rw
14.	Check name plate for each breaker, inspect & test the operating mechanics (Mechanically), interlocks, contacts, arc chutes, auxiliary devices and adjustments as required	WC	W	S
15.	Visually check all relays and meters for removal of shipping blocks and for mechanical damage. Ensure their range against approved drawings, inspect calibration, testing and setting for each relay and meter.	WC	S	S
16.	Visually check name plates of CT's and Potential Transformers and ensure their ratio, accuracy class and proper grounding against approved drawings. Test their polarity, knee point voltage, R_{CT} and ratio. Primary injection tests at three points on the characteristics curve as per manufacturer recommendation.	WC	W	S

ITP NO. : 4515

FOR INSTALLATION/ ERECTION & TESTING OF SWITCH GEARS/ PCC/ MCC/ EMCC/VFD's/ASB/LIGHTING PANELS

(Sheet 2of 2)

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT A	CAT B
17.	Test and witness IR value of the power and control bus	WC	W	W
18.	Test and witness high pot tests, as specified	WC	HP	HP
19.	Ensure tightness of connection of control wiring	WC	S	-
20.	Check phasing & phase sequence between bus section and incomer.	WC	W	S
21.	Inspect secondary injection test and ensure tripping of C.B. through protection relays	WC	W	S
22.	Inspect primary injection & check the breaker tripping through protective relays, check ammeter, voltmeter, power factor indications etc. for proper functioning	WC	W	S
23.	Switch on AC & DC control supply. Check the sequence of operation of breakers electrically, local and remote interlock; ensure proper alarm and announciation and indications in SW/GR/MCC/Control Panel. Auto/Independent/manual mode of operation of incomer & bus coupler shall be checked as per schematics. Under voltage tripping of breakers shall be verified.	WC	W	W
24.	Measure contact resistance and ensure simultaneous closing & making of breaker contacts.	WC	W	S
25.	Check for relay parameters and settings	WC	W	S
26.	Differential stability (as applicable) shall be verified.	WC	S	-
27.	Checking of Man machine communication and verification of graphics	WC	S	S
28.	Mechanical Acceptance Test/Energisation protocol	WC	HP	HP
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010
CAT A: HT Switch Gears / PCC Control Panels/VFD's
CAT B: MCC / EMCC/ASB/lighting panels.

ITP NO. : 4520

FOR INSTALLATION/ ERECTION & TESTING OF EHT/ HT MAIN BUS AND ALLIED EQUIPMENTS

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1.	Incoming Material Inspections	WC	Note-1
2.	Check the insulators wall bushing for any damage like chips or cracks. Ensure proper installation of the insulators & bushing	WC	S
3.	Check the clearance between conductor to ground & conductor to floor level. Ensure minimum clearance between two conductor Bus	WC	S
4.	Check the anchoring of the conductor bus and terminal/Tap Off connections	WC	S
5.	Ensure correctness of phase sequence	WC	W
6.	Check earth connections and measure earth resistance of the supporting structures of insulators	WC	S
7.	Check IR value of the conductor bus phase to phase and each phase to earth.	WC	W
8.	Check operation of isolators, CB, earth switch and interlocks, check ratio & polarity of CTs, Potential Transformers	WC	S
9.	Check high voltage tests keeping all the CB's and isolators closed but Potential Transformers should be disconnected	WC	W
10.	Check hot line insulator washing equipment and system-Nozzle position & resistivity of water	WC	S
11.	Check type & class of lighting arrestor, its earth connection and earth resistance	WC	S
12.	Mechanical Acceptance Test/Energisation protocol	WC	HP
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO. : 4525

FOR CABLE LAYING

(sheet 1 of 2)

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
1.	Incoming material Inspection	WC	Note-1	Note-1
2.	Survey the cable route as per AFC drawings, identify any possible obstruction like road/pipe rack crossing, heat sources etc. and finalize the cable route	WC	S	S
3.	Complete all road/pipe crossings etc. as per drawing/requirement	WC	S	S
4.	Prepare cable drum schedule to avoid wastage and minimize cable joints	WC	Rw	Rw
5.	Ensure entire route is available for cable trench	WC	S	S
6.	Ensure availability of cables of required size and length	WC	S	S
7.	Verify the dimensions of buried trench as per AFC drawings (in case of buried cables)	WC	S	S
8.	Ensure readiness of cable trays and installation of GI pipes (for cable protection) wherever required	WC	S	S
9.	Ensure the initial bed of sand is provided as per standard and of required thickness	WC	S	S
10.	Lay cables as per the cable schedule, minimizing criss-crossing of cables within the trench (1st layer). Check IR Values in drum before laying.	WC	S	S
11.	Provide cable tags at specified locations	WC	Rw	Rw
12.	Record IR value of cables of each layer after sand filling	WC	Rw	S
13.	Provide second layer of sand, and ensure proper clearance between HT/LT cables (wherever applicable)	WC	S	--
14.	Complete layer wise laying of cables and sand filling	WC	S	--
15.	Record IR value of cables of each layer after sand filling	WC	S	--
16.	Provide final layer of sand	WC	S	--
17.	Ensure cable trenches in hazardous areas are filled with sand	WC	S	--

ITP NO. : 4525

FOR CABLE LAYING

(sheet 2 of 2)

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT B	CAT C
18.	Provide bricks/slabs for cable protection in buried trenches	WC	S	--
19.	Back fill the trenches with earth and compact properly after ensuring the completion of earthing works, if any as per earthing layout drawings.	WC	S	--
20.	Install cover slabs and seal the trenches in plant/offsite areas after ensuring the completion of earthing works, if any.	WC	S	--
21.	Remove surplus earth generated as per provisions in the contract.	WC	S	--
22.	Hi pot test of cables as required.(as applicable)	WC	W	W
23.	Provide cable markers as per the specifications at identified locations	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT B: All HT/HV cable works.
CAT C: All LT/MV cable works and control cable laying works

ITP NO. : 4530

FOR LIGHTING SYSTEM

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT A	CAT B
1	Incoming material inspection	WC	Note-1	Note-1
2	Check lighting fittings for damage/ lack of accompanying documents for specialized items like lighting fixtures, control gear box, glands, flameproof/ non-flameproof equipment/ fittings, lighting poles/ accessories, lighting mast, fans, receptacles; certificates from recognized authorities for Class IIA, IIB, IIC explosion proof/ flameproof fixtures/ plugs/ sockets.	WC	HP	HP
3	Ensure lighting fixtures during installation do not interfere with any other plant equipment. In case of fouling, suggest a change of location & take approval of Owner/ EIL before proceeding	WC	W	S
4	Mounting of receptacles/mast/poles as per drawings & standards.	WC	S	S
5	On walkways, platforms & outdoor areas, lighting fixtures are located nearer to landing of stairs/ ladders, gauges, flow meters etc.	WC	-	
6	Provision of plugs for spare entry/ sockets (especially in hazardous areas). Erection of lighting poles/ fixtures manually on concrete foundations as per drawings.	WC	S	S
7	Check earth continuity for individual sockets/ outlets as well as for the complete lighting system	WC	S	Rw
8	Ensure lighting circuit are marked as per AS Built drawing.	WC	S	S
9	Ensure luminaries for emergency purpose carry identification marks.	WC	S	S
10	Illumination level checking after completion of all indoor & outdoor lighting activities.	WC	W	S
11	Load balancing of LDB	WC	S	S
12	Welding/ bolting of poles to base/ foundation. Check for verticality of poles, alignment adjustments as required	WC	S	S
13	Ensure cable termination, earth continuity , etc. and sealing of spare entries of JBs	WC	S	S
14	Ensure touch-up painting or galvoseal application done at affected areas to arrest corrosion.	WC	S	S
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: All lighting works in Hazardous area, escape routes

CAT B: All lighting works in Non hazardous areas and general office areas.

ITP NO : 4535

FOR EARTHING SYSTEM

(sheet 1 of 2)

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT A	CAT B
1	Incoming material Inspection	WC	Note1	Note1
2	Ensure materials to be used for earthing are in accordance with the contract specifications and inspected & cleared by Owner/ EIL before putting in use	WC	W	S
3	Ensure the earthing layouts are surveyed & confirmed before commencement of excavation to avoid re-works/ interference/ fouling with other underground installations.	WC	S	--
4	Ensure the electrodes have a clean surface, free from non-conducting materials like paint, grease etc.	WC	S	--
5	Check the earth pit is backfilled by using alternate layers of charcoal & common salt and individually numbered for identification.	WC	S	--
6	Measure earth resistance of each earth pit/electrode installed.	WC	S	S
7	Check top level of the earth pit is matched with the finished grade level.	WC	S	S
8	Ensure earthing grids are installed as per the pre-determined layout & earthing conductors are at a depth specified in the specifications from the grade level.	WC	S	S
9	Ensure weld joints are made by overlapping the strip equivalent to double the width of the strip and three sides continuously weld.	WC	S	S
10	Check all joints of the conductors below the grade level are welded & suitably protected by application of two coats of bitumen & wrapping with the Jute. Earthing strips laid above ground are welded and protected by applying two coats of bitumen.	WC	S	--
11	Ensure the joints are inspected before the coat application & backfilling.	WC	S	S
12	Ensure all the risers are protected against mechanical damage & are clamped to the walls, columns, etc.	WC	S	S

ITP NO : 4535

FOR EARTHING SYSTEM

(sheet 2 of 2)

SL. NO.	ACTIVITY	CONTRACTOR	EIL	
			CAT A	CAT B
13	Ensure all the risers are protected against mechanical damage & are clamped to the walls, columns, etc.	WC	S	S
14	Ensure all the MV & HV electrical equipments are doubly earthed by connecting two points on the equipment to the earth grid. Rest of the structural, mechanical, piping is connected to the earth grid as per the contract specifications & drawings.	WC	S	--
15	Ensure all process pipelines are bonded & earthed at entry & exit points of battery limit of hazardous area.	WC	S	--
16	Ensure lightening protection grid is connected to the individual electrode and bonded to the main earth grid at two or more points as per the drawings.	WC	S	S
17	Ensure each lighting fixture & receptacle is earthed through extra core provided in the lighting cable (normally, the third core of a 3 core cable)	WC	S/Rw	Rw
18.	Removal of surplus earth generated as per provisions of the contract.	WC	S	Rw
	INSPECTION & TEST DOCUMENTS			
	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

CAT A: All earthing in hazardous areas/communication/control systems.
CAT B: Earthing in non hazardous area.

ITP NO. : 4540

FOR INSTALLATION OF BUS DUCT

SL. NO.	ACTIVITY	CONTRACTOR	EIL
1	Incoming Material inspection at site	WC	Note 1
2	Ensure that the switch board terminal box & the transformer terminal boxes are inspected & cleared before proceeding to the bus duct installation.	WC	S
3	Check the equipment no. and rating as per drawings, no physical damage, etc.	WC	S
4	Check availability of all accessories	WC	S
5	Inspect the bus duct insulators for any physical damage occurred during the transit.	WC	S
6	Check bushing cracks, chips or presence of paint or dirt. Bushing cleaned as per vendor's instruction.		S
7	Ensure various sections of the bus duct enclosures are coupled together by using proper gaskets & bellows as specified.	WC	S
8	Ensure the bus bars are properly fixed & coupled on the insulator and correct phases are connected at both ends.	WC	S
9	Ensure bus bar bolts are tightened to the required torque values) using calibrated torque wrench.	WC	S
10	Ensure bus bar joints are insulated using manufacturers recommended materials, wherever required.	WC	--
11	Prior to closing of the bus duct cover, ensure that the bus duct enclosures are cleared of tools/ loose materials and debris.	WC	W
12	Ensure enclosure of bus duct & support structures earthed (to the earthing grid) as per drawing.	WC	S
13	Check touch up painting wherever required on completion of installation.		S
14.	Ensure wall sealing is done & sun shields provided as per drawings.	WC	S
15.	Ensure bus bar joints are cleaned/ polished & not oxidised before bolt-up connection.	WC	W
16.	Ensure provisions of breathers/silica gel	WC	S
17	Ensure provision of heaters and recording of its IR value	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For Incoming material Inspection please refer ITP no: 6-82-1010

ITP NO. : 4545

FOR CABLE TERMINATION

SL. NO	ACTIVITY	CONTRACTOR	EIL
1	Ensure proper tagging of the cable at both ends.	WC	S
2	Ensure cables are laid separately for HT & LT system as per spec.	WC	S
3	Ensure cables are properly dressed, clamped & glanded using suitable sizes/ class of cable glands.	WC	S
4	Ensure sufficient cable length is kept on both ends for future re-termination, if need arises.	WC	S
5	Ensure proper bending radius while laying to avoid twisting.	WC	--
6	Ensure cable segregation, spacing & depths maintained as per specifications	WC	S
7	Ensure usage of correct sizes of lugs for termination	WC	S
8	Ensure all cores are firmly terminated to terminals provided in individual feeders.	WC	S
9	Ensure proper earthing of armour.	WC	S
10	Ensure continuity & IR value checks are done on the cable from panels to equipments.	WC	W
11	Ensure unused entries are plugged tightly in panels, motor terminal boxes, JB's, etc	WC	S
12	Ensure on completion of cable termination, the cable trenches are backfilled & trench covers put back in position.	WC	S
13	Ensure all cable openings & conduit entries are properly sealed.	WC	S
	INSPECTION & TEST DOCUMENTS		
	Review Test and Inspection Documents	WC	Rw

ATTACHMENT – II

ठेकेदार द्वारा सप्लाई की गई सामग्रियों के लिए निरीक्षण एवं परीक्षण योजना (आईटीपी) अथवा आवक सामग्री की जांच

INSPECTION & TEST PLAN (ITP) FOR INCOMING MATERIAL CHECKING FOR CONTRACTOR'S SUPPLIED MATERIALS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
3	29.08.2023	REVISED AND REISSUED	DJ	DG	RKS	SM
2	27.07.2018	REVISED AND REISSUED	SKG	AP	AKK	RKT
1	14.10.2015	REVISED AND REISSUED	DJ	MKG	TKS	SC
0	04.07.2011	ISSUED FOR IMPLEMENTATION	SM	SM	MKG	

Abbreviations:

ATT	:	Anti Termite Treatment
CGI	:	Corrugated Galvanized Iron
CS	:	Carbon Steel
EOT	:	Electric Operated Traction
FLM	:	Flood Light Mast
HOT	:	Heat Operated Traction
HT	:	High Tension
HV	:	High voltage
IMIR	:	Incoming Material Inspection Report.
IRN	:	Inspection Release Note
ITP	:	Inspection Test Plan
KW	:	Kilo Watt
LR	:	Lorry Receipt
LT	:	Low Tension
LV	:	Low Voltage
LEL	:	Low Explosive Limit
MOC	:	Material of Construction
MTC	:	Manufacture Test Certificate
NACE	:	National Association of Corrosion Engineers
PLC	:	Programmable Logic Control
PRDS	:	Pressure Reducing and De-superheating Stations
QAP	:	Quality Assurance Plan
RCC	:	Reinforced Cement Concrete
SS	:	Stainless Steel
SOR	:	Schedule Of Rates
TC	:	Test Certificate
TPIA	:	Third Party Inspection Agency

Construction Standards Committee

Convenor: Sh. Rupesh Kumar Singh , ED (Construction)

Members: Sh. Janak Kishore, ED (Projects),
Sh. Chinmoy Kapuria, CGM (SCM),
Sh. Udayan Chakravarty, Sr. GM (Piping),
Sh. Debasish Ghosal, GM (Construction),
Sh. Pankaj Kumar Rai, DGM (Construction),

CONTENTS

GENERAL NOTE

The enclosed ITPs shall be followed for the works to be performed by the contractor. The provisions indicated for stage wise inspection by EIL/Owner (For specific activities), may be modified in line with EIL scope of services as per the contract between EIL and Owner. Activities for which ITP's are not provided in this specification, contractor to develop and get the same approved by EIL/Owner before start of the work. In general, role of EIL has been specified in the document. The role of owner to be specified during preparation of site specific ITPs.

Contractor to submit job procedures for the jobs for which ITP's are attached & job specific reporting formats with the aid of enclosed sample reporting formats to EIL/Owner for approval, before commencement of the activity. If the contractor has to deviate from the given ITP for a valid reason, he shall obtain prior written approval of EIL/Owner. Contractor to carry out 100% examination of all activities.

LEGEND

HP **: Hold Point**

A point which requires inspection/verification and acceptance by Owner/EIL before any further processing is permitted.
The Contractor shall not process the activity/item beyond a Hold Point without written approval by Owner/EIL except where prior written permission for further processing is available.

W **: Witness Point**

An activity which requires witnessing by Owner/EIL when the activity is performed.
After proper notification has been provided (notification modalities and period shall be finalized before hand), the Contractor is not obliged to hold further processing if Owner/EIL is not available to witness the activity or does not provide comments before the date notified. In such cases basis of acceptance shall be review of Contractor generated report/document as per relevant technical specification.

Rw **: Review** of Contractor's documentation.

S **: Surveillance** Inspection by Owner/ EIL.

Monitoring or making observations to verify whether or not material/items or services conform to specified requirements. Surveillance activities may include audit, inspections, witness of testing, review of quality documentation & records.

WC **: 100%** Supervision and Examination by Contractor.

Responsibility for execution of the inspection/testing is with the Contractor; Owner/EIL only verifies examination or testing done by the Contractor at important stages.

SL NO	ACTIVITY	CONTRACTOR	EIL/OWNER($)			Records to be submitted/ Format No:
			CAT 1	CAT2	CAT 3	
A	**Document Checking**					
1	Check whether vendor/source is approved.	WC	HP	Rw	Rw	G-01
2	Availability of QAP/ITP duly approved by TPIA.	WC	Rw	Rw	Rw	G-01
3	Availability of MTC / IRN (Availability of stage wise Inspection Reports/certificates in case of inspection by TPIA, Inspection reports of Contractor).	WC	Rw	Rw	Rw	G-01
4	Availability of certificates from statutory bodies, if applicable	WC	Rw	Rw	Rw	
5	Delivery challan /LR/ E-way Bill/ Tax Invoice	WC	Rw	Rw	-	G-01
6	For Foreign Items: Bill of landing, Country of origin, Packing List, phytosanitary certificate, bill of entry, customs invoice (as applicable)	WC	Rw	Rw	-	
B	**Physical Verification**					
1	Checking for Inspection stamp/Identification mark	WC	W*	S	S	G-01
2	Correlation of MTC w.r.t. Heat nos/ Batch no /lot no.	WC	HP	Rw*	Rw*	G-01
3	Physical assessment of Quantity.	WC	S	S	-	G-01
4	Certification of condition of material.	WC	S	S	S	G-01
C	Sampling for Field tests / tests from approved laboratories, if applicable.	WC	W	W	W	G-01
D	Review of Field Test reports/Test reports if applicable.	WC	Rw	Rw	Rw	G-01
E	Review MTC/IRN/TC etc.	WC	Rw	Rw	Rw	G-01
F	Endorsement on IMIR	WC	HP	HP	Rw	G-01

NOTE:

- **($)**A generic categorization plan could be firmed based on following guideline and as per Table A:-
- **(*)**Sampling plan for checking of bulk items shall be as per discretion of EIL
- General :

1) EIL/OWNER and contractor shall jointly finalize the list of incoming materials and categorize in line with inspection categorization plan for bought out items. The items not covered in Table A shall be finalized by Engineer In charge /Owner.
2) In general Sl no of the ITP: A (1, 3, 4 & 5) B, E and F shall be applicable to both (#) and (@) i.e. Items with and without TPI/EIL inspection
3) In general Sl no of the ITP: A (2), shall be applicable to (@) ie. Items with TPI/EIL inspection
4) In general Sl no. of ITP: C and D shall be applicable to (#) ie. Items without TPI/EIL inspection.

5) All items to be procured from approved vendors / source as per list enclosed in the contract / approved vendor list. Prior approval for the source / vendor to be taken for items not listed in the contract / approved vendor list.

6) Anodisation / galvanization shall be ensured in shops having proven track record and samples are to be tested to check galvanizing / anodizing prior to dispatch to sites.

CAT 1 CRITICAL: The materials requiring long time impact to meet the stipulation of end user. Completely engineered and inspected as per the contract.

CAT 2 MAJOR: The materials requiring lesser time impact on end user. Specified to Industry standards, lower design category (not fully reviewed of detailed Engg but all interfaces checked) and with complete compliance with code, however requiring limited inspection.

CAT 3 MINOR: Standard items, fit for the purpose with minimal Engg review.

TABLE: A

SL NO	CAT 1 (CRITICAL)	CAT 2 (MAJOR)	CAT 3 (MINOR)
		Items without TPI/EIL inspection (#)	
1	Refractory materials	• Cement • Reinforcement • Structural steel • Brick and tile brick • Asphalt(bitumen) • Paint • Sanitary wares • sanitary fittings(pipes & fittings) • Chemicals for ATT • Acid resistant tiles and mortar • Marble/ Granite/ Ceramic Tiles • Chemical hardener for flooring • Grouting compound • Wood for doors and windows • Ventilator • Flush door • Paneled door • Roof treatment materials • False ceiling & flooring materials • RCC Hume pipes • Anchor fasteners • Foundation bolts • Waterproofing Materials • Underdeck insulation materials • Water stopper/ HDPE/ LDPE Sheet • Vermiculite based cementious fireproofing materials	• AC sheets/CGI sheets • Particle board • Glazing glass • All galvanized • anodized items like GI pipes • door/window frames • Pre-coated sheets • Steel doors • Rolling shutters • Cable ducts/trays • lightning arrestors • street light poles • Earthing items • Conduits/wire/Metsec Channels • Safe area Lightning fixtures • SS Handrails • UPVC/CPVC Pipe • HDPE Pipes • PPR Pipes

SL NO	CAT 1 (CRITICAL)	CAT 2 (MAJOR)	CAT 3 (MINOR)
		Items with TPI/EIL inspection (@)	
1	• All process Compressor, pumps (with drive above 110 KW). • Diesel Generators Vessels (thickness more than 50 mm) and all Vessels with MOC NACE, alloy steel, clad steels, Inconel. • All Columns, Reactors, Heat Exchangers,	• All types of pumps, compressors excluding category 1 • Fans, blowers, Conveyors and material handling equipment's.Vessels (thickness less than 50 mm) and other vessels excluding category 1 • Trays and tower Internals • Burners for fired heaters • EOT/HOT crane • De super heaters & PRDS Air pre heaters, Damper, Soot blowers • Expansion joint ,Gas and Liquid Filters • Pipes /Piping material (flanges, fittings etc. AS, SS, clad steel, Inconel, NACE) • All types of valves All Fire Fighting equipment's, including Deluge valves LRM, Sprinklers. • FLM with fittings • HT/LT switch gear, Bus ducts • Fire alarm system • HV / LV Motors • DC System including consoles • PLC ,Batteries & battery Chargers, Capacitor banks • Plant communication system, UPS & Transformer • Variable speed drives • Tank level indicator/Instruments • All Control valves, pressure relief valves, breather valves • Meter-flow-annubar, Solenoid valve, Annunciators with panels, Self-actuating pressure control valves. • Temperature sensing Element RTD's • Thermowell and thermocouple • Mass flow meters , Pressure switches, Flow switches , Level switches (explosion Proof) • Flow sensing Element Orifice Plate & Flanges, Pitot Tube Analyzers - LEL Detectors, Level Instruments • Transmitters • Flame arrestors • Panel Control and accessories • All HV/HT and LV/LT cables and control cables. All types of flameproof fittings & fixtures.	• Hoists • Pipes & Piping materials (carbon steel & other) excluding category2 • Gauges Glass • Pressure gauges, Temperature Gauges, Draft Gauges. • Tape coat materials • Gratings • Insulation materials All fasteners, gaskets. • Hand railings

Note: For any material not covered above, the inspection requirement shall be decided by EIC based on the criticality.

Format No: **G: 0 1 REV 0**

INCOMING MATERIAL INSPECTION REPORT

Report No. :
Date :

Project :
Contractor :
Work order No. :
:

Unit :
Consultant :
P.O. No. & Date :

Name of Work :
Job No. :
LR No. :

Sl. No.	SOR Item No.	Material description/Tag no	Date of Receipt	Qty. Received	Qty. Accepted	Manufacturer/ Vendor	MTC No./ IRN No. with Date/ Field, Lab test, etc.	Heat/ Batch No.	Ref. Invoice, Challan No., E-Way Bill (as applicable)	Observation/Remarks/ Storage Instruction

Notes :

INSPECTION ACTIVITY AT SITE (Tick as applicable)

1. Quantity verified and found in order ☐
2. Material condition appears to be good ☐
3. Heat/Batch/Tag No. mentioned on the material ☐
4. Color coding done as applicable ☐
5. Site identification mark on material ☐
6. Correlation w.r.t. IRN/MTC/Lab Tests report ☐
7. TC verification w.r.t. IRN/Spec/QAP, etc. ☐
8. Check for Vendor/Source approval ☐
9. Special Requirement if any. ☐

Based on above, materials are accepted.

Contractor Field Engineer
Name:

Contractor RCM/Site In charge
Name:

EIL Field Engineer
Name:

EIL Lead Engineer/Area coordinator/Spread In charge
Name:

ATTACHMENT – III

निर्माण स्थलों पर सकारात्मक सामग्री पहचान के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR POSITIVE MATERIAL IDENTIFICATION AT CONSTRUCTION SITES

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	10/08/2023	Revised and updated	DK	DG	RKS	SM
4	23/07/2018	Revised and updated	SKG	AP	AKK	RKT
3	12/10/2015	Revised and updated	DJ	SNB	TKS	SC
2	14/11/2011	Revised and updated	SM	SM	MKG	DM
1	02/01/2007	Revised and updated	AS	MPJ	VNP	VC
0	22/07/2002	Issued as Standard Specification	MPJ	MPJ	RSG	GRR

Abbreviations:

API	:	American Petroleum Institute
ASM	:	American Society for Metals
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society for Testing and Materials
AS	:	Alloy Steel
CS	:	Carbon Steel
EIL	:	Engineers India Limited
ITP	:	Inspection Test Plan
PMI	:	Positive Material Identification
RTJ	:	Ring Type Joint
SS	:	Stainless Steel
TPI/ TPIA	:	Third Party Inspection/Third Party Inspection Agency

CONTENTS

1.0 SCOPE

1.1 This specification applies to metallic alloy materials as well as carbon steel materials as defined in this document used in piping, heater coils, storage tanks, vessels etc. at construction sites. Positive Material Identification (PMI) is to be carried out on Owner supplied material as well on materials purchased by the contractor after installation (before testing). PMI may be carried out at the ware house also for identification / segregation of materials as per instruction of Engineer in Charge

1.2 Any deviation from this specification must be approved by Owner/ EIL in the prescribed format.

2.0 DEFINITIONS

2.1 Positive Material Identification (PMI)

The term Positive Material Identification (PMI) refers primarily for determination/ verification of alloy type or its composition using portable or mobile spectrometer/ alloy analyzer. For the purpose of this specification, some carbon steel materials as defined in clause no 3.1.11 in this document are also included for PMI checking to avoid mix up with Alloy steel during installation.

Chemical spot checking, resistivity testing, eddy current testing, electromagnetic alloy sorting, thermoelectric testing shall not be considered as PMI for the purpose of this specification.

3.0 SPECIFIC APPLICABILITY

3.1 The following items (AS/SS from clause 3.1.1 up to 3.1.10 and CS at clause 3.1.11) require PMI unless specifically exempted through a Concession/ Deviation permit by Owner/ EIL.

3.1.1 All pressure containing piping components including, thermowells instrument manifolds, RTJ gaskets, fasteners etc. All valves installed on line.

3.1.2 Tubular products used in the fabrication of heaters.

3.1.3 Pressure - containing instrument housings (e.g. gauge glass housings, orifice meter tubes).

3.1.4 Internal metallic linings/cladding, and weld overlay, done at site, used for protection against corrosive environments. Weather protection jacket (cladding) materials, securement bands /wires, screws, rivets, 'S' & 'J' – clips etc used for insulation works.

3.1.5 Tubing

3.1.6 Stud, bolts and nuts

3.1.7 Plates

3.1.8 All pressure containing welds.

3.1.9 Pipe supports (welded/ bolted) such as pads, saddles, dummy pipes etc.

3.1.10 Any other components or materials specifically designated for PMI on the purchase order/ contract.

3.1.11 a) Pressure containing CS piping components of rating 900# and above
b) Pressure containing CS steel piping items under H_2 service.

c) Pressure Containing CS Piping NACE MR0103 is applicable as per PMS.

3.2 Exclusions

The following items are exempted unless specifically designated for PMI in the purchase order/contract:

3.2.1 Gaskets (spiral wound or carbon steel only).

3.2.2 Internal instrument parts.

3.2.3 Internal machinery parts.

3.2.4 Internal non pressure - containing baffles, trays, tray clips, supports, pall-rings, support rings, etc.

3.2.5 Electrical components.

3.2.6 Internal valve components.

3.2.7 Compression-type ferrules and fittings for use with 3/4 inch (19mm) outside diameter and smaller tubing.

3.2.8 All carbon steel piping components (including carbon steel pipe supports) other than those specified at 3.1.11.

3.2.9 All carbon steel Studs/ bolts/ nuts.

3.2.10 Carbon Steel Plates.

4.0 REFERENCES

American Society of Mechanical Engineers (ASME) BPV Code Section-II Part A, B and C.

ASME B 31.3

American Society for Testing and Materials (ASTM): As applicable

Material Verification Program for New and Existing Alloy Piping Systems: API RP 578

Any other material specification referenced by the Purchase Order/Contract.

IS 1239, IS 3589 and other relevant BIS codes.

5.0 GENERAL REQUIREMENTS

5.1 The test methods outlined in this specification are intended to identify the nominal composition of alloy/ Stainless steel materials. These test methods are not intended to establish the conformance of a material to a particular specification.

5.2 PMI shall not be considered as a substitute for required mill test reports listing chemical composition. In addition, mill test reports shall not be considered as confirming alloy/ composition verification.

5.3 The PMI activity shall be included in the overall quality plan and Inspection & Test Plan for fabrication/ erection. The contractor shall submit to EIL/ Owner, a procedure for PMI to

comply with the requirements of this specification. Approval of PMI procedure shall be obtained from Owner/ EIL prior to commencement of fabrication/ erection as the case may be.

5.4 Contractor shall engage reputed TPIA specified in the contract to witness inspection at site and accordingly submit ITP for review of owner/ EIL. In case list of approved TPIA is not available in contract, prior approval shall be taken before engagement of TPIA.

5.5 A copy of PMI records duly verified by TPIA shall be submitted to Owner/ EIL.

5.6 After installation, but prior to hydrostatic testing/ painting/ insulation, the contractor shall examine all components requiring PMI for proper compliance to this specification. A record of this final check duly endorsed by TPIA, as specified below, shall be submitted to EIL/ Owner and made part of the permanent inspection records.

5.6.1 Owner Supplied Material

Records signed by contractor and duly verified by TPIA (engaged by contractor)/ and reviewed by EIL/ Owner shall be generated as part of the receiving inspection at warehouse.

5.6.2 Contractor Supplied Material

Records signed by contractor and certified by an approved third party inspection agency.

5.7 After acceptance, all components shall be marked with a suitable and readily visible paint mark. These markings are in addition to markings / colour coding required by other codes/ specifications/ Technical Notes.

5.8 Controls shall be established to keep the non conforming items identified till proper resolution of non conformity.

5.9 EIL/ Owner shall have the right to witness the performance of any PMI test.

6.0 EXTENT OF PMI

PMI shall be done on each component (100 percent PMI inspection) including welds (Except carbon steel Piping welds), unless specifically exempted by Owner/ EIL.

PMI shall be done on pipe supports (welded/ bolted) such as pads, saddles, dummy pipes etc. (100 percent PMI inspection) in all piping systems of alloy material

PMI shall be done on all bolts and nuts (100 percent PMI inspection) of flange joints in all piping systems of alloy material.

7.0 PMI OF PIPING AND HEATER COIL COMPONENTS

PMI testing (irrespective of PMI done at earlier stages) shall be carried out when piping loops/ heater coils have been cleared for hydrostatic testing by EIL/ Owner. Hydrostatic Testing shall be carried out only when non conforming components have been replaced with conforming components and subsequent Non Destructive Testing, Post Weld Heat-Treatment, Hardness checking and re verification by PMI etc., as required by specifications have been completed. PMI records shall form a part of piping/ heater inspection records. Contractor shall demonstrate to EIL that each & every component of the piping system and heater coils has been subjected to PMI by providing line wise records of PMI duly endorsed by TPIA .

8.0 TESTING METHODOLOGY

8.1 The method used for PMI examination shall provide a quantitative determination of the alloying elements like chromium, nickel, molybdenum or vanadium in alloy steel items for the characteristic elements specified in clause 9.0

8.2 Instruments or methods used for PMI examination shall be able to provide quantitative, recordable, elemental composition results for positive identification of elements.

8.3 The acceptable instruments for alloy analyzer shall be either "portable X-ray Fluorescence" or "optical Emission type each capable of verifying the percentage of elements within specified range .The instruments must have the printout facility and sensitivity to detect the elements in the specified range.

8.4 Chemical spot testing, magnets, alloy sorters and other methods using eddy current or triboelectric testing methods are not acceptable for PMI examination.

8.5 All PMI instruments shall have been serviced within a 6 month period of the time of use to verify the suitability of batteries, sources,etc, and the date of the last service shall be stated on the PMI report form.

8.6 The surfaces to be examined shall be prepared and cleaned by suitable means before PMI so that surface be free from grease, oil, paint or oxides. Testing shall be done after proper surface cleaning and other requirements as outlined by the manufacturer of the portable alloy analyzer. Modification, if any, of these procedures must be approved by Owner/ EIL.

8.7 Ring type joint gaskets shall be inspected by using portable X-ray fluorescence instrument.

9.0 CHARACTERISTIC ELEMENTS

Material Specification		Characteristic Elements
ASTM A 335	Gr P11	Cr, Mo
	Gr P5	
	Gr P22	
	Gr P9	
	Gr P91	Cr, Mo, V
ASTM A 312	Type 304	Cr, Ni
	Type 316	Cr, Ni, Mo
	Type 321	Cr, Ni, Ti
	Type 347	Cr. Ni, Columbium, Tantalum

9.1 Carbon Steel materials under clause no 3.1.11 shall be checked to confirm that no mix up has taken place with alloy steel components.

9.2 Characteristic elements for materials not listed above shall be proposed by the contractor for approval of the Owner/ EIL

10.0 CALIBRATION

10.1 Instruments used for PMI shall have the sensitivity to detect the alloying elements in the specified ranges. Instruments or methods used for examination shall be of the type that will provide quantitative, recordable, elemental composition results for positive identification of the alloy elements present.

10.2 Each alloy analyzer shall be calibrated using known alloy standards for intended materials to be checked by PMI. A calibration certification from the Manufacturer or his authorized agency shall be submitted to EIL/ Owner for records.

10.3 EIL/ Owner shall review the procedure and qualification and witness sample alloy/ carbon steel materials verification tests to confirm that the procedures, equipment and personnel are capable of providing consistent and accurate results. Certified samples, with full traceability, of a known alloy materials/ carbon steel materials shall be available for use as a random spot checking on instrument calibration.

11.0 SITE VERIFICATION OF ANALYZER

Verification using Standard samples supplied by institutes such as ASM (American Society of Metals) for the intended materials type and grade shall be performed each day before using the analyzer. Such verification shall be done again if PMI test is to be performed on different grade or type of material.

12.0 PERSONNEL QUALIFICATION

The persons performing the PMI test should be knowledgeable about properties of material, all aspects of operation of PMI equipment including the method of testing. Qualification/ experience documents of the person performing the PMI test including his training and experience shall be submitted to EIL/ Owner for review and approval.

13.0 ACCEPTANCE CRITERIA

13.1 Base Metal

PMI test results showing presence of characteristic elements upto 10% less than the minimum specified value in the material specification and upto 10% more than the maximum specified value in the material specification shall be acceptable.

13.2 Deposited Weld Metal

For deposited weld metal between base metals of the same specification using matching consumables, the recorded presence of characteristic elements upto 12.5% less than the minimum specified value in the welding consumables specification and upto 12.5% more than the maximum specified value in the welding consumable specification shall be acceptable.

14.0 REJECTION CRITERIA

14.1 If the PMI test results fall outside the acceptable range as given in 13.0 above, the contractor shall obtain a quantitative check analysis performed by a laboratory acceptable to EIL/ Owner for a complete chemical analysis. Results of this analysis shall be submitted to EIL/ Owner, with contractor's recommendation, for final decision.

Decision of EIL/ Owner shall be final in this regard.

14.2 If any material component or weld is found unacceptable, all other represented materials (e.g. in case of fasteners, supports) or welds shall be considered suspect. In such cases, the contractor has the following options:

14.2.1 Scrapping all those represented materials or components and replacing with new components or welds.

14.2.2 Performing 100% examination of the remainder of the represented materials/ components and replacing each item that fails the PMI check.

14.2.3 If the performance of any verification activity is unacceptable to EIL/ Owner or if any material has been incorrectly identified, all further tests shall be subject to EIL/ Owner approval until the problem is corrected.

15.0 DOCUMENTATION

15.1 Print out from alloy analyzer, in original, duly verified by the TPIA engaged by contractor, Contractor and PMI agency.

15.2 PMI report as per format No. 6-82-0002-F1

15.3 Basis and action for resolving and documenting PMI non conformances.

15.4 Contractor shall demonstrate to EIL/ Owner that all components requiring PMI have been subjected to PMI testing and accepted.

POSITIVE MATERIAL IDENTIFICATION TEST REPORT

REPORT NO: _____

Contractor _____ Date of PMI _____

Project _____ Inspection Agency _____

Location _____ PMI Agency _____

Job No. _____ PMI Equipment Model _____

Line No./ ISO Drg. No./ Make & Serial No. _____

Heater No./ Drawing No. _____ Last Service date _____

Sr. No.	Part Identification	Material As per Drg./ Spec.	Material as per PMI	Result (Accepted/ Rejected/ Retest)

_____ _____ _____

(PMI AGENCY) **(CONTRACTOR)** **(TPI AGENCY)**

(EIL/ OWNER *)

*Sample verification

ATTACHMENT – IV

पाइपिंग सामग्री के रंग कोड हेतु मानक विनिर्देशन

STANDARD SPECIFICATION FOR COLOUR CODING OF PIPING MATERIAL

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	24/07/2024	Revised and Updated	DK	SBB	RKS	MN
3	10/07/2019	Revised and Updated	SKG	AP	AKK	RKT
2	25/06/2014	Revised and updated	SM	DJ	RKD	SC
1	10/07/2009	Revised and updated	SM	SM	RKD	ND
0	30/05/2003	Issued as Standard Specification	RKN	MPJ	RSG	SKG

Abbreviations:

API	:	American Petroleum Institute
ASTM	:	American Society for Testing & Materials
BIS	:	Bureau of Indian Standards
EIL	:	Engineers India Limited
IBR	:	Indian Boiler Regulatory
IS	:	Indian Standard

Construction Standards Committee

Convenor: Sh. R K Singh, ED (Construction)

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Sh. S.B. Burman, Sr.GM (Construction)
Sh. Abhijit Chakraborty, GM (Construction)
Sh. Pankaj Kumar Rai, DGM (Construction)
Sh. Dhananjay, AGM (Construction)

CONTENTS

1.0 SCOPE

This standard covers the method of identification of the piping materials by coloring using paints in order to avoid mix-up between materials of different metallurgy but similar in physical appearance.

2.0 REFERENCES

The following Code shall be referred to as and when required for resolution of colour shades.

IS: 5-2007: Colours for ready Mixed Paints and Enamels

RAL K5 Classic Edition

3.0 GENERAL GUIDELINES FOR IDENTIFICATION BY COLOUR CODING

i. Materials shall be painted with one colour or combination of colours as set out in this specification.

ii. Paints used for colour coding shall be of quality so as to last for at least 5 years.

iii. Studs/Bolts and Nuts shall be painted.

iv. Colour Identification is not required on Austenitic Steel.

v. Colour identification is not required on galvanized-materials and non-ferrous metals such as copper, lead, aluminum because they are easily distinguished by their specific color and character.

vi. Special items like bellows, strainer, steam traps, valves do not require colour identification as these items are tagged with their identification.

vii. Specified colour shall be marked on the inner and outer surface of pipes & fittings.

viii. Job specific colour coding covered under MR/PR for Piping items shall be referred for any additional requirements.

4.0 IDENTIFICATION COLOURS

i. Paint colours to be used for identification shall be in accordance with Table-1.

ii. Application of various colours for identification shall be as per clause 5.0 of this standard.

5.0 METHOD OF COLOUR CODING

i. Colours and locations of colour identification on pipes, fittings, flanges, gaskets, studs/bolts, nuts shall be in accordance with Table-2 to 4 and Annexure-1.

ii. The identification colour on gaskets shall be painted on the peripheral face of each gasket (refer Annexure-1).

iii. Ends of the materials to be welded shall not be painted.

iv. Width of colour band shall be a minimum of 12 mm for less than 3-inch size components and 25mm for 3 inch and larger sizes, unless otherwise specified.

The length of inner surface painting

- Shall be not less than 4 inch (100 mm) at both ends of pipes and shall start 2 inch (50mm) from pipe ends.
- Shall be about 2 inch (50 mm) at any one end of fittings.

v. Wherever combination of two or more colours is specified, materials shall be painted in parallel colour bands as close to each other as possible (Refer Annexure-1).

vi. Paints containing chlorine, chlorides, sulphur, lead, zinc or any contents detrimental to materials are not acceptable. The contractor shall satisfy and produce documents/carry out tests as required by the owner/EIL.

vii. EIL approval shall be obtained for paint materials which are not covered by this specification.

6.0 TABLE: THE FOLLOWING TABLES SHALL FORM AN INTEGRAL PART OF THIS SPECIFICATION

Table No.	*Tittle*
1.	Basic colour of identification
2.	Colour identification on pipes, fitting and flanges
3.	Colour identification on Bolts/Nuts/studs
4.	Colour identification on Gaskets
Annexure-I	Schematic representation of colour identification

TABLE – 1

BASIC COLOURS FOR IDENTIFICATION (REF. IS: 5 (2007) APPROXIMATE MUNSELL VALUE REFERENCE)

Name of Colour shade	Sl.No.	Indian standard colour (ISC) No.	'Munsell' Value		Equivalent RAL Codes (*)	
			Hue	Value/Chroma	NAME	RAL Code
Dove gray	100	694	2.3 G	5.53/0.48	Mouse Grey	RAL7005
Salmon Pink	68	443	2.5 YR	6.31/4.7	Beige Red	RAL3012
India Brown	65	415	2.7 YR	3.76/3.02	Mahogany brown	RAL 8016
Canary yellow	39	309	4.8 Y	7.89/11.02	Zinc Yellow	RAL1018
Deep orange	87	591	8.9 R	5.04/10.38	Red Orange	RAL2001
Lincoln Green	27	276	0.3 G	3.53/2.81	Fir Green	RAL6009
Sea Green	14	217	6.2 GY	6.12/6.15	Yellow Green	RAL6018
Sky Blue	1	101	8.3G	6.09/2.86	Water Blue	RAL5021
Navy Blue	6	106	6.2 PB	2.61/0.95	Cobalt Blue	RAL5013
Light Purple Brown	73	449	3.2 R	3.07/2.14	Pale brown	RAL8025
Dark Violet	104	796	6.1 P	3.5/4.27	Traffic purple	RAL4006
Chocolate	74	451	3.5 YR	2.82/0.67	Chocolate Brown	RAL8017
Maroon	83	541	1.3 R	2.9/1.36	Wine Red	RAL3005
Post Office Red	81	538	4.2 R	3.55/8.39	Carmine Red	RAL3002

NOTE: ** The Colours are based on RAL K5 Classic Edition by RAL, Deutsches institut, incorporated for international jobs.*

TABLE – 2

COLOUR CODES FOR PIPES, FITTINGS & FORGINGS

Sl. No.	Pipe	Elbows, Reducers, Tee's Caps	Flange/Blind Flange	Sl. No. (As per Table-1)	Colour No. (As per Table-1)	Colour
1		A-234 Gr WPB/WPBW-IBR	A-105 A-182	---	---	----
2		A-234 Gr WPB/WPBW-NON IBR		---	---	None
3		A-234 Gr WPBW-NON IBR &NORMALISED				None
4	API 5L Gr B – Seamless	---	---	---	---	None
5	API 5L Gr B – EFSW	---	---	---	---	None
6	API 5L Gr B – ERW	---	---	6/65	106/415	Navy Blue & India Brown
7	A 106 Gr B	---	---	87	591	Deep Orange
8	A 106 Gr B (Normalized)	A-234 Gr WPB(N)	---	87/14	591/217	Deep Orange & Sea Green
		A-234 WPBW (N)		87/14	591/217	Deep Orange & Sea Green
9	IS 1239/IS 3589 Gr 410			100	694	Dove Grey
10	IS 3589 Gr 330			100/6	694/106	Dove Grey & Navy Blue
11	A 333 Gr 6 (LTCS)	A-420 WPL 6		83	541	Maroon
		A-420 WPL 6W		83	541	Maroon
12	A 335 Gr P1	A-234 WP1	A 182 F1	65	443	Salmon Pink
		A-234 WP1W		65	443	Salmon Pink
13	Stainless steel					No Paint

NOTE i) For Hydrogen service, white colour band shall be applied in addition to above
ii) For IBR material, Post Office red shall be applied in addition to above.
iii) Equivalent RAL Codes shall be used for international jobs for above colour codes as per Table -1
iv) For NACE Service, Canary Yellow shall be applied in addition to above.
v) For CRYO Service, Light Purple brown shall be applied in addition to above.

TABLE - 2

COLOUR CODES FOR PIPES, FITTINGS & FORGINGS (.... Contd.)

Sl. No.	Pipe	Elbows, Reducers, Tee's Caps	Flange/Blind Flange	Sl. No.	Colour No.	Colour
14	A 335 Gr P11	A-234 WP11	A 182 F11	27	276	Lincoln Green
	A 691 Gr 1.25 Cr CL.42 (EFW)	A-234 WP11W		27	276	Lincoln Green
15	A 335 Gr P12	A-234 WP12	A 182 F12	1	101	Sky Blue
		A-234 WP12W	---	1	101	Sky Blue
16	A 335 Gr P22	A-234 WP22	A 182 F22	14	217	Sea Green
	A 691 Gr 2.25 Cr CL.42 (EFW)	A 234 WP22W	---	14	217	Sea Green
17	A 335 Gr P5	A-234 WP5	A 182 F5	6	106	Navy Blue
		A-234 WP5W	---	6	106	Navy Blue
18	A 335 Gr P9	A-234 WP9	A 182 F9	104	796	Dark Violet
		A-234 WP9W	---	104	796	Dark Violet
19	A335Gr P91	A-234 WP91	A182F91	74	451	Chocolate
		A-234 WP91W	---	74	451	Chocolate

NOTE: i) For schematic representation, Refer Annexure-1
ii) Equivalent RAL Codes shall be used for international jobs for above colour codes as per Table -1

TABLE - 3

COLOUR CODE - STUDS/BOLTS AND NUTS

	ASTM DESIGNATION	SL.NO.	INDIAN STD. COLOUR (ISC) NO.	COLOUR SHADES
Bolt	A 193 GR B 7	39	309	Canary Yellow
Nut	A 194 GR 2 H	39	309	Canary Yellow
Bolt	A 307 GR B	65	415	India Brown
Nut	A 307 GR B	65	415	India Brown
Bolt	A 193 GR B 16	27	276	Lincoln Green
Nut	A 194 GR 4	27	276	Lincoln Green
Bolt	A 320 GR L 7	74	451	Chocolate
Bolt	A 320 GR B 8	73	449	Light Purple Brown
Nut	A 194 GR 8	73	449	Light Purple Brown

NOTE: i) For schematic representation, Refer Annexure-1

ii) Equivalent RAL Codes shall be used for international jobs for above colour codes as per Table -1

TABLE - 4

COLOUR CODE FOR GASKETS

TYPE	PART	ASTM DESIGNATION/DESCRIPTION	SL.NO.	INDIAN STD. COLOUR (ISC) NO.	COLOUR SHADES
Compressed Fibre (Ring & Full Face)	Gasket	BS7531 GR.X (FULL FACE)	100	694	Dove Gray
		BS7531 GR.X (RING)	—	—	None
Spiral Wound	Gasket	SS 304 H + Grafoil Filler	68	443	Salmon Pink
		SS 304 + Grafoil Filler	73	449	Light Purple Brown
		SS 304 + Teflon Filler	65	415	India Brown
		SS 304 L SPR WND + Grafoil Filler	83	541	Maroon
		SS 316 SPRWND + Grafoil Filler	87	591	Deep Orange
		SS 316 L SPR. WND + Grafoil Filler	27	276	Lincoln Green
		SS 316 H SPR. WND + Grafoil Filler	39	309	Canary Yellow
		Teflon Jacketed SPR. WND	104	796	Dark Violet
		SS321 Spr WND + Grafoil filler	14	217	Sea Green
		SS347 Spr WND + Grafoil FIller	1	101	Sky Blue
OCT. Ring Gasket	Gasket	5 Cr,1/2 Mo (Max. 120 BHN)	27	276	Lincoln Green
		Soft Iron (Max. 90 BHN)	100	694	Dove Gray

NOTE: i) For schematic representation, Refer Annexure-1

ii) Equivalent RAL Codes shall be used for international jobs for above colour codes as per Table -1

ANNEXURE-1

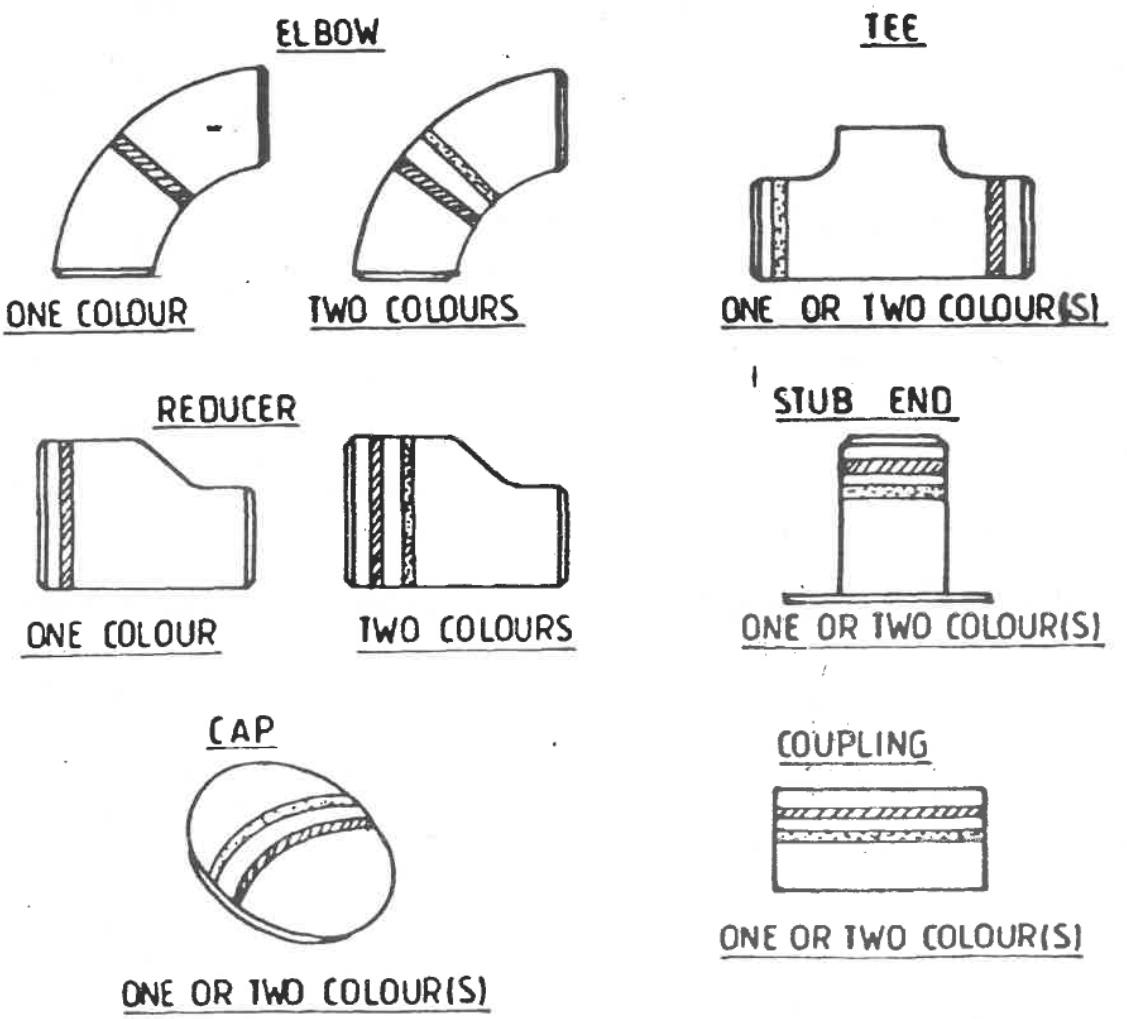
SCHEMATIC REPRESENTATION OF COLOUR IDENTIFICATION

A. COLOUR IDENTIFICATION OF PIPES

ONE COLOUR

TWO COLOUR

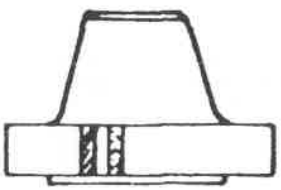
B. COLOUR IDENTIFICATION OF FITTINGS



SCHEMATIC REPRESENTATION OF COLOUR IDENTIFICATION (Contd...)

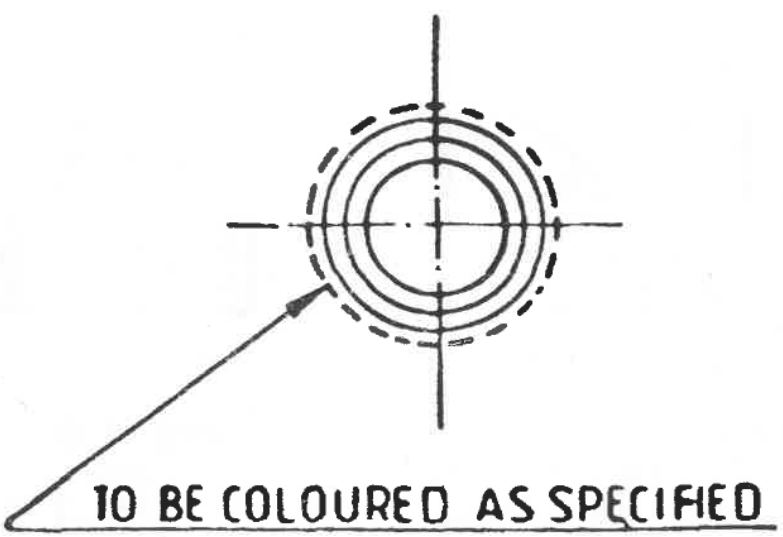
C. COLOUR IDENTIFICATION OF FLANGES

ONE COLOUR

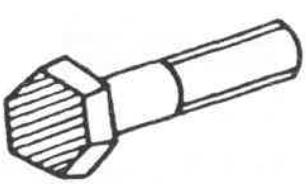


TWO COLOURS

D. COLOUR IDENTIFICATION OF GASKET



E. COLOUR IDENTIFICATION OF STUDS/BOLTS & NUTS



MACHINE BOLT

STUD BOLT

NUT

ATTACHMENT – V

उपस्कर एवं यंत्रों की स्थापना हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR ERECTION OF EQUIPMENT & MACHINERY

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	30.03.2019	Reaffirmed & Reissued	RJ	MI	RP	RKT
3	21.01.2013	Revised & Reissued	MA	RS	VK	DM
2	03.09.2008	Revised & Reissued	DM	PKR	AA	VC
1	30.05.2008	Revised & Reissued	DM	PKR	AA	VC
0	25.04.2001	Issued as Standard Specification	DM	AM	MR	MI

Abbreviations:

ASME	:	American Society of Mechanical Engineers
EC	:	Erection Contractor
EIC	:	Engineer-in-charge
ELCB	:	Earth Leakage Circuit Breaker
GAD	:	General Arrangement Drawing
IS	:	Indian Standard
NDT	:	Non Destructive Testing
SS	:	Stainless Steel

CONTENTS

1.0 SPECIFICATION FOR ERECTION OF EQUIPMENT AND MACHINERY

1.1 Scope

This specification covers technical requirements for erection of all static and rotating equipment by erection contractor at site. This specification is applicable for all the erection tenders operated by EIL.

1.2 General

1.2.1 All necessary handling equipments, tools, tackles and precision instruments for carrying out the works as specified shall be provided by the Erection Contractor (EC) at his cost. EC must provide all tools and gauges for erection and alignment. Special tools, if any, received as part of machinery, will be given to EC for erection purposes, which shall be returned in good condition after use. Suitable deductions will be made by the Engineer-in-Charge (EIC) in case of loss or damage of the special tools. The value of such loss or damage will be decided by the EIC and EC shall be bound by such a decision.

1.2.2 Equipment Manufacturer's recommendations regarding preservation during storage at site and detailed specifications for the installation alongwith layout drawings, general arrangement/equipment outline drawings and sub-assembly drawings of the various equipment and machinery will be provided to EC during the performance of work. The requirements stipulated in these shall be fulfilled by EC in addition to what is stated in this specification. Erection shall be carried out as per the instructions and supervision of Machinery manufacturer's representative, wherever such supervisory services are applicable.

1.2.3 All the items of work covered in the tender shall be carried out as per this Specification and other details to be furnished to EC. However, EIC reserves the right to give additional/alternative specifications and instructions, at any time, for execution of any particular work and EC shall execute such works in accordance with such additional/alternative specifications and instructions of the EIC. Such a step taken by the EIC shall not constitute a breach of the contract.

1.3 Preparation for Erection

1.3.1 EC shall be responsible for organising the lifting of the equipment in the proper sequence, so that orderly progress of the work is ensured and access routes for erecting the other equipment are kept open.

Rigging procedure for all the major lifts (above 10 MT) and at maximum crane capacity shall be submitted by EC for the approval of EIC. However, approval to rigging procedure proposed by EC shall not relieve EC from his responsibility in following the proper lifting/erection methods on ensuring orderly.

1.3.2 Orientation of all foundations, elevations, length and disposition of anchor bolts and diameter of holes in the supports saddles shall be checked by EC, well in advance. Minor rectifications including chipping of foundations as the case may be, shall be carried out by EC after obtaining prior approval of EIC. EC shall also be provided with the necessary structural drawings and piping layouts etc. wherever required for reference. EC shall crosscheck such piping and structural drawings with actual construction at site and in case of any mismatch inform the EIC before taking up the erection.

1.3.3 During the performance of the work, EC shall keep structures, materials or equipments adequately braced by guys, struts or otherwise approved means which shall be supplied and installed by EC as required till the installation work is satisfactorily completed. Such guys, shoring, bracing, strutting, planking supports etc. shall not interfere with the work of other agencies and shall not damage or cause distortion to other works executed by him or other agencies.

2.0 ERECTION OF COLUMNS, TANKS, VESSELS AND DRUMS ETC.

2.1 Scope of work of Erection Contractor

(a) Preparation of erection scheme and rigging procedure and obtaining its approval from EIC wherever necessary.

(b) Withdrawal of equipments from Owner's storage point, checking and reporting its conditions, transporting the same to EC's stores of work site including unloading etc.

(c) Erection on foundations furnished by Owner including aligning, levelling and grouting.

(d) Assembly and fixing of demisters, grids, internal distributors and other internal fittings in Columns, Vessels etc.

(e) Filling of Columns, Reactors, Vessels/ Drums etc. with Raschig rings, supporting elements, sand, concrete etc. as required.

(f) Welding of washers for equipments, erection of pipe davit & minor welding of their parts as per specifications and instruction of EIC.

(g) Assembly & erection of Agitator (Mixer) along with drive unit (Motor) including all accessories for vessels/drums/reactors (wherever indicated) as per specification drawings & instructions of EIC.

(h) Flushing, cleaning and drying of Columns, Vessels/Drums etc.

(i) Completing the equipments in all respects for commissioning the plant as per drawings, specifications & instructions of EIC.

(j) Any modification in the erected Columns, Reactors, Vessels/Drums to the complete satisfaction of EIC.

2.2 General Conditions of Erection

2.2.1 Unless otherwise specified Columns, Vessels, Drums etc. will be generally supplied to the Erection Contractor in single piece and EC will not be required to carry out any assembly or welding. In case column is supplied in multiple pieces and erection of the equipment is not possible in single piece, EC shall be responsible for lifting the pieces, for aligning, welding and hydrotest etc. in vertical position under the supervision of column Supplier (Fabricator). However, EIC shall be responsible for coordination between Erection Contractor & Fabricator. The schedule of quantities (SOQ) for equipment erection enclosed with the tender document outlines details of each equipment such as diameter, overall height, type of support (saddle/skirt/leg/bracket), position (horizontal or vertical) and approximate erection weight etc. However the erection elevation and location of equipment shall be as per the piping layout drawing enclosed with the tender.

2.2.2 Rigging procedures and erection schemes for all the heavy lifts weighing 10 MT & above shall be prepared by EC and got approved by EIC. Approval by EIC shall not relieve EC of his responsibilities. The details to be submitted will include the location of equipment from where it will be lifted, location of crane(s), details of crane(s) (like configuration, boom length, operating radius, boom point elevation, clearance underside the boom and the equipment, lifting capacity, counter weights to be deployed, holds on any neighbouring foundations, structures, equipments etc.), the load chart of the crane(s), design of the lifting tackles like spreader beam, D-shackles, wire rope slings etc. Unless the erection scheme and rigging procedures are approved by EIC, erection of such equipments shall not be undertaken in any case by EC.

2.2.3 Before starting the erection of Columns, Vessels etc., top surface of the foundations is to be cleared/chipped, roughened to obtain proper bond, while grouting. Also the sleeves are to be cleaned before erecting the equipments. Line (orientation) and levels are to be marked on all the foundations to facilitate checking of alignment.

EC shall also check the correct elevation and orientation of civil, structural foundations, before proceeding with the erection work. Discrepancy, if any, shall be brought to the notice of EIC. However, minor rectifications and chipping of foundations upto a thickness of 15 mm in foundation height shall be carried out at no extra cost, by the EC. EC shall be responsible for supply of levelling plates, (if required) and shall carry out levelling of equipment under the directions of EIC.

2.2.4 While handling, transporting or erecting the equipments, care shall be taken not to damage the nozzles, instrument connections, structural clips etc. EC shall also take care of the orientation of the nozzles and other connections of the equipments while erecting the same and ensure compliance with the drawings and specifications supplied. Discrepancy, if any, in the number/orientation of the nozzles, cleats etc. should be brought to the notice of the EIC before actual erection is started.

2.2.5 Verticality of the Columns, Reactors/Vessels shall be checked with theodolites. After erection the equipment shall be levelled and properly aligned with necessary shims and wedges supplied by EC, at his cost. After the level, alignment and verticality etc. are checked and approved by EIC, EC shall carry out grouting.

2.2.6 EC shall produce recent test certificates of the slings which they will be using for erection work. However, retesting of the slings shall be done at site by EC at his cost, as and when required by EIC. The weights of test loads shall be as per IS-807. The test loads shall be supplied by EC at his cost. Tested slings will be punched for test loads and date of testing as directed by EIC.

2.2.7 EC shall also carry out the assembly, erection, levelling and alignment of all types of weir plates, baffles, distributors, collectors, spray nozzles, demisters, grids and other internal fittings etc. Work shall be carried out as per manufacturer's standards/specifications which shall be made available to EC at the time of erection. Raschig rings, molecular sieves, intalax saddles packing and other types of tower packings such as sand, catalyst etc. and SS wire mesh shall be loaded into sections of Vessels, Columns as per specifications and drawings. Details for internals to be installed by EC shall be as per separate schedule of quantities enclosed with the tender document. All packings except clay and lime stone shall be washed with water before filling. Bottom layers, if required, shall be arranged as directed and random filling shall be done afterwards with equipment filled with water. Installation of packings, shall be done only after flushing and cleaning of Columns/Vessels and completed to the satisfaction of EIC.

2.2.8 EC shall carry out minor welding for attachment of prefabricated pipe davit parts such as rain covers, handles etc. with pipe davit, during or after erection of the same as per the manufacturer's specifications, at no extra cost to the Owner.

2.2.9 EC shall execute erection of wooden pillow for saddle support for cold horizontal vessels wherever necessary as indicated on the drawings/ EIL STD 7-12-0003 and as per the instructions of EIC.

2.2.10 EC shall execute assembly & erection of agitator/mixer along with drive unit including all accessories as per supplier's instructions, specification drawings & instructions of EIC.

2.3 Flushing & Cleaning of Columns, Vessels, Drums etc.

2.3.1 After the erection, alignment and grouting of these equipments are complete, flushing and cleaning shall be carried out by EC as per specifications and instructions of EIC.

2.3.2 After flushing, cleaning and draining, equipments shall be dried by compressed air at the pressure and for duration decided by the EIC. The Vessel interior shall be thoroughly inspected to the complete satisfaction of EIC before it is finally boxed up. Boxing up of manholes and handholes shall be leak proof. All joints which need remaking, shall be remade. Compressed air for drying shall be arranged by EC.

2.4 Inspection and Acceptance Limits for Level and Alignment

2.4.1 Co-ordinates of foundations/supporting structures/mounting holes etc. shall be checked with respect to the plot plans by EC.

2.4.2 Before equipments are placed on foundations, orientations shall be checked with respect to piping drawings.

2.4.3 When equipments are firmly bolted down but prior to grouting, verticality of all the Columns, vertical vessels etc. shall be checked by using theodolite. Tolerances for equipment after erection shall be as per EIL Standard 7-12-0001. The allowable deviation from plumb line shall be 1 mm per metre height, subject to maximum of 15 mm unless otherwise stated on the drawings.

2.4.4 Horizontal Vessels shall be checked for level across machined face of nozzle flanges with precision level.

2.5 Additional requirements for Underground buried vessels

2.5.1 **Underground vessels for operating temp upto 60°C**

The vessels shall be supplied at site with one coat of inorganic zinc silicate primer duly applied on its external surfaces as per Spec. 6-79-0020. All other works such as application of coaltar enamel, as per EIL Spec. 6-79-0020 and wrapping and coating as per EIL Spec. 6-79-0011 shall be carried out by EC. This shall include necessary materials, tools and tackles to complete the Job in all respect as per the instructions of EIC.

2.5.2 **Underground Vessels for operating temp. Above 60°C and upto 300°C**

The vessels shall be supplied at site with one coat of inorganic zinc silicate primer as per Spec. 6-79-0020 duly applied on its external surfaces. EC shall be required to carryout touch-up and repair of outside primer before erection of equipment.

2.5.3 EC shall do the necessary excavation, backfilling and removal of surplus earth at the site as per the directions of the EIC. EC's rate shall include the excavation, blast cleaning, painting, wrapping by kraft paper, placing and fixing of Vessels, backfilling and removal of excess earth.

3.0 ERECTION OF MECHANICAL EQUIPMENT

3.1 Scope of Work of Erection Contractor

The scope of EC shall consist of withdrawal and transportation of equipments and accessories from Owner's stores to site, assembly of loose supplied components/parts erection of equipment on foundations, levelling, aligning and grouting, preparation of equipments for trial runs and hand over in fit condition for the start up of the plant as per instructions of EIC.

3.2 Details of Owner Supplied Equipments

Equipments to be erected shall be supplied by the owner. Equipments may be supplied in any of the following conditions.

- Single equipment such as filter, static mixer, silencer etc.
- Skid mounted equipment, fully assembled.
- Skid mounted equipment with some items supplied loose or as subassemblies involving interconnections also.
- System comprising of many equipments, skids with interconnected piping & hook up.

3.3 Technical Requirements

3.3.1 All equipment/machinery erection shall be done by experienced fitters. For this purpose EC shall employ an experienced erection supervisor and crew who have done similar jobs.

3.3.2 EC shall study the layout drawings, for the machineries and equipments with their auxiliaries, controls defining scope of supply.

3.3.3 Equipments shall be checked for any damages as a result of transport, handling and defects, if any, shall be reported to the EIC. Rectification of defects shall be carried out in accordance with approved procedure.

3.3.4 Correct procedures for handling of equipment & installation on the foundation shall be followed as given in the manufacturer's manual. In case of non-availability of such procedures, EC shall develop & submit handling procedures for all equipment weighing more than 10 metric tonnes. The handling procedure shall be approved by the EIC.

3.3.5 EC shall check the correctness of equipment foundations or supporting structures as per the drawings. Equipment/Skid foot print dimensions shall be verified to match with the foundation. Minor chipping of foundation, pockets if required shall be carried out by EC.

3.3.6 All accessories like pressure gauges, seal oil, cooling water & Lube oil headers etc., shall be tagged and separately kept in Contractor's stores till erection. All flanged connections and openings shall be kept blanked with dummies, plugs to prevent entry of foreign particles.

3.3.7 Equipments shall be installed on the foundations in proper sequence. Incase the equipments are delivered in subassemblies, EC shall do the assembly work as per manufacturer's instructions.

3.3.8 Equipments shall be installed in the correct orientation and alignment.

3.3.9 After installation and levelling the equipment shall be grouted with the specified grouting applied to the baseplate and support.

3.3.10 EC shall remove all the packing and protective devices used during transport and handling from the equipment such as shock absorbent materials from machined faces, blocking of shafts or rolling bearings & restraining devices from instruments, safety devices and protective equipments.

3.3.11 After the grouting is set & cured, the foundation bolts shall be checked to make sure that they are in straight and vertical position and properly tightened. Shims, if used, shall be on either side of the foundation bolts.

3.3.12 Desiccant, catalyst where supplied loose shall be loaded on to the respective vessels in specified quantities as per the suppliers instructions.

3.3.13 Internals, where supplied loose shall be assembled as per the drawings and manufacturer's instructions.

3.3.14 Unless otherwise specified, all the instruments such as pressure gauges, sight glasses temperature recorders etc. including instrument panels, if any, supplied along with the equipment with necessary connections, shall be installed by EC as part of Equipment erection.

3.3.15 Equipments shall be checked for final cleanliness before boxing up.

3.3.16 Any interconnected piping & ducting shall be properly installed and supported. EC shall connect the gas, steam, air, utility piping, instruments, oil piping etc. as per manufacturer's drawings, specifications and instructions of the EIC.

3.3.17 Safety devices shall be correctly installed.

3.3.18 Ladders, platforms, walkways shall be correctly installed with handrails, and flooring shall be properly secured.

3.3.19 Field welding, where specified shall be in accordance with the specified procedures and NDT tests where specified shall be carried out. Results of NDT tests shall be recorded.

3.3.20 Equipment alignment & couplings shall comply with tolerances specified in manufacturer's drawings and manuals. Provisions of dowel pins or similar arrangements for retaining the alignment shall be carried out.

3.3.21 After the piping has been connected, the alignment shall be checked by EC again, to ensure that piping connections do not induce any undue stresses on the Equipments. After making necessary corrections on the piping, if any, realignment shall be done by EC to ensure that no undue stresses are induced on the equipment.

3.3.22 Painting, insulation & fireproofing where specified shall be carried out in accordance with the applicable specifications attached in the tender document.

3.3.23 Any alterations, deviations made during equipment erection with respect to manufacturer's drawings or instructions shall be duly recorded and approval shall be taken from the EIC.

3.3.24 Any special tools, tackles supplied along with the equipment and used during installation shall be returned to the stores through the EIC.

3.3.25 Any protection of the equipment after installation, if required shall be carried out in accordance of the instructions of the EIC.

3.4 Trial Runs

3.4.1 Wherever specified, Machinery & Equipment erected & installed by EC under the supervision of Machinery/Equipment supplier shall be subjected to trial runs in accordance with clause 5.4 of this specification. Job specific trial run procedure, if specified, supersedes the trial run procedure as described in clause 5.4.

3.5 System Start-up

During this phase of work, EC shall provide as part of his work necessary skilled personnel as per requirement of EIC. Any defects noticed in the Equipment shall be made good by EC at his cost if such defects are attributable to him.

4.0 HEAT AND MASS TRANSFER EQUIPMENT

This section covers the minimum requirements for erection of the following equipment by the EC.

- Deaerator
- Trays/ Tower Internals and Tower Packings
- Separators and Internals
- Shell and Tube Heat Exchangers
- Double Pipe Exchangers
- Electric Heaters
- Plate Exchangers
- Plate Fin Exchangers
- Sulphur Recovery Unit Equipment like Combustion Chambers, Waste Heat Boilers, Sulphur Condensers, Incinerators, Burners, Etc.
- Waste Heat Recovery Units
- Desalters
- Vacuum Ejectors
- Ejector Condensers

4.1 Scope of Work of Erection Contractor

4.1.1 Preparation of erection scheme and rigging procedure and obtaining its approval from EIC wherever necessary.

4.1.2 Withdrawal of equipment from Owner's storage point, checking and reporting its conditions, transporting the same to EC's stores and work site including unloading etc.

4.1.3 Preparation of foundation by chipping & installation of base plates for foundations. Minor rectifications & chipping of foundations up to a thickness of 15 mm due to error in foundation height, shall be carried out by the EC at no extra cost

4.1.4 Before starting the erection, top surface of the foundations are to be cleaned/chipped/roughened to obtain proper bond while grouting. Line (Orientation) & Levels are also to be marked on the respective foundations prior to erection to facilitate checking of alignment.

4.1.5 Supply of necessary shims, levelling plates, wedges, sliding base plate.

4.1.6 Erection on foundations furnished by Owner including aligning, levelling and grouting.

4.1.7 Assembly and fixing of trays, tower internals (distributor, bed limiter, support plate, chimney trays, vapour distributor etc.), demisters, grids, internal distributors and other internal fittings in columns, vessels etc.

4.1.8 Installation of transformers on desalters and their electrical connection to electrode grid etc.

4.1.9 Welding of chimney trays, lattice girders, beams etc. wherever required.

4.1.10 Carrying out minor adjustments, modifications, seal welding of seal plates etc. wherever necessary during installation.

4.1.11 Checking of installed trays & tower internals and filling of installation formats as referred in 6-14-0016.

4.1.12 Filling of columns, vessels/drums etc. with Raschig rings/Pall rings/ Structured packing, as required.

4.1.13 Welding of washers for equipment, erection of pipe davit & minor welding of their parts as per specifications and instruction of EIC.

4.1.14 Hydrotesting of shell and tube heat exchangers if the time gap between last hydrotest is more than six months or in case it is found to be necessary by EIC. Procedure is given in para 4.3 & 4.4 below. EC to note that any equipment which are refractory lined at shop shall not be hydrotested.

4.1.15 Flushing, cleaning and drying of equipment using compressed air and blinding to prevent ingress of rain, dust etc.

4.1.16 Installation of refractory lining, brick lining, ceramic boards etc., as per specifications, recommendations of manufacturer and instructions of EIC.

4.1.17 Mounting of instruments like safety valves, rupture disks, sight glasses etc as required.

4.1.18 Completing the equipment in all respects for the commissioning of the plant as per drawings, specifications & instructions of EIC.

4.1.19 Any modification in the equipment to the complete satisfaction of EIC.

4.1.20 In addition to the above EC may be called upon to do other jobs like rectification of defects etc. as per instructions of EIC.

4.2 General Conditions of Erection

4.2.1 All carbon steel components of trays/tower internals shall be cleaned to remove rust preventive coating.

4.2.2 All welding shall be done by qualified welders only. The electrodes/filler material to be used shall be compatible with the metallurgy of component and shall be used only after prior approval of EIC.

4.2.3 A proposed Welding Procedure Specification (WPS) shall be submitted to EIL/ Owner's Inspector for his approval. On approval, a Procedure Qualification Test (PQT) shall be conducted which shall be witnessed by EIL/Owner's Inspector. On acceptance of all tests as per ASME Section IX, a final WPS along with Procedure Qualification Record (PQR) shall be submitted. Production welding shall start only after approval of final WPS/PQR and

qualification of welders as per ASME Section IX. EIL/Owner's Inspector may accept previously qualified WPS/PQR at his sole discretion.

4.2.4 Lattice girders wherever provided for supporting tray & tower internals have been designed in such a way that various components pass through column manway. Components/parts of lattice girders are to be welded inside the column as per respective drawings. EC shall also ensure that all parts of lattice girder are properly welded & levelness of the lattice girder shall be checked before & after the welding. The limits of levelness as mentioned in GA drawings shall be adhered to.

4.2.5 The rigging procedure shall include the following as a minimum:

Location of equipment from where it will be lifted, location of crane(s), details of crane(s) (like configuration, boom length, operating radius, boom point elevation, clearance underside the boom and the equipment, lifting capacity, counter weights to be deployed, holds on any neighbouring foundations, structures, equipment etc.), the load chart of the crane(s), design of the lifting tackles like spreader beam, D-shackles, wire rope slings etc. Unless the erection scheme and rigging procedures are approved by the EIC, erection of equipment shall not be undertaken in any case by the EC.

4.2.6 While handling, transporting or erecting the equipment, care shall be taken not to damage the nozzles, instrument connections, structural clips, refractory lining etc. EC shall also take care of the orientation of the nozzles and other connections of the equipment while erecting the same and ensure compliance with the drawings and specifications supplied. Discrepancy, if any, in the number/orientation of the nozzles, cleats etc. should be brought to the notice of the EIC before actual erection is started.

4.2.7 After erection, the equipment shall be levelled and properly aligned with necessary shims and wedges supplied by EC, at his cost. After the level, alignment and verticality etc. are checked and approved by EIC, EC shall carry out grouting.

4.2.8 EC shall produce recent test certificates of the slings which they will be using for erection work. However, retesting of the slings shall be done at site by the EC at his cost, as and when required by the EIC. The weights of test loads shall be as per IS-807. The test loads shall be supplied by EC at his cost. Tested slings will be punched for test loads and date of testing as directed by EIC.

4.2.9 EC shall also carry out the assembly, erection, levelling and alignment of all types of weir plates, baffles, distributors, collectors, spray nozzles, demisters, grids and other internal fittings etc. Work shall be carried out as per manufacturer's standards/specifications which shall be made available to EC at the time of erection. Raschig rings/Pall rings/Structured packing, molecular sieves, intalox saddles packing and other types of tower packing such as sand, catalyst etc. and SS wire mesh shall be loaded into sections of vessels, columns as per specifications and drawings. Details for internals to be installed by EC shall be as per separate schedule of quantities enclosed with the tender document. All packing except clay and lime stone shall be washed with water before filling. Bottom layers, if required, shall be arranged as directed and random filling shall be done afterwards with equipment filled with water. Installation of packing, shall be done only after flushing and cleaning of columns/vessels and completed to the satisfaction of EIC.

4.2.10 EC shall carry out minor welding for attachment of prefabricated pipe davit parts such as rain covers, handles etc. with pipe davit, during or after erection of the same as per the manufacturer's specifications, at no extra cost to the Owner.

4.2.11 EC shall install base plate over the sliding end foundation before erection of shell and tube exchangers.

4.2.12 Levelling and plumbness shall be approved by EIC and shall be checked using theodolite before grouting and final finishing of the foundations. The record of the same shall be maintained.

4.2.13 EC to ensure that shell and tube exchangers shall be firmly bolted down to foundations at the fixed end. Further EC to ensure that foundation bolts at the sliding saddle end are at the centre of slotted holes & nuts at sliding end are only hand tightened. Projected bolt threads shall be properly protected by application of grease etc. to avoid rusting and for facilitating free movement of nuts.

4.2.14 EC shall ensure that no equipment is subjected to any corrosion during any stage during his period of work till handling over to EIC/Client.

4.2.15 Instruments, as required, shall be mounted by EC. On instructions of EIC, EC shall also remove and hand over the instruments to EIC for calibrations. During this period, EC shall cover all openings to protect the equipment.

4.2.16 Before transportation to site, EC shall check and report to EIC on the condition of equipment, specifically highlighting the nitrogen pressure indicated in the nitrogen gauges and the absence of blinds on any of the nozzles.

4.2.17 In case the shell and tube exchangers are to be stacked, but have been stored as single shells at the store, then EC shall erect the bottom most shell, then erect other shell(s) sequentially using the nozzle gaskets/bolting and saddle bolting supplied by owner. Additional shims, if necessary, shall be supplied by EC. If the exchangers do not have interconnecting nozzles, then nozzle elevations shall be maintained as per piping GAD.

4.2.18 All equipment, consumable and other accessories required for completion of the job shall be arranged by the EC. This would include but not limited to cranes, tools and tackles, manpower etc; machinery for cutting, grinding , drilling etc. of base plates; instruments like dumpy level, plumb lines, Engineer's levels, precision levels, theodolite, straight edges etc. for checking the alignment/erection accuracy, hydrostatic testing pumps, potable water for hydrotesting, necessary materials including making the arrangements for hydro-testing, hoses, compressed air supply, pressure gauge, sealing taps, blinds, shims and wedges for alignment etc.

4.2.19 EC shall execute the erection of wooden pillows for saddle supports for cold equipment as indicated in schedule of quantities, EIL standard 7-12-002 and instructions of EIC.

4.2.20 For bought out items like plate exchangers, plate fin exchangers, electric heater, etc. vendor's instructions shall be followed.

4.2.21 For erection of piping of ejector system, EC shall follow relevant erection specification of piping for the project.

4.2.22 EC shall check the health of the equipment refractory lined at shop on receipt and shall report any defect or damage in the same to EIC. During installation all precautions shall be taken to avoid any damage to refractory lining. Any damage to refractory during erection shall be repaired by EC at his own cost without loss of time.

4.2.23 Wherever equipment with refractory are bolted or welded at the girth joints, the gaps between the refractory shall be suitably filled with ceramic fiber of suitable grade as given in the drawings or other relevant documents of the equipment.

4.2.24 Refer section 1.0 (General) for additional requirements.

4.3 Hydrotesting of Shell and Tube Exchangers including Condensers

4.3.1 These shall hydrotested at site using potable water. Hydrotesting of both shell and tube sides shall be carried out as per procedure given below or as per instructions of EIC. For exchangers fitted with SS bellow or SS part, potable water with max. 25 ppm chlorides shall be used for hydrotesting.

4.3.2 Suitable pump set, piping, test pressure gauges and other instruments, water-hoses, temporary gaskets, metallic blinds, bolts, nuts, consumable and other temporary arrangements and equipment for testing shall be provided by the EC at his cost. Test pressure gauges shall be calibrated by the EC and got approved from EIC.

4.3.3 Stacked exchangers shall be hydrotested in stacked conditions.

4.3.4 Test pressure shall be as indicated in the name plates mounted on each exchangers. Duration of hydrotest shall be at least one hour. Test pressures and duration of hydrotest may be reduced by EIC. Minimum test water temperature shall be 20°C.

4.3.5 Any defects noticed during hydrotesting shall be repaired by EC as per the procedure approved by EIC. Cost for rectifying defects, not attributable to the EC shall be paid separately.

4.3.6 No equipment shall in general form part of the piping loop during hydrotesting and shall be blinded off, except when instructed otherwise by EIC.

4.3.7 EC to take adequate care during pressurising & depressurising the equipment. EC shall also take care of any instruction given regarding hydrotest in the exchanger drawing.

4.4 Hydrotesting Procedure

4.4.1 Shell side & tube side shall be hydrotested separately, unless specified otherwise. If both sides are to be tested together, a warning plate would be fixed to the exchanger, and the instructions given therein are to be followed.

4.4.2 The side, shell or tube which ever to be tested at higher pressure shall be taken first.

4.4.3 During hydrotest all gasket joints should be checked for any leakage. In case of leakage from any gasket joint, bolting at that joint shall be further tightened following proper tightening sequence (bolts should not be overtightened or tightened by hammering). In case it is not possible to stop leakage by bolt tightening, drain the water in exchanger & replace gasket at that joint by new gasket (gasket will be supplied by owner). After replacing gasket exchanger must be again hydrotested with same procedure to ensure leak tightness.

4.4.4 In case of floating head heat exchangers, if it is found during hydrotest that the pressure is dropping, while the external gasketed joints are not leaking, this could be due to floating head gasket joint leakage. This shall be further investigated, by removing shell cover & pressurising tube side to check the floating head gasket joint leakage. In case of leakage observed at floating head flange joint, replace floating head gasket by new gasket. After replacing gasket exchanger must be again hydrotested first on tube side & then on shell side with same procedure to ensure leak tightness of gasket joints.

In case of heat exchangers with shell side hydrotest pressure higher than tube side, it is possible that above procedure (with tube side hydrotest to detect floating head gasket leakage) may not help. Absence of leakage during this test is not conclusive in such a case, as the shell side pressure was dropping during hydrotest. In such a case, floating head gasket shall in any case be replaced and then equipment retested to ensure leak tightness.

4.4.5 When hydrotested as per above procedure after floating head gasket replacement, if it is observed that test pressure is still dropping, this could mean leakage from tube to tubesheet joint. For such cases matter shall be reported to EIC for further investigations/instructions.

4.5 Flushing & Cleaning

4.5.1 After the erection, alignment and grouting of these equipment are complete, and after hydrotest if any, flushing and cleaning shall be carried out by EC as per specifications and instructions of the EIC.

4.5.2 After flushing, cleaning and draining, equipment shall be dried by compressed air at the pressure and for duration decided by EIC. The equipment interior shall be thoroughly inspected to the complete satisfaction of EIC before it is finally boxed up. Boxing up of manholes and handholes shall be leak proof. All joints which need remaking, shall be remade. Compressed air for drying shall be arranged by EC at his cost.

4.6 Inspection and Acceptance Limits for Level & Alignment

4.6.1 Co-ordinates of foundations/supporting structures/mounting holes etc. shall be checked with respect to the plot plans by EC.

4.6.2 Before equipment are placed on foundations, orientations shall be checked with respect to piping drawings.

4.6.3 When equipment are firmly bolted down but prior to grouting, verticality of all equipment shall be checked by using theodolite. Tolerances for equipment after erection shall be as per EIL Standard 7-12-0001. The allowable deviation from plumb line shall be 1 mm per metre height, subject to maximum of 6 mm.

4.6.4 Horizontal equipment shall be checked for level across machined face of nozzle flanges with precision level.

4.6.5 Difference in elevation of centerline from one end to the other end shall not be more than 1 mm per meter and limited to ± 3 mm maximum. Further elevation difference shall be such as to ensure complete draining of equipment.

4.6.6 Survey of column inside and checking the levelness of support rings, location of bolting bars to ensure that the same are as per column drawings and within tolerances specified in standard 7-14-0001. In case these are not within permissible tolerances, the same shall be reported to EIC for necessary rectification/modification.

4.7 Safety, Health & Environment

EC shall install an exhaust fan for exhaling welding/ cutting fumes etc. and to maintain adequate oxygen level, before any work is started inside confined spaces (i.e. columns). Adequate ventilation shall be maintained at all times. Gas/LPG cylinders shall not be taken inside confined space. When a worker/supervisor enters a confined space, it shall be mandatory to have a second man as standby. Safety belts shall be worn while entering columns, if there is a danger of falling. All ladders/stair cases shall be in place before any item is offered to owner's inspectors. Rope ladders/scaffolding shall be provided inside the column in case tower internals are not easily approachable from column manhole. Low voltage (24 V) lamps equipped with guards shall be used to prevent accidental contact with bulb. All electrical connections shall be through ELCB's and proper earthing shall be ensured. Acids and other materials used for pickling shall be disposed off to a designated place as directed by owner/EIL. All statutory Regulations and owner's safety, health and environment requirements

shall be complied with. Inspection aids for carrying out the inspection of internals shall also be provided.

5.0 ERECTION OF ROTATING EQUIPMENT

5.1 Scope of Work of Erection Contractor

The scope of work shall consist of transportation of Rotating Equipments and accessories from Owner's stores to site, assembly of sub-assemblies/parts, erection of Rotating Equipments on foundations, levelling, aligning and grouting, preparation of Rotating Equipments for trial runs, carrying out no load/trial runs, return of any unused material to the owners stores and hand over in fit condition for the start- up of the Plant, as per instructions of EIC.

Defects due to EC's fault noticed during trial runs shall be rectified by him. Schedule of Quantities, indicate estimated numbers, dimensions and weights of the Rotating Equipments. The actual data on dimensions and weights will be in the vendor data manuals.

The term 'Rotating Equipment' includes all pumps, compressors, steam & gas turbines, fans and blowers, diesel engine/steam turbine/gas turbine generator sets along with drivers accessories & auxiliary systems.

5.2 General Conditions of Erection

5.2.1 All Rotating Equipment erection shall be done by experienced fitters. For this purpose EC shall employ experienced and suitably qualified erection supervisor and crew who have done similar jobs.

5.2.2 The Rotating Equipment manufacturer's instructions as available regarding installation and trial runs will be passed on to EC during the course of work. The requirements prescribed therein shall be met in addition to what is stated in this specification. Erection shall be carried out as per instructions of the Rotating Equipment manufacturer's representative and under their supervision whenever the manufacturer is present at site. In all other cases instructions of the EIC, regarding procedure/sequence of erection shall be binding on EC.

5.2.3 For all Rotating Equipment, EC shall follow the proper sequence for assembly and erection. For Rotating Equipment received along with driver in coupled condition, the coupling bolts shall be dismantled by EC, and alignment shall be rechecked. Realignment, if required, shall be done before recoupling.

Where drivers and couplings are provided separately, drilling and tapping of holes in the base plates for fixing drivers, fixing of couplings on shafts, after enlarging the pilot bores to the correct size with key way etc. and dowelling including provision of dowel pins, alignment screws, jack-up screws or similar arrangements for retaining the alignment shall be carried out by EC as part of erection work. Shims & wedges as required for alignment shall be supplied by EC.

5.2.4 Process and utility (such as cooling water, steam flushing, quenching, lubricating oil, sealing etc.) connections connected with rotating equipment and its auxiliaries shall be fabricated and/or installed by EC from materials supplied by the Owner as per drawings, specifications and instructions of the EIC.

5.2.5 Piping and accessories supplied with the rotating equipment such as seal oil/Gas system, cooling water system & Lube oil system etc. shall be tagged separately and kept in EC's stores till erection. All flanged connections and openings shall be kept blanked with dummies/plugs to prevent entry of foreign matter.

5.2.6 The local mounted instruments such as pressure gauges, sight glasses, temperature gauges etc. and Local instrument panels, if any, with necessary connections, shall be installed by EC as part of rotating equipment erection.

5.2.7 After initial alignment, the Rotating Equipments shall be properly grouted. Grouting shall be carried out as per this specification. Wherever grout holes are provides in the base plates, grout shall be filled through them also.

Epoxy grout where recommended by the rotating equipment manufacturer, shall be provided by EC and shall be as specified in this standard.

5.2.8 Alignment between the Driver and driven equipment shall be done without connecting the equipment nozzles to respective piping. After completion of alignment, the equipment shall be connected to Piping. After the piping has been connected, the alignment shall be re-checked by EC, to ensure that piping connections do not induce any undue stresses on the Rotating Equipments. After making necessary corrections on the piping, if any, re-alignment shall be done by EC and he will ensure that no undue stresses are induced on the Rotating Equipment.

5.3 Special Instructions

EC in addition to general instructions for erection as out lined in para 5.2 above, shall also follow the following special instructions.

5.3.1 Pumps

Depending upon the size of equipment, Pump train will be supplied for erection in any of the following modes :

(a) Pumps with drivers and accessories fully assembled on a common skid (Base plate).

(b) Pumps mounted on base plate and couplings and driver supplied loose in separate packs.

(c) Various major components such as pump, drivers, couplings, gear boxes & base plates auxiliary systems like lube, seal flush equipment in separate packs.

5.3.2 Reciprocating Type Compressors

5.3.2.1 Reciprocating compressors may be supplied for erection in knocked down condition in multiple packaged subassemblies such as frame assembly, distance pieces, fly wheels, cylinder block assemblies, valve assemblies etc. and other accessories such as, drivers, couplings, gear boxes (if any), control panels, gauge boards, coolers, lube oil systems, cooling water systems, etc. would be in separate packages.

Besides the above there would be other packages for loose supplied items such as instruments, pre-fabricated piping, and piping/tubing in commercial lengths.

Lifting devices for erection shall be arranged by EC depending on the weight of packages and elevation of installation.

5.3.2.2 In case of Rotating Equipments received in knocked down condition, the various parts shall be assembled as per instructions of the EIC and as per manufacturer's instructions. All parts of the Compressor shall be thoroughly cleaned with solvents to remove protective compounds if any, before assembly.

5.3.2.3 The compressor, driver and other accessories shall be erected on their respective foundations and the compressor, couplings, gear box and driver shall be aligned and grouted as per the manufacturer's instructions and instructions of EIC and the manufacturers supervisor (when present). There-after all process and utility, drain & vent connections shall be completed as per the relevant drawings/instructions of equipment manufacturer and advice of EIC.

5.3.2.4 Final alignment shall be done after all the piping connections such as water, steam, drains and connection to coolers etc. are made. Tolerances for alignment shall be maintained as specified in the Manufacturer's Instruction Manual. To ensure that piping connections do not induce any undue stresses on the Rotating Equipment, the alignment shall be checked once again by EC after the piping has been connected. Any correction necessary for proper alignment shall be done by EC.

5.3.2.5 EC shall carefully study the vendor drawings, manuals and other data before start of the job to ensure correct erection, alignment and commissioning.

5.3.3 **Centrifugal Compressors & Expanders**

5.3.3.1 Centrifugal Compressors are supplied for erection in multiple packages such as,

- Compressor casings
- Drivers (Electrical motors, Steam/Gas turbines -♦)
  {♦ : Steam/Gas turbines would be further supplied in multiple packages}
- Base plates (or skids)
- Lube oil/control oil systems
- Sealing systems
- Air filters (for gas turbines & compressors for air service)
- Temporary strainers
- Couplings
- Gear boxes
- Coolers
- Gauge boards
- Control panels
- Lube & Seal Oil tanks
- Fire systems (for gas turbines)
- Condensers (for steam turbines)
- Condensate systems (for steam turbines)
- Loose supply items
- Pre-fabricated & Commercial lengths piping, tubing.
- Other miscellaneous packages

5.3.3.2 Other requirements shall be same as defined in para's 5.3.2.2 to 5.3.2.5 above.

5.4 Trial Runs of Machinery

5.4.1 Any construction defects shall be intimated to EIC before start-up. All protective and safety guards shall be installed and rotating equipment shall be checked for free movement by manual barring over. All foundation bolts and alignment shall be checked before starting the trial runs, if damaged, rotating equipment may have to be opened and repaired as directed by EIC. Prior to carrying out the trial runs, the rotating equipment will be subjected to necessary checks by the EIC and the trial runs shall be commenced only after the approval of the EIC.

5.4.2 Unless otherwise specified, all the rotating equipment will be subjected to trial runs for a continuous operation of 72 hours. In case of motor driven rotating equipments, motors shall be decoupled and turned over to other agencies doing electrical work for testing and no load running of motors. After the no load runs of motors are satisfactorily completed, EC shall recouple the motors to the rotating equipment and recheck the alignment. The trial run of the rotating equipment shall be started only after the above is completed. EC shall provide, as part of his work, necessary skilled personnel (excluding the operating personnel) for conducting the trial runs round the clock during the trial runs period. The duration of trial run may be extended if it is considered necessary in the opinion of EIC and EC shall provide personnel for such extended period also. Final inspection of bearing etc. shall be carried out by EC after the Machinery had gone through the trial run and defects, if any, shall be made good for rendering the rotating equipment ready for start up.

5.4.3 During the trial runs, readings of bearing temperature, cooling water inlet and outlet temperatures, lube oil inlet/outlet temperature and pressure, rotating equipment discharge pressure and temperature, starting in current, no load/full load current etc. shall be recorded, wherever necessary, by EC. Trial reports shall be prepared in the approved proforma by EC containing all the above details and submitted to the EIC as part of completion documents.

5.4.4 EC shall also provide necessary improvised fencing and watch & ward personnel as safety measures during trial runs.

5.5 System Start up

During start-up, EC shall provide necessary skilled personnel as per requirement of EIC, to rectify defects noticed in the rotating equipment, if such defects are attributed to him.

6.0 EQUIPMENT GROUTING

All anchor bolt sleeves/pockets and space under Base plates/machine base frames/shoe plates, etc. shall be grouted with either free flow non shrink cementitious or epoxy grout as per the following categorisation:

Sr. No.	Type of Grout	Application
1	Non shrink cementitious grout	All static and rotating equipments, unless covered in 2) below, viz Static equipments like tall columns, vertical silo, blender etc. and horizontal vessel, drum, sphere, bullets, filter, heat exchangers, coolers etc. and other similar equipments, steel stack/chimney, furnace etc. Low frequency, medium frequency, high frequency rotating machines like compressors (centrifugal, reciprocating, diaphram, screw, gear type etc.). Induced draft fan, forced draft fan, air blowers, pumps (centrifugal, reciprocating, diaphram, gear type etc.), expanders, turbine, generator, diesel generator, air coolers (fin fan cooler) and other similar equipment. Machine like screen vibrator, extractor, centrifuge pulverizer, dryer, drop hammer, ball mill, crushers, bagging machine and general workshop equipment.
2	Epoxy grout	Specifically if requested by the Machine Vendor.

6.1 Grout (Material)

All material used for grout shall be in EC's scope. Only approved grout material shall be used. EC shall submit details of grout materials for prior approval of EIC.

6.1.1 Non-Shrink Grout

Non-shrink grout shall be premix type of cementitious (cement pregraded fibre and additive) non-shrink, ready to use grout in dry powder form. It shall have free flow property when mixed with required quantity of water. It shall have initial setting time of 30 minutes.

It shall have the following features:

- Non corrosive to anchor bolts, base plate/saddle/frame, sliding plate.
- Not harmful to concrete and reinforcing steel.
- Non toxic
- Frost, oil and fire resistant
- Require normal curing
- Suitable to use under restraints and grout thickness required
- Expansive to counteract initial shrinkage
- Ensure high early strength without surface crack.
- Suitable for temperature of above 0 deg.C to 200 deg.C.
- Maximum flow distance is compatible to the dimensions of base plate/ saddle/frame.
- It should be resisted to the chemicals, gases etc. being handled in equipment/machines.

It should have the following physical properties:

-	Min. Compressive strength at	3 days	25 N/mm^2
		7 days	30 N/mm^2
		28 days	40 N/mm^2
-	Min. Tensile strength at	28 days	3.5 N/mm^2
-	Min. Bond strength at	7 days	12 N/mm^2
-	Max. Onstrained Expansion in	2 hours	4%
-	Min. Density		2000 kg/m^3

6.1.2 Epoxy Grout

Epoxy grout shall consist of epoxy resin base, hardener and filler component like graded and blended aggregate. Components of epoxy grout shall be of desired grade and mixed in proportion recommended by manufacturer such that it is injectable under base plate/frame/saddle etc., has low viscosity to meet the flow distances according to dimensions of base plate saddle/frame, it is suitable for the desired thickness, it is homogenous, free from segregation, attains high early and high final strength. It shall have minimum Pot life of 30 minutes. It shall have all the features as specified in clause 6.1.1 except for expansive properties.

It should have the following physical properties :

-	Min. compressive strength at	1 day	75 N/mm^2
		7 days	85 N/mm^2
-	Min. Flexural strength	7 days	25 N/mm^2

6.2 Grouting (Placement)

6.2.1 Surface Preparation

Prior to positioning of equipment/machine etc. over concrete pedestal, foundation, slab, beam, etc. all laitance & loose material shall be removed by wire brushing & chipping. The bearing concrete surface shall be sufficiently levelled, hacked with flat chisels to make it rough, clean (using compressed air). Additional chipping, if required, to suit level of base plate and/or minimum thickness of grout shall also be done. In case of use of cementitious grout surface shall be thoroughly wet. All pockets for anchor bolts shall also be similarly cleaned. Any excess water shall be removed. In case of use of epoxy grout, it shall be ensured that surface/pocket to receive grout is totally dry. After erection, alignment/plumbing of equipment/machine in required level, orientation and plumb and installation of sliding plate. Forms shall be constructed around and joints made tight to prevent leakage of the grout.

6.2.2 Preparation of Grout

6.2.2.1 In case of premix type of grout water shall be added in required quantity as specified by supplier and/or EIC. Any specific instruction of manufacturer will be strictly followed.

6.2.2.2 In case of epoxy grout required quantity of all constituents shall be mixed in proportion recommended by manufacturer/supplier and/or EIC. All specific requirements of manufacturer/ supplier shall be strictly followed.

6.2.2.3 Required quantity of grout shall be made considering initial setting/pot life of grout. Any grout not used within initial setting time/pot life shall be rejected and in no case used for grouting.

6.2.3 Placement of Grout

6.2.3.1 Placing of grout shall be taken up only after level, orientation, alignment of equipment/machine has been approved by EIC and anchor bolts are placed in pocket.

6.2.3.2 In case of epoxy grout EC shall give details of grouting scheme and get approval of EIC.

6.2.3.3 The grout mixture shall be poured/injected continuously (without interruption till completion) by grouting pump/injecting gun from one side of base plate and spread uniformly with flexible steel strip and rammed with rods till the space is filled solidly and grout mixture carried to the other side of base plate and fill all pockets. Any specific requirement of manufacturer/ supplier shall be strictly followed. Epoxy grout shall be done by or under supervision of manufacturer/supplier and/or agency having adequate experience in this field as per direction of EIC.

Total work shall be done under supervision and direction of EIC and care shall be taken that alignment of equipment/machine is not disturbed.

6.2.3.4 Grout mixture shall be allowed to harden for a period of minimum 7 days or as required by manufacturer/supplier of grout and/or as decided by EIC. At the end of this period, the shims/edges/pack plate may be removed and anchor bolts tightened uniformly. Alignment of equipment/machine shall be rechecked and if found correct, the voids left by the removal of shims/wedges/pack plate (if removed) must be filled up with a similar mixture of grout. In case after checking, serious misalignment is indicated, the grout shall be removed completely and fresh grouting is done after making appropriate correction of alignment.

6.2.3.5 Minimum thickness of grout shall be 25mm for all types of grout and maximum thickness shall be 40mm for non-shrink grout. For epoxy grout the maximum thickness shall be as per manufacturer's recommendation and/or as specified in drawing.

7.0 REFERENCE EIL STANDARDS/ SPECIFICATIONS

6-14-0003	Installation Procedure for Trays & Tower Internals
6-14-0011	Specification for Packing the Column
6-14-0016	Standard Specification for Review of Site Installation of Column Internals.
6-79-0011	Standard Specification for Corrosion Protection Tape Coating for Underground Steel Piping.
6-79-0020	Standard Specification for Surface Preparation and Protective Coating (New Construction)
7-12-0001	Vessel Tolerances.
7-12-0002	Support for Horizontal Vessel
7-12-0003	Wooden Pillow for Saddle Support
7-12-0004	Skirt Base Details
7-12-0024	Lifting Lug Top Head Type
7-14-0001	Construction Tolerance for Welded Supports for Tray / Tower Internals

ATTACHMENT – VI

फ्लैंज जोड़ों के लिए बल-आघूर्ण (टॉर्क) तथा हाइड्रोलिक बोल्ट टेंशन के अनुप्रयोग हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR APPLICATION OF TORQUE AND HYDRAULIC BOLT TENSION FOR FLANGE JOINTS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
3	30-06-2021	Revised and reissued for Implementation	PVK	PG	VM	SM
2	04-05-2016	Issued for Implementation	PG	SVRS	RP	RN
1	26-05-2008	Issued for Implementation	PG	KPS	AA	VC
0	15-05-2003	Issued for Implementation	PG	KPS	VC	SKG

Abbreviations:

ASME	American Society of Mechanical Engineers
PMS	Piping Material Specification

General Engineering Standards Committee

Convenor : Mr. Vinod Mahajan

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Mr. Ankul Mondal
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Mr. Bharat Bhushan Shukla
Mr. Surojit K Gayen

CONTENTS

1.0 PURPOSE

The purpose of this specification is to describe the methodology for preparation of bolted flange joints by controlled bolt tightening during construction and commissioning stage of process plant piping. This specification shall be used in conjunction with the other process/project specific requirements and the licensor/vendor recommendations.

2.0 SCOPE

This specification covers ASME B16.5 and ASME B16.47 Series B bolted flanged joints, involving identical pair of flanges, which are tightened by means of either hydraulic bolt tensioning or calibrated torque wrenches.

3.0 REFERENCES

EIL Spec no. 6-44-0005 Rev 7	-	Standard Piping Material Specification
ASME B16.5	-	Pipe Flanges and Flanged Fittings (1/2" to 24" NPS)
ASME B16.47 Series B	-	Pipe Flanges and Flanged Fittings (26" to 60" NPS)
ASME B31.3	-	Process Piping
BP RP 42-2	-	British Petroleum Recommended Practice: Bolting for flange joints
ASME Section VIII Division 1 and Division 2	-	Boiler and Pressure Vessel Code

4.0 DEFINITIONS

None.

5.0 METHODOLOGIES AND CONTROL

5.1 Identification of joints for controlled bolt tightening

Controlled bolt tightening can be done either by application of calculated bolt tension with hydraulic tensioner or by application of calculated bolt torque with calibrated torque wrenches. The criteria for selection of joints for these two application procedure are given below.

5.1.1 Hydraulic Bolt tensioning

Hydraulic bolt tensioning shall be applied for all joints where the bolt sizes match the criteria outlined in Table 1, except those in the category 'D' services. Category 'D' service is defined in ASME B31.3.

**Table 1: Criteria for Bolt Tensioning –
Not applicable for flange joints in category 'D' services**

Nominal Bolt diameter	Condition	Remarks
All	When specified by the Process licensor/ vendor / project specifications	
50 mm and above	All joints	
38 mm and above, but less than 50 mm	Class 600 and above	
	Hydrogen service	(See Note-1 below)
	Category 'M' fluid services	Refer ASME B31.3
	Joints with leakage potential	(See Note-2 below)
	Critical joints with equipments	(See Note-3 below)
25 mm and above, but less than 38 mm	Joints with leakage potential	(See Note-2 below)
	Critical joints with equipments	(See Note-3 below)

Note-1: Hydrogen Service

In absence of project specific definition, Hydrogen service may be defined as service in contact with Hydrogen or gaseous mixtures containing Hydrogen in which the partial pressure of Hydrogen is 7 bar (100 psi) abs. or more.

Note-2: Joints with leakage potential shall include

a) Joints involving tapped holes.
b) Joints not subjected to hydro test e.g. joints for equipment manholes, equipment mounted temperature, pressure and level instruments, line mounted temperature connections, on line instrument joints like control valves and safety valves, compressor volume bottles.
c) Items involving two sets of gaskets with one set of bolt e.g. orifice flange joint, joints with spectacle blind, spacer, flangeless wafer check valve, wafer type butterfly valves.
d) Tie-in joints with other contractors and package vendors.
e) High temperature (above 371°C) joints in hydrocarbon services.

Note-3: Critical joints with the equipments shall include the inlet and the outlet flanges of pumps, compressors and turbines.

5.1.2 Application of torque

Controlled bolt torque, with calculated torque values, shall be applied using calibrated torque wrench. Joints those qualify for hydraulic bolt tensioning per 5.1.1 shall not be considered for torque application. Controlled bolt torque should be applied for the joints meeting the criteria given in Table 2. Joints fulfilling the criteria for Hydraulic bolt tensioning need not be checked for these criteria

Table 2: Criteria for Bolt Torque application

Service	Joints
Hydrogen service	All joints (Note-1)
Category 'M' services	All joints (Note-1)
Other services	Class 600 and above

Note-1: Joints, those qualify for hydraulic bolt tensioning as per cl. 5.1.1, shall not be considered for torque application.

5.2 Pre-bolting Operations

5.2.1 Design

a) Flange connection with bolting of nominal diameter 25 mm and above shall have sufficient clearances and access to allow the use of hydraulic tensioning equipment (wherever hydraulic bolt tensioning is being used).

b) Stud bolts shall be longer by one diameter to suit the bolt tensioners for hydraulic bolt tensioning. Excess threads shall be protected by using nut, threaded cap etc. On bolts at ambient temperature duty the cap should have a grease nipple.

c) All flanges on hydrogen service must be left exposed unless otherwise agreed.

d) Interface joints shall be system pressure tested as per the relevant code to ensure their integrity.

5.2.2 General

a) Use of right type of gasket, fasteners etc. conforming to the specifications as per design and drawings should be ensured.

b) The Vickers hardness number of ring joint gaskets should be 30 to 40 less than that of the mating face of the flange.

c) All non-ring joint gaskets shall be replaced with the new ones whenever an opened joint is to be re-closed during construction and commissioning stage. Ring joint gaskets normally can be re-used provided they are inspected and are free from any damage

d) Shop tested flange joints should not be disturbed at site. In case the joint is opened, the Contractor shall be responsible for final hook-up joints including bolt tensioning if applicable.

5.2.3 Visual inspection

a) Condition of flange faces should be checked. Those shall be free from dirt, scale, remnant gasket, and protrusions. Faces with pitting, indentations or radial tool marks, or scratches are not desirable. Surface finish should conform to specifications.

b) Flanges should be aligned properly. Flange faces shall be parallel and boltholes shall match so that the studs can be inserted freely.

c) Visual examination of gaskets should be carried out prior to installation to ensure that these are free of any defects such as bends, crease or loose spiral windings etc.

d) Gasket position should be checked.

e) Studs and nuts shall be free from dirt, nicks, burrs and chips. Studs shall be straight and nuts shall turn freely on the stud.

f) No external load shall be used to align the flanges.

5.2.4 Corrective measures

a) Faces with pitting, indentations or radial tool marks, or scratches that form leakage paths or with the surface finish not in accordance with design requirements shall be replaced or re-machined to specified surface finish.

b) If necessary, gasket seating face should be cleaned using wire brush (SS bristles on alloy components) and/or suitable solvent.

c) Damaged gaskets shall be replaced.

d) If holding gasket in place after installation is a problem, a thin adhesive tape should be used along the outside edge of gasket.

5.2.5 Lubrication/anti-seize compound

a) Threads and nuts to flange contact face should be lubricated with suitable lubricant. Thread compound or lubricant, suitable for line temperature, may be used.

b) Gaskets should not be lubricated.

c) Lubricant shall not be applied on bolts, used in oxygen services.

d) Some of the types of lubricants used are as follows:

Molybdenum Lead oxide (graphite based)
Molykote G-n plus
Molykote P37
Molykote HSC Plus / Never Seez nickel special
API SA2
Molykote 1000
Machine oil
Graphite grease

5.2.6 Assembly

a) Suitable lubricant (refer cl. 5.2.5) to be applied to the threads and the face of the nut that contacts the flange.

b) Four studs should be placed in positions 1, 2, 3 and 4 according to "Stud Tightening Pattern" in Fig.1, as centring guides for the gasket.

c) Balance studs should be inserted next.

d) Nuts should be run down by hand in such a way that an equal number of threads project at each end.

5.2.7 Torque/tension calculation

a) Bolting load calculation and stress analysis used for computation of the listed tightening torque and tension values primarily follow the procedures outlined in ASME Section VIII Division 1/ Division 2.

b) Basic formulae used for torque calculation takes care of friction between bolt threads and nut threads as well as that between nut and back face of flange.

c) A frictional co-efficient of 0.15 is assumed for calculation of torque values for the lubricant - graphite grease. When a lubricant with different co-efficient of friction (μ) is used, the calculated values get multiplied by the ratio μ/0.15. The approximate μ values of some of the lubricants are as follows:

Type of Lubricant	Co-efficient of friction (μ)
Molybdenum lead oxide + graphite based	0.085
Molykote G-n plus	0.09
Molykote P37	0.10
Molykote HSC Plus / Never Seez nickel special	0.11
API SA2	0.117
Molykote 1000	0.13
Graphite grease / Machine oil	0.15

However, it is advisable to obtain the appropriate co-efficient of friction (μ) value from the lubricant manufacturer.

5.2.8 The PMS classes included in this specification are given in Table 3.

Table 3: PMS classes included in this specification

Sl. no	Piping class	Sl. no	Piping class	Sl. no	Piping class	Sl. no	Piping class
From Standard PMS (6-44-0005 rev 7)							
1	A1A	26	B1A	51	B6N	76	F2D
2	A2A	27	B2A	52	D1A	77	F2G
3	A4A	28	B4A	53	D2A	78	G2G
4	A6A	29	B5A	54	D4A		
5	A7A	30	B6A	55	D5A		
6	A8A	31	B9A	56	D9A		
7	A9A	32	B13A	57	D16A		
8	A11A	33	B16A	58	D19A		
9	A13A	34	B19A	59	D1D		
10	A15A	35	B32A	60	D2D		
11	A16A	36	B1D	61	D5D		
12	A19A	37	B5D	62	D5E		
13	A20A	38	B1E	63	D1K		
14	A32A	39	B3F	64	D2K		
15	A33A	40	B4F	65	E1A		
16	A4F	41	B4G	66	E2A		
17	A4G	42	B1K	67	E5A		
18	A1K	43	B2K	68	E9A		
19	A2K	44	B4K	69	E19A		
20	A6K	45	B5K	70	E5E		
21	A11K	46	B6K	71	F1A		
22	A1M	47	B1M	72	F2A		
23	A1N	48	B3M	73	F5A		
24	A4Y	49	B5M	74	F9A		
25	A33Y	50	B1N	75	F19A		

5.2.9 Torque and tension values

Table 4 contains the tension and torque values to be used for bolt tightening of each bolt using hydraulic bolt tensioner and torque wrench respectively. These values are listed PMS class and flange size wise. The tension values specified are the target load per bolt intended after the bolt tensioning operation is complete. This means any allowance inherent in bolt tensioning equipment (viz. backlash etc.) shall also to be taken care of as recommended by the equipment manufacturer.

5.2.10 Notes to Torque and tension values in Table 4

a) The **maximum allowed** design pressure & temperature combination and test pressure values are listed in Table 4. These values corresponds to PMS rating table values, except as stated in c) below. **Recalculation** of torque and tension is necessary if the design condition exceeds these limits.

b) Values in the table are **not** valid if the design condition for pipe wall thickness calculation is lower than 80% of the class rating condition. **Recalculation** of torque and tension is necessary in such cases.

c) It may be noted that for the sizes above 24" and rating class above 150 (except Lists B-1 and B-2), the calculations are carried out for 80% of the pressure used for sizes up to 24".

d) Torque / tension computation of sizes and pipe thickness, which are not covered in the respective classes of the standard PMS, are carried out based on approximate calculated pipe thickness for the specified pressure and temperature condition.

e) The "Flange Std" column of table 4 is the standard rating class followed by a suffix. Suffixes to the rating class numbers denote the flange dimensional standard and are as follows:

S - ASME B16.5 B - ASME B16.47 Series B

f) The values in the tables are not valid for non-standard flanges or flanges conforming to any other dimensional standards, e.g., ASME B16.47 Series A, AWWA (American Water Works association) etc.

g) All pressure values are in kg/cm^2 (g) and all temperature values are in °C

h) Bolt tightening torque or tension values at equipment interface flanges, if specified by the equipment vendor, shall be used.

5.3 Bolting Operation

5.3.1 General

a) Categorisation of joints for tension or torque application shall be as per cl. 5.1.

b) Bolt tightening tension or torque value shall be as per cl. 5.2.9.

c) Guidelines and safety requirements provided by the manufacturer bolt tightening equipment should be followed.

5.3.2 Hydraulic bolt tension application

a) Hydraulic pressure adequate to get the target bolt load can be calculated dividing the bolt load by the load cell hydraulic seal area. This pressure should be applied simultaneously to all load cells.

b) 4 load cells equally spaced should be used.

c) Nuts should be run down to flange surface manually.

d) Load cells should be shifted following the Criss-cross Pattern shown in Fig. 1 but in-groups of 4 bolts each (i.e. 1-2-3-4, 5-6-7-8, 9-10-11-12 etc.) and the tensioning of all bolts should be completed.

e) Tensioning operations should be repeated once again applying the same pressure.

5.3.3 Stud bolt torque application

a) Bolt torque application sequence shall be in accordance with "Criss-cross Stud Tightening Pattern" (Fig. 1).

b) Properly calibrated torque wrenches should be used.

c) Torque wrench should be held perpendicular to the axis of the bolt and if hydraulic wrench is used, it has to be ensured that it reacts against a rigid support parallel to the axis of bolt.

d) Torque should be applied using a minimum of following five steps:

i. All the nuts should be made snug tight with a short wrench (Criss-cross Pattern – Fig.1).

Flange should be bearing uniformly on the gasket (Distance between mating flanges shall be uniform).

ii. Tightening to 30% of the final torque value (Criss-cross Pattern – Fig. 1).

Flange should be bearing uniformly on the gasket (Distance between mating flanges shall be uniform).

iii. Tightening to 60% of the final torque value (Criss-cross Pattern – Fig.1).

Flange should be bearing uniformly on the gasket (Distance between mating flanges shall be uniform).

iv. Tightening to the final torque value (Criss-cross Pattern – Fig. 1).

Flange should be bearing uniformly on the gasket (Distance between mating flanges shall be uniform).

v. Tightening should be continued with the final torque in a clockwise manner (bolt to bolt) until no further rotation is observed.

e) In the event of nut seizure, the nut should be backed off and additional lubricant should be applied or the nut or/and bolt should be replaced, if necessary.

5.3.4 Testing of joints

Checking up of the individual joints for any leak during system pressure testing should be carried out using special tapes, soap solutions.

6.0 RESPONSIBILITIES / APPROVALS

6.1 All procedures/documents to be used during Construction should be submitted by the Contractor to Engineer-in-charge at site in advance.

6.2 The equipment supplier shall be subjected to EIL/Owner approval.

6.3 The details of hydraulic tensioner equipment to be used for tightening shall be intimated to Engineer-in-charge before application.

6.4 Boxing up and tightening of flange joints shall be done by skilled technicians, qualified and approved by Contractor and EIL/Owner.

6.5 Any conflict between the requirements of this standard specification and applicable codes, licensor specification, standards, data sheets, drawings, requisitions etc. shall be referred to client/ consultant. Agency carrying out bolt tightening shall list and describe all the deviations from this standard specification and the related reference documents.

7.0 DOCUMENTATION

7.1 History sheet for flange joints shall be maintained as per Annexure-I.

7.2 Sequence of the activities involved for reopening/ making/ blinding/ de-blinding/ wedge opening of flange joints shall be as per Annexure-II.

7.3 All joints shall be boxed-up and the record shall be maintained of salient points and names of the persons involved in the execution/inspection of boxing-up operation.

7.4 All critical joints shall be boxed-up under the supervision of the Contractor's representative and EIL's Engineer-in-charge or his representative and separate records shall be maintained for such joints.

7.5 Box up records of interface joints and on-line instrument joints, like control valves, safety valves, turbine flow meters etc., which are not subjected to hydro test shall be maintained separately.

7.6 If mentioned in project specification, complete set of Bolt Tensioning Equipment/ Torque Wrenches shall be supplied by Contractor to the Owner, after commissioning of the plant, as mandatory spares.

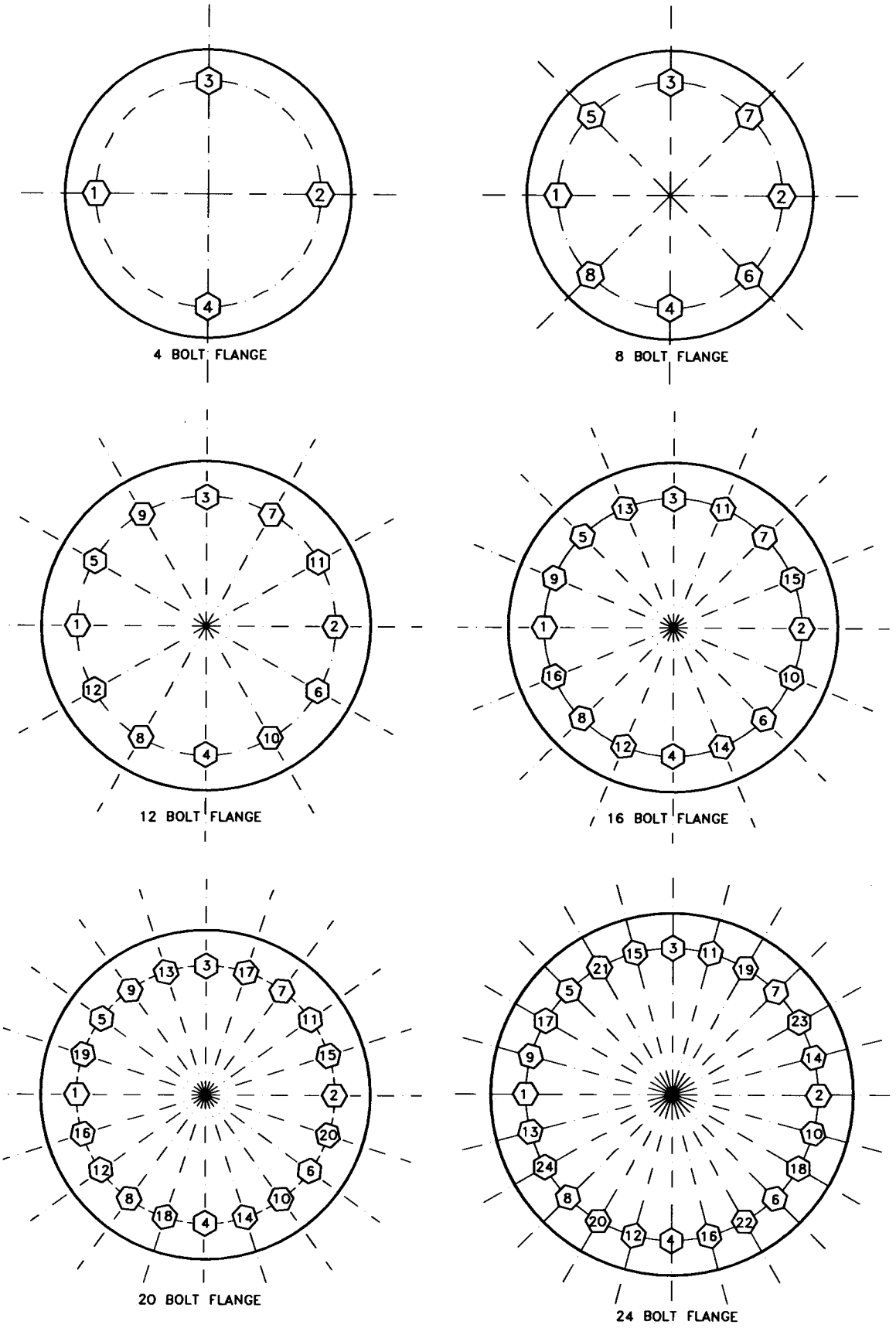

Figure 1 Typical "Criss-cross" Bolt tightening/Torque application pattern

Table 4: Bolt Tension and Torque Values

Refer cl. 5.2.8, 5.2.9 and 5.2.10 for applicability of these values

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
LIST A-1													
A1A	PMS rated Temperature / Pressure		371 / 7.73	Up to 48"	7.73	371	30.05	150S	1/2	1/2	4	684	2.1
	A105	A193 Gr. B7	Spiral wound SS	A106 Gr. B	7.73	371	30.05	150S	3/4	1/2	4	855	2.6
				A672 Gr. B60	7.73	371	30.05	150S	1	1/2	4	1027	3.1
A2A	PMS rated Temperature / Pressure		371 / 7.73	Up to 36"	7.73	371	30.05	150S	1-1/2	1/2	4	1597	4.8
	A105	A193 Gr. B7	Spiral wound SS	A106 Gr. B	7.73	371	30.05	150S	2	5/8	4	2562	9.4
				A672 Gr. B60	7.73	371	30.05	150S	3	5/8	4	3020	11.1
A6A	PMS rated Temperature / Pressure		371 / 7.73	Up to 24"	7.73	371	30.05	150S	4	5/8	8	2471	9.1
	A105	A193 Gr. B7	Spiral wound SS	A106 Gr. B	7.73	371	30.05	150S	6	3/4	8	3972	17.2
				A672 Gr. B60	7.73	371	30.05	150S	8	3/4	8	4931	21.3
A7A	PMS rated Temperature / Pressure		371 / 7.73	Up to 24"	7.73	371	30.05	150S	10	7/8	12	5135	25.5
	A105	A193 Gr. B7	Spiral wound SS	A106 Gr. B	7.73	371	30.05	150S	12	7/8	12	5326	26.5
				A672 Gr. B60	7.73	371	30.05	150S	14	1	12	6249	35.2
A9A	PMS rated Temperature / Pressure		371 / 7.73	Up to 36"	7.73	371	30.05	150S	16	1	16	5999	33.8
	A105	A193 Gr. B7	Spiral wound SS	A106 Gr. B	7.73	371	30.05	150S	18	1-1/8	16	8583	53.7
				A672 Gr. B60	7.73	371	30.05	150S	20	1-1/8	20	8583	53.7
A11A	PMS rated Temperature / Pressure		371 / 7.5	Up to 48"	7.73	371	30.05	150S	24	1-1/4	20	11379	78.3
	A105	A193 Gr. B7	Spiral wound SS	A106 Gr. B	7.73	371	30.05	150B	26	3/4	36	4111	17.7
				A672 Gr. B60	7.73	371	30.05	150B	28	3/4	40	4111	17.7
A13A	PMS rated Temperature / Pressure		371 / 7.73	Up to 24"	7.73	371	30.05	150B	30	3/4	44	4385	18.9
	A105	A193 Gr. B7	Spiral wound SS	A106 Gr. B	7.73	371	30.05	150B	32	3/4	48	4522	19.5
				A672 Gr. B60	7.73	371	30.05	150B	34	7/8	40	6274	31.2
A19A	PMS rated Temperature / Pressure		371 / 7.73	Up to 36"	7.73	371	30.05	150B	36	7/8	44	6274	31.2
	A105	A193 Gr. B7	Spiral wound SS	A106 Gr. B	7.73	371	30.05	150B	38	1	40	7750	43.7
				A 672 Gr.B 60 Cl.22	7.73	371	30.05	150B	40	1	44	7750	43.7
					7.73	371	30.05	150B	42	1	48	7750	43.7
					7.73	371	30.05	150B	44	1	52	7750	43.7
					7.73	371	30.05	150B	46	1-1/8	40	11230	70.3
					7.73	371	30.05	150B	48	1-1/8	44	10570	66.2

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
					7.73	371	30.05	150B	**50**	1-1/8	48	**10570**	**66.2**
					7.73	371	30.05	150B	**52**	1-1/8	52	**10240**	**64.1**
					7.73	371	30.05	150B	**54**	1-1/8	56	**10240**	**64.1**
					7.73	371	30.05	150B	**56**	1-1/8	60	**10240**	**64.1**
					7.73	371	30.05	150B	**58**	1-1/4	48	**13488**	**92.8**
					7.73	371	30.05	150B	**60**	1-1/4	52	**13488**	**92.8**
LIST A-2													
	PMS rated Temperature / Pressure		50 / 10.55	Up to 12"	10.55	186	15.80	150S	**1/2**	1/2	4	**684**	**2.1**
A4Y	A105	A307 GR.B	BUTYL RUBBER	API 5L GR.B PSL1	10.55	186	15.80	150S	**3/4**	1/2	4	**855**	**2.6**
					10.55	186	15.80	150S	**1**	1/2	4	**1027**	**3.1**
					10.55	186	15.80	150S	**1-1/2**	1/2	4	**1255**	**3.8**
					10.55	186	15.80	150S	**2**	5/8	4	**2013**	**7.4**
					10.55	186	15.80	150S	**3**	5/8	4	**2013**	**7.4**
					10.55	186	15.80	150S	**4**	5/8	8	**2013**	**7.4**
					10.55	186	15.80	150S	**6**	3/4	8	**3014**	**13.0**
					10.55	186	15.80	150S	**8**	3/4	8	**3014**	**13.0**
					10.55	186	15.80	150S	**10**	7/8	12	**4184**	**20.8**
					10.55	186	15.80	150S	**12**	7/8	12	**4184**	**20.8**
					10.55	186	15.80	150S	**14**	1	12	**5499**	**31.0**
					10.55	186	15.80	150S	**16**	1	16	**5499**	**31.0**
					10.55	186	15.80	150S	**18**	1-1/8	16	**7263**	**45.5**
					10.55	186	15.80	150S	**20**	1-1/8	20	**7263**	**45.5**
					10.55	186	15.80	150S	**24**	1-1/4	20	**9272**	**63.8**
LIST A-3													
	PMS rated Temperature / Pressure		204 / 14.06	Up to 48"	14.06	204	27.95	150S	**1/2**	1/2	4	**684**	**2.1**
A4A	A 350 GR.LF2 CL.1	A320 GR.L7	Spiral wound SS	A 333 GR.6	14.06	204	27.95	150S	**3/4**	1/2	4	**855**	**2.6**
				A 671 GR.CC60 CL.32	14.06	204	27.95	150S	**1**	1/2	4	**1027**	**3.1**
					14.06	204	27.95	150S	**1-1/2**	1/2	4	**1597**	**4.8**
					14.06	204	27.95	150S	**2**	5/8	4	**2562**	**9.4**
					14.06	204	27.95	150S	**3**	5/8	4	**3020**	**11.1**
					14.06	204	27.95	150S	**4**	5/8	8	**2471**	**9.1**
					14.06	204	27.95	150S	**6**	3/4	8	**3972**	**17.2**
					14.06	204	27.95	150S	**8**	3/4	8	**4931**	**21.3**

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
					14.06	204	27.95	150S	10	7/8	12	5135	25.5
					14.06	204	27.95	150S	12	7/8	12	5326	26.5
					14.06	204	27.95	150S	14	1	12	6249	35.2
					14.06	204	27.95	150S	16	1	16	5999	33.8
					14.06	204	27.95	150S	18	1-1/8	16	8583	53.7
					14.06	204	27.95	150S	20	1-1/8	20	8583	53.7
					14.06	204	27.95	150S	24	1-1/4	20	11379	78.3
					14.06	204	27.95	150B	26	3/4	36	4111	17.7
					14.06	204	27.95	150B	28	3/4	40	4111	17.7
					14.06	204	27.95	150B	30	3/4	44	4385	18.9
					14.06	204	27.95	150B	32	3/4	48	4522	19.5
					14.06	204	27.95	150B	34	7/8	40	6274	31.2
					14.06	204	27.95	150B	36	7/8	44	6274	31.2
					14.06	204	27.95	150B	38	1	40	7750	43.7
					14.06	204	27.95	150B	40	1	44	7750	43.7
					14.06	204	27.95	150B	42	1	48	7750	43.7
					14.06	204	27.95	150B	44	1	52	7750	43.7
					14.06	204	27.95	150B	46	1-1/8	40	11230	70.3
					14.06	204	27.95	150B	48	1-1/8	44	10570	66.2
LIST A-4													
A8A	PMS rated Temperature / Pressure		65 / 19.17	Up to 6"	8.78	343	30.05	150S	1/2	1/2	4	684	2.1
	A105	A193 GR.B7	BS7531 GR X	A 106 GR.B	8.78	343	30.05	150S	3/4	1/2	4	855	2.6
					8.78	343	30.05	150S	1	1/2	4	1027	3.1
A15A	PMS rated Temperature / Pressure		343 / 8.78	Up to 16"	8.78	343	30.05	150S	1-1/2	1/2	4	1597	4.8
	A105	A193 GR.B7	BS7531 GR X	A 106 GR.B	8.78	343	30.05	150S	2	5/8	4	2562	9.4
				A672 Gr. B60	8.78	343	30.05	150S	3	5/8	4	3020	11.1
A20A	PMS rated Temperature / Pressure		343 / 8.78	Up to 18"	8.78	343	30.05	150S	4	5/8	8	2471	9.1
	A105	A193 GR.B7	BS7531 GR X	A 106 GR.B	8.78	343	30.05	150S	6	3/4	8	3972	17.2
				A672 Gr. B60	8.78	343	30.05	150S	8	3/4	8	4931	21.3
A32A	PMS rated Temperature / Pressure		280 / 11.19	Up to 3"	8.78	343	30.05	150S	10	7/8	12	5135	25.5
	A105	A193 GR.B7	BS7531 GR X	A 106 GR.B	8.78	343	30.05	150S	12	7/8	12	5326	26.5
					8.78	343	30.05	150S	14	1	12	6249	35.2

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
A33A	PMS rated Temperature / Pressure		65 / 18.9	Up to 48"	8.78	343	30.05	150S	16	1	16	5999	33.8
	A105	A193 GR.B7	BS7531 GR X	A 106 GR.B	8.78	343	30.05	150S	18	1-1/8	16	8583	53.7
				IS-3589 GR.410	8.78	343	30.05	150S	20	1-1/8	20	8583	53.7
A33Y	PMS rated Temperature / Pressure		65 / 18.9	Up to 48"	8.78	343	30.05	150S	24	1-1/4	20	11379	78.3
	A105	A193 GR.B7	BS7531 GR X	A 106 GR.B	8.78	343	30.05	150B	26	3/4	36	4111	17.7
				IS-3589 GR.410	8.78	343	30.05	150B	28	3/4	40	4111	17.7
					8.78	343	30.05	150B	30	3/4	44	4385	18.9
					8.78	343	30.05	150B	32	3/4	48	4522	19.5
					8.78	343	30.05	150B	34	7/8	40	6274	31.2
					8.78	343	30.05	150B	36	7/8	44	6274	31.2
					8.78	343	30.05	150B	38	1	40	7750	43.7
					8.78	343	30.05	150B	40	1	44	7750	43.7
					8.78	343	30.05	150B	42	1	48	7750	43.7
					8.78	343	30.05	150B	44	1	52	7750	43.7
					8.78	343	30.05	150B	46	1-1/8	40	11230	70.3
					8.78	343	30.05	150B	48	1-1/8	44	10570	66.2
					8.78	343	30.05	150B	50	1-1/8	48	10570	66.2
					8.78	343	30.05	150B	52	1-1/8	52	10240	64.1
					8.78	343	30.05	150B	54	1-1/8	56	10240	64.1
					8.78	343	30.05	150B	56	1-1/8	60	10240	64.1
					8.78	343	30.05	150B	58	1-1/4	48	13488	92.8
					8.78	343	30.05	150B	60	1-1/4	52	13488	92.8
LIST A-5													
A16A	PMS rated Temperature / Pressure		371 / 7.73	Up to 24"	7.73	371	30.05	150S	1/2	1/2	4	684	2.1
	A105	A193 Gr. B7M	Spiral wound SS	A106 Gr. B	7.73	371	30.05	150S	3/4	1/2	4	855	2.6
				A672 Gr. B60	7.73	371	30.05	150S	1	1/2	4	1027	3.1
					7.73	371	30.05	150S	1-1/2	1/2	4	1597	4.8
					7.73	371	30.05	150S	2	5/8	4	2562	9.4
					7.73	371	30.05	150S	3	5/8	4	3020	11.1
					7.73	371	30.05	150S	4	5/8	8	2471	9.1
					7.73	371	30.05	150S	6	3/4	8	3972	17.2
					7.73	371	30.05	150S	8	3/4	8	4931	21.3
					7.73	371	30.05	150S	10	7/8	12	5135	25.5

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
					7.73	371	30.05	150S	12	7/8	12	5326	26.5
					7.73	371	30.05	150S	14	1	12	6249	35.2
					7.73	371	30.05	150S	16	1	16	5999	33.8
					7.73	371	30.05	150S	18	1-1/8	16	8583	53.7
					7.73	371	30.05	150S	20	1-1/8	20	8583	53.7
					7.73	371	30.05	150S	24	1-1/4	20	11379	78.3
LIST A-6													
A4F	PMS rated Temperature / Pressure		371 / 7.73	Up to 24"	7.73	371	30.57	150S	1/2	1/2	4	798	2.4
	A182 Gr.F5	A193 Gr.B16	Spiral wound SS	A 335 GR.P5	7.73	371	30.57	150S	3/4	1/2	4	970	2.9
				A 691 GR.5Cr CL.42	7.73	371	30.57	150S	1	1/2	4	1141	3.4
					7.73	371	30.57	150S	1-1/2	1/2	4	1540	4.6
					7.73	371	30.57	150S	2	5/8	4	2745	10.1
					7.73	371	30.57	150S	3	5/8	4	3020	11.1
					7.73	371	30.57	150S	4	5/8	8	3020	11.1
					7.73	371	30.57	150S	6	3/4	8	5205	22.5
					7.73	371	30.57	150S	8	3/4	8	5274	22.8
					7.73	371	30.57	150S	10	7/8	12	6277	31.2
					7.73	371	30.57	150S	12	7/8	12	6277	31.2
					7.73	371	30.57	150S	14	1	12	8249	46.5
					7.73	371	30.57	150S	16	1	16	7249	40.9
					7.73	371	30.57	150S	18	1-1/8	16	11885	74.4
					7.73	371	30.57	150S	20	1-1/8	20	11554	72.4
					7.73	371	30.57	150S	24	1-1/4	20	14751	101.5
					7.73	371	30.57	150B	26	3/4	36	4109	17.7
					7.73	371	30.57	150B	28	3/4	40	4383	18.9
					7.73	371	30.57	150B	30	3/4	44	4520	19.5
					7.73	371	30.57	150B	32	3/4	48	4794	20.7
					7.73	371	30.57	150B	34	7/8	40	6847	34.0
					7.73	371	30.57	150B	36	7/8	44	7037	35.0
					7.73	371	30.57	150B	38	1	40	8748	49.3
					7.73	371	30.57	150B	40	1	44	8748	49.3
					7.73	371	30.57	150B	42	1	48	8498	47.9

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
LIST A-7													
A4G	PMS rated Temperature / Pressure		371 / 7.73	Up to 24"	7.73	371	30.57	150S	1/2	1/2	4	798	2.4
	A182 Gr.F9	A193 Gr.B16	Spiral wound SS	A 335 GR.P9	7.73	371	30.57	150S	3/4	1/2	4	970	2.9
				A 691 GR.9Cr CL.42	7.73	371	30.57	150S	1	1/2	4	1255	3.8
					7.73	371	30.57	150S	1-1/2	1/2	4	1825	5.5
					7.73	371	30.57	150S	2	5/8	4	3203	11.8
					7.73	371	30.57	150S	3	5/8	4	3386	12.4
					7.73	371	30.57	150S	4	5/8	8	3386	12.4
					7.73	371	30.57	150S	6	3/4	8	5342	23.1
					7.73	371	30.57	150S	8	3/4	8	5342	23.1
					7.73	371	30.57	150S	10	7/8	12	7037	35.0
					7.73	371	30.57	150S	12	7/8	12	6847	34.0
					7.73	371	30.57	150S	14	1	12	8748	49.3
					7.73	371	30.57	150S	16	1	16	7999	45.1
					7.73	371	30.57	150S	18	1-1/8	16	12215	76.5
					7.73	371	30.57	150S	20	1-1/8	20	11885	74.4
					7.73	371	30.57	150S	24	1-1/4	20	15594	107.3
					7.73	371	30.57	150B	26	3/4	36	4383	18.9
					7.73	371	30.57	150B	28	3/4	40	4589	19.8
					7.73	371	30.57	150B	30	3/4	44	4726	20.4
					7.73	371	30.57	150B	32	3/4	48	5137	22.2
					7.73	371	30.57	150B	34	7/8	40	7132	35.5
					7.73	371	30.57	150B	36	7/8	44	7132	35.5
					7.73	371	30.57	150B	38	1	40	9123	51.4
					7.73	371	30.57	150B	40	1	44	9123	51.4
					7.73	371	30.57	150B	42	1	48	8998	50.7
LIST A-8													
A2K	PMS rated Temperature / Pressure		120 / 15.32	Up to 24"	15.32	120	29.00	150S	1/2	1/2	4	570	1.7
	A 182 GR.F304	A320 GR.B8CL.2	Spiral wound SS	A 312 TP304	15.32	120	29.00	150S	3/4	1/2	4	855	2.6
				A 358 GR.304	15.32	120	29.00	150S	1	1/2	4	1141	3.4
					15.32	120	29.00	150S	1-1/2	1/2	4	1597	4.8
					15.32	120	29.00	150S	2	5/8	4	2379	8.7
					15.32	120	29.00	150S	3	5/8	4	3203	11.8

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
					15.32	120	29.00	150S	4	5/8	8	2837	10.4
					15.32	120	29.00	150S	6	3/4	8	4383	18.9
					15.32	120	29.00	150S	8	3/4	8	5068	21.9
					15.32	120	29.00	150S	10	7/8	12	5516	27.4
					15.32	120	29.00	150S	12	7/8	12	5896	29.3
					15.32	120	29.00	150S	14	1	12	7499	42.3
					15.32	120	29.00	150S	16	1	16	6749	38.1
					15.32	120	29.00	150S	18	1-1/8	16	9574	59.9
					15.32	120	29.00	150S	20	1-1/8	20	9574	59.9
					15.32	120	29.00	150S	24	1-1/4	20	12644	87.0
					15.32	120	29.00	150B	26	3/4	36	4109	17.7
					15.32	120	29.00	150B	28	3/4	40	4246	18.3
					15.32	120	29.00	150B	30	3/4	44	4383	18.9
					15.32	120	29.00	150B	32	3/4	48	4520	19.5
					15.32	120	29.00	150B	34	7/8	40	5896	29.3
					15.32	120	29.00	150B	36	7/8	44	5991	29.8
LIST A-9													
A1K	PMS rated Temperature / Pressure		371 / 7.73	Up to 24"	7.73	371	29.00	150S	1/2	1/2	4	570	1.7
	A 182 GR.F304	A193 GR.B7	Spiral wound SS	A 312 TP304	7.73	371	29.00	150S	3/4	1/2	4	798	2.4
				A 358 GR.304	7.73	371	29.00	150S	1	1/2	4	913	2.7
A6K	PMS rated Temperature / Pressure		371 / 7.73	Up to 24"	7.73	371	29.00	150S	1-1/2	1/2	4	1141	3.4
	A 182 GR.F304L	A193 GR.B7	Spiral wound SS	A 312 TP304L	7.73	371	29.00	150S	2	5/8	4	2562	9.4
				A 358 GR.304L	7.73	371	29.00	150S	3	5/8	4	3020	11.1
A11K	PMS rated Temperature / Pressure		371 / 7.73	Up to 24"	7.73	371	29.00	150S	4	5/8	8	2471	9.1
	A 182 GR.F304L	A193 GR.B7	Spiral wound SS	A 312 TP304L	7.73	371	29.00	150S	6	3/4	8	3972	17.2
				A 358 GR.304L	7.73	371	29.00	150S	8	3/4	8	4931	21.3
					7.73	371	29.00	150S	10	7/8	12	5135	25.5
					7.73	371	29.00	150S	12	7/8	12	5326	26.5
					7.73	371	29.00	150S	14	1	12	6249	35.2
					7.73	371	29.00	150S	16	1	16	5999	33.8
					7.73	371	29.00	150S	18	1-1/8	16	8583	53.7
					7.73	371	29.00	150S	20	1-1/8	20	8583	53.7
					7.73	371	29.00	150S	24	1-1/4	20	11379	78.3

Piping Class	PMS class data: Temperature, pressure, materials and size range				Calculation Data								
	Flange	Bolt	Gasket	Pipe	Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
LIST A-10													
A1M	PMS rated Temperature / Pressure		371 / 7.73	Up to 24"	7.73	371	29.00	150S	1/2	1/2	4	570	1.7
	A 182 GR.F316	A193 GR.B7	Spiral wound SS	A 312 TP316	7.73	371	29.00	150S	3/4	1/2	4	798	2.4
				A 358 GR.316	7.73	371	29.00	150S	1	1/2	4	913	2.7
					7.73	371	29.00	150S	1-1/2	1/2	4	1141	3.4
					7.73	371	29.00	150S	2	5/8	4	2562	9.4
					7.73	371	29.00	150S	3	5/8	4	3020	11.1
					7.73	371	29.00	150S	4	5/8	8	2471	9.1
					7.73	371	29.00	150S	6	3/4	8	3972	17.2
					7.73	371	29.00	150S	8	3/4	8	4931	21.3
					7.73	371	29.00	150S	10	7/8	12	5135	25.5
					7.73	371	29.00	150S	12	7/8	12	5326	26.5
					7.73	371	29.00	150S	14	1	12	6249	35.2
					7.73	371	29.00	150S	16	1	16	5999	33.8
					7.73	371	29.00	150S	18	1-1/8	16	8583	53.7
					7.73	371	29.00	150S	20	1-1/8	20	8583	53.7
					7.73	371	29.00	150S	24	1-1/4	20	11379	78.3
LIST A-11													
A1N	PMS rated Temperature / Pressure		371 / 7.73	Up to 24"	7.73	371	24.26	150S	1/2	1/2	4	570	1.7
	A 182 GR.F316L	A193 GR.B7	Spiral wound SS	A 312 TP316L	7.73	371	24.26	150S	3/4	1/2	4	798	2.4
				A 358 GR.316L	7.73	371	24.26	150S	1	1/2	4	913	2.7
					7.73	371	24.26	150S	1-1/2	1/2	4	1426	4.3
					7.73	371	24.26	150S	2	5/8	4	2562	9.4
					7.73	371	24.26	150S	3	5/8	4	3020	11.1
					7.73	371	24.26	150S	4	5/8	8	2471	9.1
					7.73	371	24.26	150S	6	3/4	8	3972	17.2
					7.73	371	24.26	150S	8	3/4	8	4931	21.3
					7.73	371	24.26	150S	10	7/8	12	5135	25.5
					7.73	371	24.26	150S	12	7/8	12	5326	26.5
					7.73	371	24.26	150S	14	1	12	6249	35.2
					7.73	371	24.26	150S	16	1	16	5999	33.8
					7.73	371	24.26	150S	18	1-1/8	16	8583	53.7
					7.73	371	24.26	150S	20	1-1/8	20	8583	53.7

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
					7.73	371	24.26	150S	24	1-1/4	20	11379	78.3
LIST B-1													
B1A	PMS rated Temperature / Pressure		427 / 28.82	Up to 24"	28.82	427	79.10	300S	1/2	1/2	4	741	2.2
	A105	A193 GR.B7	Spiral wound SS	A 106 GR.B	28.82	427	79.10	300S	3/4	5/8	4	1373	5.0
				A 672 GR.B60 CL.12	28.82	427	79.10	300S	1	5/8	4	1647	6.0
B2A	PMS rated Temperature / Pressure		427 / 28.82	Up to 24"	28.82	427	79.10	300S	1-1/2	3/4	4	2740	11.8
	A105	A193 GR.B7	Spiral wound SS	A 106 GR.B	28.82	427	79.10	300S	2	5/8	8	2105	7.7
				A 672 GR.B60 CL.12	28.82	427	79.10	300S	3	3/4	8	3972	17.2
B5A	PMS rated Temperature / Pressure		230 / 43.66	Up to 24"	28.82	427	79.10	300S	4	3/4	8	5205	22.5
	A105	A193 GR.B7	Spiral wound SS	A 106 GR.B	28.82	427	79.10	300S	6	3/4	12	5205	22.5
				A 672 GR.B60 CL.32	28.82	427	79.10	300S	8	7/8	12	7608	37.8
B6A	PMS rated Temperature / Pressure		427 / 28.82	Up to 24"	28.82	427	79.10	300S	10	1	16	8748	49.3
	A105	A193 GR.B7	Spiral wound SS	A 106 GR.B	28.82	427	79.10	300S	12	1-1/8	16	11554	72.4
				A 672 GR.B60 CL.12	28.82	427	79.10	300S	14	1-1/8	20	8913	55.8
B9A	PMS rated Temperature / Pressure		427 / 28.82	Up to 24"	28.82	427	79.10	300S	16	1-1/4	20	10958	75.4
	A105	A193 GR.B7	Spiral wound SS	A 106 GR.B	28.82	427	79.10	300S	18	1-1/4	24	11801	81.2
				A 672 GR.B60 CL.12	28.82	427	79.10	300S	20	1-1/4	24	14330	98.6
B13A	PMS rated Temperature / Pressure		427 / 28.82	Up to 24"	28.82	427	79.10	300S	24	1-1/2	24	17849	144.9
	A105	A193 GR.B7	Spiral wound SS	A 106 GR.B	28.82	427	79.10	300B	26	1-1/4	32	13065	89.9
				A 672 GR.B60 CL.12	28.82	427	79.10	300B	28	1-1/4	36	13065	89.9
B19A	PMS rated Temperature / Pressure		427 / 28.82	Up to 24"	28.82	427	79.10	300B	30	1-3/8	36	15197	114.0
	A105	A193 GR.B7	Spiral wound SS	A 106 GR.B	28.82	427	79.10	300B	32	1-1/2	32	18487	150.1
				A 672 GR.B60 CL.22	28.82	427	79.10	300B	34	1-1/2	36	18168	147.5
B32A	PMS rated Temperature / Pressure		427 / 28.82	Up to 3"	28.82	427	79.10	300B	36	1-5/8	32	23630	206.5
	A105	A193 GR.B7	Spiral wound SS	A 106 GR.B	28.82	427	79.10	300B	38	1-5/8	36	25154	219.9
				A 672 GR.B60 CL.12	28.82	427	79.10	300B	40	1-5/8	40	24392	213.2
					28.82	427	79.10	300B	42	1-3/4	36	29631	277.5
LIST B-2													
B4A	PMS rated Temperature / Pressure		204 / 43.23	Up to 24"	28.82	427	79.10	300S	1/2	1/2	4	741	2.2
	A350 Gr.LF2 CL.1	A320 Gr.L7	Spiral wound SS	A333 Gr.6	28.82	427	79.10	300S	3/4	5/8	4	1373	5.0
				A671 Gr.CC60 CL.32	28.82	427	79.10	300S	1	5/8	4	1647	6.0
B16A	PMS rated Temperature / Pressure		427 / 28.82	Up to 24"	28.82	427	79.10	300S	1-1/2	3/4	4	2740	11.8
	A105	A193 Gr.B7M	Spiral wound SS	A106 Gr.B	28.82	427	79.10	300S	2	5/8	8	2105	7.7

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
				A672 Gr.B60 CL.22	28.82	427	79.10	300S	3	3/4	8	3972	17.2
					28.82	427	79.10	300S	4	3/4	8	5205	22.5
					28.82	427	79.10	300S	6	3/4	12	5205	22.5
					28.82	427	79.10	300S	8	7/8	12	7608	37.8
					28.82	427	79.10	300S	10	1	16	8748	49.3
					28.82	427	79.10	300S	12	1-1/8	16	11554	72.4
					28.82	427	79.10	300S	14	1-1/8	20	8913	55.8
					28.82	427	79.10	300S	16	1-1/4	20	10958	75.4
					28.82	427	79.10	300S	18	1-1/4	24	11801	81.2
					28.82	427	79.10	300S	20	1-1/4	24	14330	98.6
					28.82	427	79.10	300S	24	1-1/2	24	17849	144.9
					28.82	427	79.10	300B	26	1-1/4	32	13065	89.9
					28.82	427	79.10	300B	28	1-1/4	36	13065	89.9
					28.82	427	79.10	300B	30	1-3/8	36	15197	114.0
LIST B-3													
B1D	PMS rated Temperature / Pressure		538 / 15.11	Up to 24"	15.11	538	79.10	300S	1/2	1/2	4	741	2.2
	A182 Gr. F11 Cl. 2	A193 Gr. B16	Spiral wound SS	A335 Gr. P11	15.11	538	79.10	300S	3/4	5/8	4	1007	3.7
				A691 Gr.1.25Cr Cl.42	15.11	538	79.10	300S	1	5/8	4	1647	6.0
B5D	PMS rated Temperature / Pressure		538 / 15.11	Up to 24"	15.11	538	79.10	300S	1-1/2	3/4	4	3014	13.0
	A182 Gr. F11 Cl. 2	A193 Gr. B16	Spiral wound SS	A335 Gr. P11	15.11	538	79.10	300S	2	5/8	8	2196	8.1
				A691 Gr.1.25Cr Cl.42	15.11	538	79.10	300S	3	3/4	8	4794	20.7
B3F	PMS rated Temperature / Pressure		538 / 14.06	Up to 24"	15.11	538	79.10	300S	4	3/4	8	5205	22.5
	A 182 GR.F5	A193 GR.B16	Spiral wound SS	A 335 GR.P5	15.11	538	79.10	300S	6	3/4	12	5205	22.5
				A 691 GR5CR CL.42	15.11	538	79.10	300S	8	7/8	12	7228	35.9
B4F	PMS rated Temperature / Pressure		538 / 14.06	Up to 24"	15.11	538	79.10	300S	10	1	16	9498	53.6
	A 182 GR.F5	A193 GR.B16	Spiral wound SS	A 335 GR.P5	15.11	538	79.10	300S	12	1-1/8	16	11885	74.4
				A 691 Gr. 5CR CL.42	15.11	538	79.10	300S	14	1-1/8	20	9574	59.9
					15.11	538	79.10	300S	16	1-1/4	20	11801	81.2
					15.11	538	79.10	300S	18	1-1/4	24	12222	84.1
					15.11	538	79.10	300S	20	1-1/4	24	14751	101.5
					15.11	538	79.10	300S	24	1-1/2	24	17849	144.9
					12.09	538	63.28	300B	26	1-1/4	32	10958	75.4
					12.09	538	63.28	300B	28	1-1/4	36	10958	75.4

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
					12.09	538	63.28	300B	30	1-3/8	36	12577	94.3
					12.09	538	63.28	300B	32	1-1/2	32	15937	129.4
					12.09	538	63.28	300B	34	1-1/2	36	15299	124.2
					12.09	538	63.28	300B	36	1-5/8	32	19819	173.2
					12.09	538	63.28	300B	38	1-5/8	36	22105	193.2
					12.09	538	63.28	300B	40	1-5/8	40	21343	186.5
					12.09	538	63.28	300B	42	1-3/4	36	26937	252.3
LIST B-4													
B1E	PMS rated Temperature / Pressure		538 / 18.63	Up to 24"	18.63	538	79.10	300S	1/2	1/2	4	855	2.6
	A 182 GR.F22 CL.3	A193 Gr. B16	Spiral wound SS	A335 Gr. P22	18.63	538	79.10	300S	3/4	5/8	4	1098	4.0
				A691 Gr.2.25Cr Cl.42	18.63	538	79.10	300S	1	5/8	4	1830	6.7
B4G	PMS rated Temperature / Pressure		538 / 17,92	Up to 24"	18.63	538	79.10	300S	1-1/2	3/4	4	3287	14.2
	A 182 GR.F9	A193 GR.B16	Spiral wound SS	A 335 GR.P9	18.63	538	79.10	300S	2	5/8	8	2288	8.4
				A 691 GR9CR CL.42	18.63	538	79.10	300S	3	3/4	8	4931	21.3
					18.63	538	79.10	300S	4	3/4	8	5342	23.1
					18.63	538	79.10	300S	6	3/4	12	5342	23.1
					18.63	538	79.10	300S	8	7/8	12	7418	36.9
					18.63	538	79.10	300S	10	1	16	9748	55.0
					18.63	538	79.10	300S	12	1-1/8	16	12215	76.5
					18.63	538	79.10	300S	14	1-1/8	20	10234	64.1
					18.63	538	79.10	300S	16	1-1/4	20	12644	87.0
					18.63	538	79.10	300S	18	1-1/4	24	13065	89.9
					18.63	538	79.10	300S	20	1-1/4	24	15173	104.4
					18.63	538	79.10	300S	24	1-1/2	24	18487	150.1
					14.90	538	63.28	300B	26	1-1/4	32	11801	81.2
					14.90	538	63.28	300B	28	1-1/4	36	11801	81.2
					14.90	538	63.28	300B	30	1-3/8	36	13625	102.2
					14.90	538	63.28	300B	32	1-1/2	32	17212	139.8
					14.90	538	63.28	300B	34	1-1/2	36	16574	134.6
					14.90	538	63.28	300B	36	1-5/8	32	21343	186.5
					14.90	538	63.28	300B	38	1-5/8	36	23630	206.5
					14.90	538	63.28	300B	40	1-5/8	40	22868	199.9
					14.90	538	63.28	300B	42	1-3/4	36	28733	269.1

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
LIST B-5													
B6K	PMS rated Temperature / Pressure		427 / 24.25	Up to 24"	24.25	427	63.27	300S	1/2	1/2	4	570	1.7
	A 182 GR.F304L	A193 GR.B7	Spiral wound SS	A 312 TP304L	24.25	427	63.27	300S	3/4	5/8	4	915	3.4
				A 358 TP304L CL.1	24.25	427	63.27	300S	1	5/8	4	1281	4.7
					24.25	427	63.27	300S	1-1/2	3/4	4	2192	9.5
					24.25	427	63.27	300S	2	5/8	8	1464	5.4
					24.25	427	63.27	300S	3	3/4	8	2466	10.6
					24.25	427	63.27	300S	4	3/4	8	2740	11.8
					24.25	427	63.27	300S	6	3/4	12	3150	13.6
					24.25	427	63.27	300S	8	7/8	12	4945	24.6
					24.25	427	63.27	300S	10	1	16	5249	29.6
					24.25	427	63.27	300S	12	1-1/8	16	7263	45.5
					24.25	427	63.27	300S	14	1-1/8	20	6933	43.4
					24.25	427	63.27	300S	16	1-1/4	20	8851	60.9
					24.25	427	63.27	300S	18	1-1/4	24	9694	66.7
					24.25	427	63.27	300S	20	1-1/4	24	11379	78.3
					24.25	427	63.27	300S	24	1-1/2	24	14662	119.1
LIST B-6													
B1K	PMS rated Temperature / Pressure		454 / 27.77	Up to 24"	5.97	704	75.93	300S	1/2	1/2	4	798	2.4
	A 182 GR.F304	A193 GR.B7	Spiral wound SS	A 312 TP304	5.97	704	75.93	300S	3/4	5/8	4	1281	4.7
				A 358 TP304 CL.1	5.97	704	75.93	300S	1	5/8	4	1464	5.4
B2K	PMS rated Temperature / Pressure		120 / 40.14	Up to 24"	5.97	704	75.93	300S	1-1/2	3/4	4	2740	11.8
	A 182 GR.F304	A320 GR.B8CL.2	Spiral wound SS	A 312 TP304	5.97	704	75.93	300S	2	5/8	8	2105	7.7
				A 358 TP316L CL.1	5.97	704	75.93	300S	3	3/4	8	3561	15.4
B4K	PMS rated Temperature / Pressure		704 /8.08	Up to 24"	5.97	704	75.93	300S	4	3/4	8	3972	17.2
	A 182 GR.F304H	A453 GR.660CL.A	Spiral wound SS	A 312 TP304H	5.97	704	75.93	300S	6	3/4	12	4109	17.7
					5.97	704	75.93	300S	8	7/8	12	6086	30.3
B5K	PMS rated Temperature / Pressure		704/8.08	Up to 24"	5.97	704	75.93	300S	10	1	16	7499	42.3
	A 182 GR.F304H	A453 GR.660CL.A	Spiral wound SS	A 312 TP304H	5.97	704	75.93	300S	12	1-1/8	16	9574	59.9
					5.97	704	75.93	300S	14	1-1/8	20	8253	51.7
					5.97	704	75.93	300S	16	1-1/4	20	10537	72.5
					5.97	704	75.93	300S	18	1-1/4	24	11379	78.3
					5.97	704	75.93	300S	20	1-1/4	24	12644	87.0

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
					5.97	704	75.93	300S	24	1-1/2	24	15937	129.4
					4.78	704	60.74	300B	26	1-1/4	32	10537	72.5
					4.78	704	60.74	300B	28	1-1/4	36	11801	81.2
					4.78	704	60.74	300B	30	1-3/8	36	12577	94.3
					4.78	704	60.74	300B	32	1-1/2	32	15937	129.4
					4.78	704	60.74	300B	34	1-1/2	36	15937	129.4
					4.78	704	60.74	300B	36	1-5/8	32	19819	173.2
					4.78	704	60.74	300B	38	1-5/8	36	20581	179.9
					4.78	704	60.74	300B	40	1-5/8	40	19819	173.2
					4.78	704	60.74	300B	42	1-3/4	36	25142	235.5
LIST B-7													
B1M	PMS rated Temperature / Pressure		427 / 29.52	Up to 24"	26.66	538	75.95	300S	1/2	1/2	4	570	1.7
	A 182 GR.F316	A193 GR.B7	Spiral wound SS	A 312 TP316	26.66	538	75.95	300S	3/4	5/8	4	1373	5.0
				A 358 TP316 CL.1	26.66	538	75.95	300S	1	5/8	4	1373	5.0
B3M	PMS rated Temperature / Pressure		538 / 25.66	Up to 24"	26.66	538	75.95	300S	1-1/2	3/4	4	2192	9.5
	A 182 GR.F321	A453 GR.660CL.A	Spiral wound SS	A 312 TP321	26.66	538	75.95	300S	2	5/8	8	1556	5.7
				A 358 TP321 CL.1	26.66	538	75.95	300S	3	3/4	8	2603	11.2
B5M	PMS rated Temperature / Pressure		538 / 24.60	Up to 24"	26.66	538	75.95	300S	4	3/4	8	3972	17.2
	A 182 GR.F316H	A453 GR.660CL.A	Spiral wound SS	A 312 TP316H	26.66	538	75.95	300S	6	3/4	12	3972	17.2
					26.66	538	75.95	300S	8	7/8	12	5706	28.4
					26.66	538	75.95	300S	10	1	16	6999	39.5
					26.66	538	75.95	300S	12	1-1/8	16	8253	51.7
					26.66	538	75.95	300S	14	1-1/8	20	7593	47.5
					26.66	538	75.95	300S	16	1-1/4	20	9694	66.7
					26.66	538	75.95	300S	18	1-1/4	24	10537	72.5
					26.66	538	75.95	300S	20	1-1/4	24	12222	84.1
					26.66	538	75.95	300S	24	1-1/2	24	16256	132.0
					20.53	538	60.82	300B	26	1-1/4	32	10537	72.5
					20.53	538	60.82	300B	28	1-1/4	36	10537	72.5
					20.53	538	60.82	300B	30	1-3/8	36	11791	88.4
					20.53	538	60.82	300B	32	1-1/2	32	14981	121.6
					20.53	538	60.82	300B	34	1-1/2	36	14343	116.5
					20.53	538	60.82	300B	36	1-5/8	32	17913	156.6

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
					20.53	538	60.82	300B	38	1-5/8	36	19056	166.6
					20.53	538	60.82	300B	40	1-5/8	40	18294	159.9
					20.53	538	60.82	300B	42	1-3/4	36	22897	214.4
LIST B-8													
B1N	PMS rated Temperature / Pressure		454 / 23.90	Up to 24"	23.90	454	63.27	300S	1/2	1/2	4	570	1.7
	A 182 GR.F316L	A193 GR.B7	Spiral wound SS	A 312 TP316L	23.90	454	63.27	300S	3/4	5/8	4	915	3.4
				A 358 TP 316L CL.1	23.90	454	63.27	300S	1	5/8	4	1281	4.7
B6N	PMS rated Temperature / Pressure		427 / 24.25	Up to 24"	23.90	454	63.27	300S	1-1/2	3/4	4	2192	9.5
	A 182 GR.F316L	A193 GR.B7	Spiral wound SS	A 312 TP316L	23.90	454	63.27	300S	2	5/8	8	1464	5.4
				A 358 TP 316L CL.1	23.90	454	63.27	300S	3	3/4	8	2466	10.6
					23.90	454	63.27	300S	4	3/4	8	2740	11.8
					23.90	454	63.27	300S	6	3/4	12	3150	13.6
					23.90	454	63.27	300S	8	7/8	12	4945	24.6
					23.90	454	63.27	300S	10	1	16	5249	29.6
					23.90	454	63.27	300S	12	1-1/8	16	7263	45.5
					23.90	454	63.27	300S	14	1-1/8	20	6933	43.4
					23.90	454	63.27	300S	16	1-1/4	20	8851	60.9
					23.90	454	63.27	300S	18	1-1/4	24	9694	66.7
					23.90	454	63.27	300S	20	1-1/4	24	11379	78.3
					23.90	454	63.27	300S	24	1-1/2	24	14662	119.1
LIST D-1													
D1A	PMS rated Temperature / Pressure		427 / 58.00	Up to 24"	58.00	427	156.08	600S	1/2	1/2	4	970	2.9
	A105	A193 GR.B7	Spiral wound SS	A 106 GR.B	58.00	427	156.08	600S	3/4	5/8	4	1373	5.0
				A 672 GR.B60 CL.12	58.00	427	156.08	600S	1	5/8	4	2013	7.4
D2A	PMS rated Temperature / Pressure		427 / 58.00	Up to 24"	58.00	427	156.08	600S	1-1/2	3/4	4	4520	19.5
	A105	A193 GR.B7	Spiral wound SS	A 106 GR.B	58.00	427	156.08	600S	2	5/8	8	3112	11.4
				A 672 GR.B60 CL.12	58.00	427	156.08	600S	3	3/4	8	5205	22.5
D5A	PMS rated Temperature / Pressure		230 / 86.96	Up to 24"	58.00	427	156.08	600S	4	7/8	8	7228	35.9
	A105	A193 GR.B7	Spiral wound SS	A 106 GR.B	58.00	427	156.08	600S	6	1	12	8998	50.7
				A 672 GR.B60 CL.32	58.00	427	156.08	600S	8	1-1/8	12	12875	80.6
D9A	PMS rated Temperature / Pressure		427 / 58.00	Up to 24"	58.00	427	156.08	600S	10	1-1/4	16	14751	101.5
	A105	A193 GR.B7	Spiral wound SS	A 106 GR.B	58.00	427	156.08	600S	12	1-1/4	20	14751	101.5
				A 672 GR.B60 CL.12	58.00	427	156.08	600S	14	1-3/8	20	17294	129.7

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
D16A	PMS rated Temperature / Pressure		427 / 58.00	Up to 24"	58.00	427	156.08	600S	16	1-1/2	20	21037	170.8
	A105	A193 GR.B7M	Spiral wound SS	A 106 GR.B	58.00	427	156.08	600S	18	1-5/8	20	27441	239.8
				A 672 GR.B60 CL.22	58.00	427	156.08	600S	20	1-5/8	24	26679	233.2
D19A	PMS rated Temperature / Pressure		427 / 58.00	Up to 24"	58.00	427	156.08	600S	24	1-7/8	24	34482	343.7
	A105	A193 GR.B7	Spiral wound SS	A 106 GR.B	46.40	427	124.90	600B	26	1-5/8	28	25917	226.5
				A 672 GR.B60 CL.22	46.40	427	124.90	600B	28	1-3/4	28	28733	269.1
					46.40	427	124.90	600B	30	1-7/8	28	35527	354.2
					46.40	427	124.90	600B	32	2	28	39708	420.7
					46.40	427	124.90	600B	34	2-1/4	24	55895	661.6
					46.40	427	124.90	600B	36	2-1/4	28	49684	588.1
					46.40	427	124.90	600B	38	2-1/4	28	54342	643.2
					46.40	427	124.90	600B	40	2-1/4	32	51237	606.4
					46.40	427	124.90	600B	42	2-1/2	28	66195	865.9
LIST D-2													
D4A	PMS rated Temperature / Pressure		204 / 86.47	Up to 24"	86.47	204	147.05	600S	1/2	1/2	4	970	2.9
	A 350 GR.LF2 CL.1	A320 GR.L7	Spiral wound SS	A 333 GR.6	86.47	204	147.05	600S	3/4	5/8	4	1373	5.0
				A 671 GR.CC60 CL.32	86.47	204	147.05	600S	1	5/8	4	2013	7.4
					86.47	204	147.05	600S	1-1/2	3/4	4	4520	19.5
					86.47	204	147.05	600S	2	5/8	8	3112	11.4
					86.47	204	147.05	600S	3	3/4	8	5205	22.5
					86.47	204	147.05	600S	4	7/8	8	7228	35.9
					86.47	204	147.05	600S	6	1	12	8998	50.7
					86.47	204	147.05	600S	8	1-1/8	12	12875	80.6
					86.47	204	147.05	600S	10	1-1/4	16	14751	101.5
					86.47	204	147.05	600S	12	1-1/4	20	14751	101.5
					86.47	204	147.05	600S	14	1-3/8	20	17294	129.7
					86.47	204	147.05	600S	16	1-1/2	20	21037	170.8
					86.47	204	147.05	600S	18	1-5/8	20	27441	239.8
					86.47	204	147.05	600S	20	1-5/8	24	26679	233.2
					86.47	204	147.05	600S	24	1-7/8	24	34482	343.7

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
LIST D-3													
D1D	PMS rated Temperature / Pressure		538 / 30.23	Up to 24"	30.23	538	158.20	600S	1/2	1/2	4	1084	3.3
	A 182 GR.F11 CL.2	A193 GR.B16	Spiral wound SS	A 335 GR.P11	30.23	538	158.20	600S	3/4	5/8	4	1373	5.0
				A 691 GR.1.25Cr CL.42	30.23	538	158.20	600S	1	5/8	4	2196	8.1
D2D	PMS rated Temperature / Pressure		538 / 30.23	Up to 24"	30.23	538	158.20	600S	1-1/2	3/4	4	4246	18.3
	A 182 GR.F11 CL.2	A193 GR.B16	Spiral wound SS	A 335 GR.P11	30.23	538	158.20	600S	2	5/8	8	3295	12.1
				A 691 GR.1.25Cr CL.42	30.23	538	158.20	600S	3	3/4	8	5342	23.1
D5D	PMS rated Temperature / Pressure		538 / 30.23	Up to 24"	30.23	538	158.20	600S	4	7/8	8	7798	38.8
	A 182 GR.F11 CL.2	A193 GR.B16	Spiral wound SS	A 335 GR.P11	30.23	538	158.20	600S	6	1	12	9498	53.6
				A 691 GR.1.25Cr CL.42	30.23	538	158.20	600S	8	1-1/8	12	13535	84.8
					30.23	538	158.20	600S	10	1-1/4	16	16016	110.2
					30.23	538	158.20	600S	12	1-1/4	20	15594	107.3
					30.23	538	158.20	600S	14	1-3/8	20	18342	137.6
					30.23	538	158.20	600S	16	1-1/2	20	21674	176.0
					30.23	538	158.20	600S	18	1-5/8	20	28966	253.2
					30.23	538	158.20	600S	20	1-5/8	24	28203	246.5
					30.23	538	158.20	600S	24	1-7/8	24	36572	364.6
					24.19	538	126.56	600B	26	1-5/8	28	26679	233.2
					24.19	538	126.56	600B	28	1-3/4	28	30529	285.9
					24.19	538	126.56	600B	30	1-7/8	28	35527	354.2
					24.19	538	126.56	600B	32	2	28	40911	433.4
					24.19	538	126.56	600B	34	2-1/4	24	55895	661.6
					24.19	538	126.56	600B	36	2-1/4	28	49684	588.1
LIST D-4													
D5E	PMS rated Temperature / Pressure		538 / 37.61	Up to 24"	37.61	538	158.20	600S	1/2	1/2	4	1255	3.8
	A182 Gr. F22 Cl. 3	A193 Gr. B16	Spiral wound SS	A335 Gr. P22	37.61	538	158.20	600S	3/4	5/8	4	1556	5.7
				A 691 GR2.25CR CL.42	37.61	538	158.20	600S	1	5/8	4	2471	9.1
					37.61	538	158.20	600S	1-1/2	3/4	4	4657	20.1
					37.61	538	158.20	600S	2	5/8	8	3478	12.8
					37.61	538	158.20	600S	3	3/4	8	5479	23.7
					37.61	538	158.20	600S	4	7/8	8	7798	38.8
					37.61	538	158.20	600S	6	1	12	9748	55.0
					37.61	538	158.20	600S	8	1-1/8	12	13535	84.8

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
					37.61	538	158.20	600S	10	1-1/4	16	16437	113.1
					37.61	538	158.20	600S	12	1-1/4	20	16437	113.1
					37.61	538	158.20	600S	14	1-3/8	20	19914	149.3
					37.61	538	158.20	600S	16	1-1/2	20	22949	186.3
					37.61	538	158.20	600S	18	1-5/8	20	29728	259.8
					37.61	538	158.20	600S	20	1-5/8	24	28966	253.2
					37.61	538	158.20	600S	24	1-7/8	24	38662	385.4
					30.09	538	126.60	600B	26	1-5/8	28	28203	246.5
					30.09	538	126.60	600B	28	1-3/4	28	32325	302.7
					30.09	538	126.60	600B	30	1-7/8	28	37617	375.0
					30.09	538	126.60	600B	32	2	28	43318	458.9
					30.09	538	126.60	600B	34	2-1/4	24	59000	698.3
					30.09	538	126.60	600B	36	2-1/4	28	52789	624.8
LIST D-5													
D1K	PMS rated Temperature / Pressure		454 / 55.54	Up to 24"	55.54	454	114.00	600S	1/2	1/2	4	627	1.9
	A 182 GR.F304	A193 GR.B7	Spiral wound SS	A 312 TP304	55.54	454	114.00	600S	3/4	5/8	4	915	3.4
				A 358 TP304 CL.1	55.54	454	114.00	600S	1	5/8	4	1281	4.7
D2K	PMS rated Temperature / Pressure		120 / 80.12	Up to 24"	55.54	454	114.00	600S	1-1/2	3/4	4	2466	10.6
	A 182 GR.F304	A320 GR.B8CL.2	Spiral wound SS	A 312 TP304	55.54	454	114.00	600S	2	5/8	8	1647	6.0
				A 358 TP304 CL.1	55.54	454	114.00	600S	3	3/4	8	3150	13.6
					55.54	454	114.00	600S	4	7/8	8	5135	25.5
					55.54	454	114.00	600S	6	1	12	6249	35.2
					55.54	454	114.00	600S	8	1-1/8	12	8913	55.8
					55.54	454	114.00	600S	10	1-1/4	16	9272	63.8
					55.54	454	114.00	600S	12	1-1/4	20	10115	69.6
					55.54	454	114.00	600S	14	1-3/8	20	12053	90.4
					55.54	454	114.00	600S	16	1-1/2	20	15299	124.2
					55.54	454	114.00	600S	18	1-5/8	20	19056	166.6
					55.54	454	114.00	600S	20	1-5/8	24	19056	166.6
					55.54	454	114.00	600S	24	1-7/8	24	25078	250.0
					44.44	454	91.20	600B	26	1-5/8	28	18294	159.9
					44.44	454	91.20	600B	28	1-3/4	28	20652	193.4
					44.44	454	91.20	600B	30	1-7/8	28	24033	239.6

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
LIST E-1													
E1A	PMS rated Temperature / Pressure		427 / 86.83	Up to 24"	86.83	427	234.12	900S	1/2	3/4	4	2877	11.9
	A105	A193 GR.B7	RTJ - Soft Iron	A 106 GR.B	86.83	427	234.12	900S	3/4	3/4	4	3698	15.3
				A 672 GR.B60 CL. 12	86.83	427	234.12	900S	1	7/8	4	4565	21.7
E2A	PMS rated Temperature / Pressure		427 / 86.83	Up to 24"	86.83	427	234.12	900S	1-1/2	1	4	6999	37.7
	A105	A193 GR.B7	RTJ - Soft Iron	A 106 GR.B	86.83	427	234.12	900S	2	7/8	8	5135	24.4
				A 672 GR.B60 CL. 12	86.83	427	234.12	900S	3	7/8	8	6847	32.6
E5A	PMS rated Temperature / Pressure		230 / 130.63	Up to 24"	86.83	427	234.12	900S	4	1-1/8	8	8583	51.4
	A105	A193 GR.B7	RTJ - Soft Iron	A 106 GR.B	86.83	427	234.12	900S	6	1-1/8	12	10234	61.3
				A 672 GR.B60 CL. 32	86.83	427	234.12	900S	8	1-3/8	12	15197	109.0
E9A	PMS rated Temperature / Pressure		427 / 86.83	Up to 24"	86.83	427	234.12	900S	10	1-3/8	16	16245	116.5
	A105	A193 GR.B7	RTJ - Soft Iron	A 106 GR.B	86.83	427	234.12	900S	12	1-3/8	20	17294	124.1
				A 672 GR.B60 CL. 22	86.83	427	234.12	900S	14	1-1/2	20	21674	168.3
E19A	PMS rated Temperature / Pressure		427 / 86.83	Up to 24"	86.83	427	234.12	900S	16	1-5/8	20	26679	223.0
	A105	A193 GR.B7	RTJ - Soft Iron	A 106 GR.B	86.83	427	234.12	900S	18	1-7/8	20	35527	338.8
				A 672 GR.B60 CL. 22	86.83	427	234.12	900S	20	2	20	40911	414.6
					86.83	427	234.12	900S	24	2-1/2	20	62301	779.5
					69.47	427	187.30	900B	26	2-1/2	20	60354	755.2
					69.47	427	187.30	900B	28	2-3/4	20	66799	915.6
					69.47	427	187.30	900B	30	3	20	77472	1152.8
LIST E-2													
E5E	PMS rated Temperature / Pressure		538 / 56.24	Up to 24"	56.24	538	237.28	900S	1/2	3/4	4	3150	13.0
	A182 Gr. F22 Cl. 3	A193 Gr. B16	RTJ - 5Cr-0.5Mo	A335 Gr. P22	56.24	538	237.28	900S	3/4	3/4	4	3835	15.8
				A 691 GR2.25CR CL.42	56.24	538	237.28	900S	1	7/8	4	5326	25.3
					56.24	538	237.28	900S	1-1/2	1	4	7749	41.8
					56.24	538	237.28	900S	2	7/8	8	5896	28.0
					56.24	538	237.28	900S	3	7/8	8	6467	30.7
					56.24	538	237.28	900S	4	1-1/8	8	9904	59.3
					56.24	538	237.28	900S	6	1-1/8	12	10894	65.3
					56.24	538	237.28	900S	8	1-3/8	12	16245	116.5
					56.24	538	237.28	900S	10	1-3/8	16	16770	120.3
					56.24	538	237.28	900S	12	1-3/8	20	17818	127.8
					56.24	538	237.28	900S	14	1-1/2	20	22949	178.2

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
					56.24	538	237.28	900S	16	1-5/8	20	28203	235.8
					56.24	538	237.28	900S	18	1-7/8	20	36572	348.7
					56.24	538	237.28	900S	20	2	20	44521	451.1
					56.24	538	237.28	900S	24	2-1/2	20	68142	852.6
					56.24	538	189.83	900B	26	2-1/2	20	64248	803.9
					56.24	538	189.83	900B	28	2-3/4	20	73956	1013.8
					56.24	538	189.83	900B	30	3	20	83211	1238.2
LIST F-1													
F1A	PMS rated Temperature / Pressure		427 / 144.83	Up to 24"	144.83	427	390.74	1500S	1/2	3/4	4	3014	12.4
	A105	A193 GR.B7	RTJ - Soft Iron	A 106 GR.B	144.83	427	390.74	1500S	3/4	3/4	4	3972	16.4
				A 672 GR.B60 CL.12	144.83	427	390.74	1500S	1	7/8	4	4945	23.5
F2A	PMS rated Temperature / Pressure		427 / 144.46	Up to 24"	144.83	427	390.74	1500S	1-1/2	1	4	7499	40.4
	A105	A193 GR.B7	RTJ - Soft Iron	A 106 GR.B	144.83	427	390.74	1500S	2	7/8	8	6467	30.7
				A 672 GR.B60 CL.22	144.83	427	390.74	1500S	3	1-1/8	8	12215	73.2
F5A	PMS rated Temperature / Pressure		230 / 217.79	Up to 24"	144.83	427	390.74	1500S	4	1-1/4	8	16016	105.4
	A105	A193 GR.B7	RTJ - Soft Iron	A 106 GR.B	144.83	427	390.74	1500S	6	1-3/8	12	19914	142.8
				A672 Gr. B60 Cl. 22	144.83	427	390.74	1500S	8	1-5/8	12	29728	248.5
F9A	PMS rated Temperature / Pressure		427 / 144.83	Up to 24"	144.83	427	390.74	1500S	10	1-7/8	12	41797	398.5
	A105	A193 GR.B7	RTJ - Soft Iron	A 106 GR.B	144.83	427	390.74	1500S	12	2	16	43318	439.0
				A 672 GR.B60 CL.12	144.83	427	390.74	1500S	14	2-1/4	16	55895	632.8
F19A	PMS rated Temperature / Pressure		427 / 144.83	Up to 24"	144.83	427	390.74	1500S	16	2-1/2	16	70089	877.0
	A105	A193 GR.B7	RTJ - Soft Iron	A 106 GR.B	144.83	427	390.74	1500S	18	2-3/4	16	85884	1177.3
				A672 Gr. B60 Cl. 22	144.83	427	390.74	1500S	20	3	16	103296	1537.0
					144.83	427	390.74	1500S	24	3-1/2	16	142889	2467.4
LIST F-2													
F2D	PMS rated Temperature / Pressure		538 / 75.93	Up to 24"	75.93	538	395.48	1500S	1/2	3/4	4	3972	16.4
	A 182 GR.F11 CL.2	A193 GR.B16	RTJ - 5Cr-0.5Mo	A 335 GR.P11	75.93	538	395.48	1500S	3/4	3/4	4	4931	20.4
				A 691 GR.1.25Cr CL.42	75.93	538	395.48	1500S	1	7/8	4	6277	29.8
					75.93	538	395.48	1500S	1-1/2	1	4	9248	49.9
					75.93	538	395.48	1500S	2	7/8	8	7037	33.5
					75.93	538	395.48	1500S	3	1-1/8	8	13205	79.1
					75.93	538	395.48	1500S	4	1-1/4	8	16858	110.9
					75.93	538	395.48	1500S	6	1-3/8	12	20962	150.4

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure kg/cm²(g)	Des Temp. °C	Test Pressure kg/cm²(g)	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
					75.93	538	395.48	1500S	8	1-5/8	12	30490	254.9
					75.93	538	395.48	1500S	10	1-7/8	12	41797	398.5
					75.93	538	395.48	1500S	12	2	16	46927	475.5
					75.93	538	395.48	1500S	14	2-1/4	16	55895	632.8
					75.93	538	395.48	1500S	16	2-1/2	16	72036	901.3
					75.93	538	395.48	1500S	18	2-3/4	16	88270	1210.0
					75.93	538	395.48	1500S	20	3	16	106165	1579.7
					75.93	538	395.48	1500S	24	3-1/2	16	146858	2535.9
LIST F-3													
F2G	PMS rated Temperature / Pressure		538 / 127.95	Up to 24"	127.95	538	395.48	1500S	1/2	3/4	4	3972	16.4
	A182 Gr. F91	A193 GR.B16	RTJ - 9Cr-1Mo	A 335 GR.P91	127.95	538	395.48	1500S	3/4	3/4	4	4931	20.4
				A 691 GR.P91 CL.42	127.95	538	395.48	1500S	1	7/8	4	6277	29.8
					127.95	538	395.48	1500S	1-1/2	1	4	9248	49.9
					127.95	538	395.48	1500S	2	7/8	8	7037	33.5
					127.95	538	395.48	1500S	3	1-1/8	8	13205	79.1
					127.95	538	395.48	1500S	4	1-1/4	8	16858	110.9
					127.95	538	395.48	1500S	6	1-3/8	12	20962	150.4
					127.95	538	395.48	1500S	8	1-5/8	12	30490	254.9
					127.95	538	395.48	1500S	10	1-7/8	12	41797	398.5
					127.95	538	395.48	1500S	12	2	16	46927	475.5
					127.95	538	395.48	1500S	14	2-1/4	16	55895	632.8
					127.95	538	395.48	1500S	16	2-1/2	16	72036	901.3
					127.95	538	395.48	1500S	18	2-3/4	16	88270	1210.0
					127.95	538	395.48	1500S	20	3	16	106165	1579.7
					127.95	538	395.48	1500S	24	3-1/2	16	146858	2535.9
LIST G-1													
G2G	PMS rated Temperature / Pressure		538 / 213.02	Up to 12"	213.02	538	510.00	2500S	1/2	3/4	4	5068	20.9
	A182 Gr. F91	A193 GR.B16	RTJ - 5Cr-0.5Mo	A 335 GR.P91	213.02	538	510.00	2500S	3/4	3/4	4	5479	22.6
				A 691 GR.P91 CL.42	213.02	538	510.00	2500S	1	7/8	4	7228	34.4
					213.02	538	510.00	2500S	1-1/2	1-1/8	4	13535	81.1
					213.02	538	510.00	2500S	2	1	8	9748	52.6
					213.02	538	510.00	2500S	3	1-1/4	8	15594	102.6
					213.02	538	510.00	2500S	4	1-1/2	8	24224	188.1

PMS class data					Calculation Data								
Piping Class	Temperature, pressure, materials and size range				Des Pressure $kg/cm^2(g)$	Des Temp. °C	Test Pressure $kg/cm^2(g)$	Flange Std	Flange size inch	Bolt Dia inch	No. of Bolts	Tension kg	Torque kg-m
	Flange	Bolt	Gasket	Pipe									
					213.02	538	510.00	2500S	6	2	8	46927	475.5
					213.02	538	510.00	2500S	8	2	12	46927	475.5
					213.02	538	510.00	2500S	10	2-1/2	12	70089	877.0
					213.02	538	510.00	2500S	12	2-3/4	12	95426	1308.1

HISTORY SHEET FOR FLANGE JOINTS

Annexure - I

Project : _____
Unit : _____
System/Sub System Description : _____
Line No. : _____

Test loop No. : _____
ISO Drawing No.: _____
Connected P & ID No.: _____

Flange Joint No.	Flange Parallelity OK/Not OK		Flange Dia & Rating	Gasket		Studs *				Nuts		Torque Value	Bolt Tension Value	Flange joint Acceptance	
	Upstream	Down Stream		Spec.	OK/ Not OK	Size	Spec	Total Nos.	Accepted/ Nos Accepted	Spec.	Nos Accepted			Contractor	Owner/ EIL

* Special Care to be taken for tapped hole and it is to be certified by Contractor that full engagement of stud is there to the tapped hole. Contractor to carry out 100% verification

Acceptance by Licensor/Owner.

1. Pre-commissioning .....
   (Signature with Name and Date)
2. Commissioning .....
   (Signature with Name and Date)

Annexure - II

SEQUENCE OF ACTIVITIES INVOLVED FOR REOPENING / MAKING / BLINDING / DEBLINDING / WEDGE OPENING OF FLANGE JOINTS

Sl. No.	Activity	Checked by Contractor (Signature)
1	Compliance of all check points.	
2	Availability and use of recommended tools i.e. Standard tools / Non-sparking tools/Pneumatic of Hydraulic torque wrench with suitable sockets and other accessories / Hydraulic bolt tensioner etc depending upon service pressure temperature rating of the line on which job is to be carried out.	
3	Skilled manpower with protective clothing, safety shoes etc.	
4	Proper access to flange joints for all bolts, proper scaffolding etc if required.	
5	Proper escape route	
6	Readiness of proper type, size & rating of blinds/gaskets/wedges & fasteners etc	
7	Loosening of the flange joints, starting from 6 '0' clock position (vertical joints)	
8	Check for leakage of any hot water / gas / steam / hydrocarbon etc and wait for depressurization of line, if any product leakage is observed.	
9	Complete opening of flange joint with recommended tools	
10	Removal of gasket / blind / wedge etc. and checking of old gaskets for improper loading from marking on gasket surface.	
11	Checking of old fasteners for proper metallurgy, sizing, length etc and ensure replacement of fasteners based on observations during final box up and also ensure that all fasteners to be of same size for uniform loading.	
12	Making gap in flange joints with proper tools (flange spreader etc.) For proper observations of gasket sitting area. Ensure proper cleaning of gasket seating surface with suitable non-sparking tools and inspection of gasket face.	
13	Ensure use of recommended gaskets of proper type and size for blinding / final box up	
14	Placing of fasteners in bottom half of flange joint (vertical joints).	
15	In case of blinding ensure that tail of the blind is vertically upward and blind is of proper size and not interfering with studs movement.	
16	Ensure proper placement of gasket on raised face/ring groove/serrated area.	
17	Ensuring slight tightening of studs in random in bottom half vertical joint(s) for holding of gasket in proper position	
18	Fixing all fasteners in position and tightening of nuts by hand to ensure uniform stud length on both sides.	
19	Tightening of all studs as per tightening sequence by recommended tools.	

ACCEPTANCE BY OWNER / EIL

ATTACHMENT – VII

OBSERVATION ON QUALITY ASPECTS	
Job No: Name of Work: No: FOI/LOA No: Issued To : M/s Date of Issue:	
Location Of Work: Item Of Work:	
Details Of Observation (Deficiency)	Recommended Course of Action Time Allowed For Correction
Issued By: Name : Designation: Signature:	Received by: Name: Signature: Date and Time:
Corrective Action Report By Contractor/Vendor: Date:	Name Signature:
Distribution Before Resolution: RCM/ Area Coordinator /QA Mgr:	
Verification Of Resolution By Issuer/Area Coordinator/RCM(EIL): Date:	Name: Signature:
Distribution After Resolution: RCM/ Area Coordinator /QA Mgr:	

ATTACHMENT – VIII

OBSERVATION ON SAFETY ASPECTS	
Job No: Name of Work: No: FOI/LOA No: Issued To: M/s Date of issue:	
Location Of Work: Item Of Work:	
Details Of Lapses/Shortfalls/Hazards Identified	Recommended Course of Action Suspension of work required till resolution. (Yes/No)
	Time allowed for Correction:
Issued By: Name: Designation: Signature:	Received by: Name: Signature: Date and Time:
Corrective Action Report by Contractor/Vendor: Date:	Name and Signature:
Distribution Before Resolution: RCM/ Area Coordinator/QA Mgr :	
Verification Of Resolution by Issuer/Area Coordinator/RCM (EIL): Date:	Name: Signature:
Distribution After Resolution: : RCM/ Area Coordinator /QA Mgr:	

PLANNING, SCHEDULING, MONITORING & CONTROL SYSTEM FOR PACKAGE CONTRACT

Abbreviations:

ATR	Action taken report
FEED	Front End Engineering Design
HO	Home Office
KOM	Kick Off Meeting
LOA	Letter of acceptance (Award of Contract)
MOM	Minutes of Meeting
MR	Material Requisition
WBS	Work Breakdown Structure

CONTENTS

1.0 INTRODUCTION

It is the requirement for all "Bidders" for Package works covering entire scope starting from Basic/Residual engineering up to Construction / Installation & Commissioning to maintain a proper Planning, Scheduling and Monitoring system to ensure timely completion of the contract.

This Procedure is applicable for various Package MR / Tender wherein Residual basic/detailed engineering is done by the contractor based on design parameters given in the Tender.

Therefore, every bidder shall establish and maintain an effective Planning, Scheduling, Monitoring & Control System including deployment of professionally qualified and experienced Planning Engineer for entire duration of the contract. The system should be predictive type to diagnose and anticipate the problems well in advance and provide preventive measures. To achieve this objective, Bidder / Vendor or Contractor shall prepare & submit following Schedules / documents for review / approval by client / Consultant at various stages of the project.

2.0 ALONG WITH THE BID

2.1 Time Schedule

The bidder is required to submit a "Proposed Time Schedule" in bar chart form covering major milestones along with the bid. The schedule shall cover all phases of the contract i.e. Basic / Residual Engineering, Detailed Engineering, Ordering, Manufacturing & Delivery, Tendering, Construction and Commissioning within the time stipulated in the bid document covering Client's interfaces / activities.

2.2 Planning, Scheduling & Monitoring System

The Bidder shall describe the system of Planning, Scheduling & Monitoring, level of detailing / tracking methodology etc. along with the name of computer packages like Primavera, MS Excel Spread Sheet etc. and sample outputs in line with guideline of this procedure.

Client / Consultant reserves the right to disqualify the bidder if the above-mentioned documents are not furnished / not in line with the requirement as stated above.

3.0 AFTER AWARD OF THE CONTRACT

3.1 Documents to be submitted within 2 weeks from LOA.

Following documents to be submitted to Consultant/ Client within 2 weeks from award of contract. These documents will be discussed during KOM, comments if any shall be provided in line with provision of the contract.

- Planning, Scheduling and Monitoring Procedure
- L-1 Schedule as defined in Section – 2.1 above
- Proposed Progress Measurement system/ Progress WBS
- 90 Days Look ahead schedule – List of activities to be performed in the initial phase of the project.

3.2 Overall Schedule for the contract & WBS

The Vendor / Contractor shall submit within 4 weeks from award of contract / Effective Start date, a detailed "Overall Project Schedule" in the activity network form clearly indicating the major milestones, inter-relationship / inter-dependencies between various activities together with critical path and floats covering all functions, disciplines, work groups & activity level, preferably in Primavera or MS Project. While developing the Overall Project schedule time period indicated in L-1 schedule to be adhered to.

Grace period available if any shall not be considered while developing Overall Project schedule.

A Work Breakdown Structure (WBS) indicating the scope of work, execution philosophy and the magnitude of work in hierarchal fashion shall be submitted with the Overall Project Schedule. The network and WBS shall be reviewed and approved by Client / Consultant and after incorporating their comments (if any) shall be issued for implementation by Vendor / Contractor within one week from receipt of comments.

Milestone List: A list of milestones extracted from Overall Project schedule for the entire duration of the contract also to be submitted along with Overall Project Schedule. Milestones shall be chosen in such a way that minimum 1 milestone to maximum 5 milestones are scheduled every month (Average 2 to 3 milestones per month). These milestones should have importance with respect to key areas / activities of project execution covering all functions viz., Engineering, Procurement, Construction and Commissioning.

The Overall Project Schedule once approved by the Client / Consultant shall be referred as "Baseline Schedule" and shall not be changed without prior approval of the Client / Consultant.

The Overall Schedule shall be updated on monthly basis and submitted along with Monthly Progress Report indicating base line schedule.

3.3 Progress Measurement Methodology

Level 1 weightages at functional level as per annexure attached with this procedure shall be followed for preparation of Progress WBS. Based on initial proposed progress WBS discussed during Kick off meeting, the Vendor / Contractor shall submit detailed progress measurement methodology within 4 weeks from award of contract/ Effective Start date for approval, to be adopted for measurement of progress for all phases of work i.e. Engineering, Ordering, Manufacturing & Delivery, Tendering, Construction and Commissioning along with breakup of weightages. Weightages for as built drawings shall be considered as separate function if applicable as per terms of the contract.

The progress basis shall be physical realization of work, such as in terms of deliverables and construction quantities accomplished.

3.4 Functional Schedules

Based on approved Overall Project Schedule and progress measurement system / methodology, the Vendor / Contractor shall prepare detailed functional schedule for each function viz. Residual Basic Engineering, Detailed Engineering, Ordering, Manufacturing & Delivery, Tendering, Construction and Commissioning. Based on functional schedules, the Vendor / Contractor shall also develop schedule progress "S" curve for each function and one overall schedule progress "S" curve for the total contract and submit the same to Client / Consultant for approval. Functional schedules i.e. deliverable / task wise schedule in tabular form after assigning weightages and dates to all activity milestones / major work steps for each deliverable / task shall preferably be prepared in Excel Worksheets and finalised within 2 months from LOA or within 15 days of approval of Overall Schedule whichever is earlier.

All functional schedules along with Progress S-Curves shall get approved from consultant/ Client's Home office except for Construction portion. Construction functional schedule shall be vetted and approved by Construction group of Consultant / Client. For development of Overall schedule progress "S" curve as stated above, tentative construction schedule shall be prepared initially which shall be replaced upon approval of construction schedule by Consultant/ Client.

Functional Schedules once approved by the Client/ Consultant shall not be changed without prior approval of the Client/Consultant.

Functional Schedules shall be updated on monthly basis and submitted along with Monthly Progress Report as a part of Annexure.

3.5 **Resource Deployment Schedule**

The Vendor / Contractor shall submit resource deployment schedule, manpower (category-wise), equipment & machinery to be deployed to achieve the schedule of progress, as per "S" curve furnished for the total contract duration for both HO services & site activities. Resource deployment schedule shall be submitted as supporting document along with functional schedules which shall be retained for information.

3.6 **Catch-up Schedule**

During the project execution, depending on the trend & slippage (if any), Client / Consultant may ask Vendor / Contractor to develop catch-up schedules for completion of all balance activities without change in contract completion date. This schedule shall be submitted to Client / Consultant for review. Accordingly, the "S" curve for catch-up schedule shall be made and shown along with the original schedule.

Catch up schedule shall clearly indicate details of re-scheduled activities along with resource deployment plan and ways & means to achieve revised targets.

On completion of contractual duration, catch up schedule shall be referred as "Completion Outlook" for balance activities.

"Completion Outlook" for balance activities shall not be treated as regularization of schedule for contractual commitments.

3.7 **Planning Package:**

On approval of all Planning documents, 2 hard copies of Planning package comprising of following documents shall be submitted for record & reference by Client / Consultant. Native files all document also shall be submitted through e-mail.

- Procedure for Planning, Scheduling and monitoring system.
- Project Physical WBS
- Overall L-1 Schedule
- Overall Project schedule (Network).
- List of Milestones.
- Progress Measurement System WBS
- Detailed Functional schedule along with progress curves
  - Residual Basic Engineering
  - Detailed Engineering
  - Ordering
  - Manufacturing & Delivery
  - Sub-contracting / Tendering
  - Construction and Commissioning
- Overall Progress Curve with back up calculation sheet.
- HO and Site organogram clearly indicating Planning function and responsibility. Resource deployment schedule

3.8 **Contract Review Meetings**

The vendor / contractor shall present project status at various review meetings as required or as asked by client / consultant strictly based on agenda with fixed time.

3.8.1 Monthly Review Meeting

Level of participation : Senior person of Client / Consultant and Vendor / Contractor. In case of Vendor / Contractor, the participants shall be Project Manager or above and Construction-In-Charge or above.

Agenda : a. Action taken report on MOM of last month Review meeting.

b. Progress Status / Statistics
c. Status of Engineering, Ordering, Manufacturing & Delivery, Tendering, Construction and Commissioning.
d. Major hold ups / slippages
e. Completion outlook
f. Critical issues with Action Plan
g. Any specific point from Client / Consultant.

During the initial phase of Project, Monthly review meeting shall be held mainly at Consultant's or Clients' Home office and during Construction phase, meeting shall be held at Construction Site. Agenda based meeting with fixed timings

3.8.2 Weekly Review Meeting at Site: Agenda based meeting with fixed timings

Level of participation : Contractor / Consultant, Resident Construction Manager / Site Engineers / Job Engineers.

Agenda : a. Weekly Programme v/s actual achieved in the last week and programme for the next week with resource mobilization plan.
b. Hold-up analysis and Action Plan.

3.8.3 Management Review Meeting: Meeting shall be called on Need basis to expedite completion of work.

Level of participation : Contractor MD/ Director, Consultant Directors/ Resident Construction Manager along with Project Managers.

Agenda : a. Overall Progress and reason for delays.
b. Setting of Priorities for completion of work as per Overall Project/ Complex scenario and contractual requirements.
c. Mitigation / corrective action and catch-up plan.

3.9 Progress Reporting

3.9.1 Monthly Progress Report

The Vendor / Contractor shall submit the Monthly Progress Report on regular basis to Client / Consultant from very next month of award of the contract as per formats which will be provided to successful bidder, covering total scope of work as per the contract. This report is to be issued within five calendar days from cut-off date. Issue of the report shall be continued till completion of contract in all respects. The broad sections covered would be Introduction, Executive Summary, Progress Statistics, Updated Overall Project Schedule, Areas of Concern with Action Plan, Detailed Status and supporting annexures.

3.9.2 Weekly Flash / Activity Report

A brief report carrying status of activities performed during the week including any major concerns shall be submitted on weekly basis preferably on every Monday.

3.9.3 Weekly Progress Report (Construction)

This report shall be prepared for activities in summarized fashion as per formats which will be provided to successful bidder, and submitted by the Vendor / Contractor, every week on the next day of weekly cut-off. The weekly cut-off day shall be informed during the kick-off meeting. The broad sections covered would be Executive Summary, Summary Report of Contracts, Quantitative Construction Progress Status and Resource Deployment Status.

3.9.4 Daily Progress Report (Construction)

The Vendor / Contractor shall submit daily report to the Consultant **through an online portal for which access shall be provided to contractor at construction site. The report will be**

verified by the respective Area coordinator in online portal itself to enable availability of DPR to Project Controls-Planning for further usage. The report will cover Quantitative Construction Progress Status supported by Drawing, Material and Resource Deployment Status.

3.10 **Documentation**

The formats of reports, schedules and other Planning documents submitted by Vendor / Contractor shall be strictly as required by Client / Consultant. Other required formats shall be finalized during the kick-off meeting and shall be binding on the Vendor / Contractor.

3.11 **Native Files of Planning Deliverables**

The Vendor / Contractor shall submit native files of various planning documents (including Primavera .xer/ native files of Schedules) to Consultant as and when required for analysis purpose.

SL NO	EPC/PACKAGES	DESCRIPTION	WEIGHTED VALUE PROPOSED	REMARKS
1	COOLING TOWER	BASIC ENGINEERING	1-2	- Construction weightage may vary depend upon Type of Cooling Tower FRP (Fiberglass reinforced polyester) or RCC (composite material of steel and concrete). Wtg. Considered for RCC type Cooling Tower. In Case of FRP, M&D to be considered as 35-40% and reduce %age in Construction.
		DETAILED ENGINEERING	8-10	
		ORDERING	2-4	
		MANUFACTURING & DELIVERY	30-35	
		SUB-CONTRACTING/TENDERING	1	
		CONSTRUCTION	55-60	
		PRE-COMM/ COMMISSIONING	2	
		AS-BUILT	*	
		OVERALL PHYSICAL PROGRESS		

* **Note:** For As Built Maximum 0.5% to be considered if defined in the contract.

TECHNICAL COMPLIANCE
PLANNING
COOLING TOWER PACKAGE-PP UNIT
NUMALIGARH REFINERY, NRL

Sl. No.	COMPLIANCE STATEMENT/QUERY	BIDDER'S CONFIRMATION / ANSWER
	BIDDERS TO GIVE SPECIFIC CONFIRMATION THAT FOLLOWING DOCUMENTS HAVE BEEN SUBMITTED ALONG WITH BID. (PLEASE REFER DOC. NO 8-2744-1002 REV 6 FOR "PLANNING, SCHEDULING, MONITORING & CONTROL SYSTEM FOR PACKAGE CONTRACT" "CLAUSE NO 4" "DOCUMENT ALONGWITH BID")	
a.	Bidder to submit proposed Overall Project Schedule in network form showing details of all Units / facilities identifying major / key milestones.	
b.	Write up on Project Planning, Scheduling and Monitoring & Control system (proposed) in line with procedure 8-2744-1002 Rev.6 attached with bid document.	
c.	Organizational set up for Planning, Scheduling, Monitoring & Control at Contractor's design Office & Site Office	
d.	Progress Measurement Methodology with details such as weightage, milestones, frequency etc.	
e.	Project execution methodology	
f.	Function wise Resource Deployment Schedule (manpower & construction equipment)	
g.	Software to be used for planning & material control - Bidder to use P6 Software for Planning & scheduling activities and to identify software for material control. MS Office to be used for progress calculation.	
h.	Statement confirming compliance to the "Planning, Scheduling, Monitoring & Control System for Package Contract" requirements regarding contents of the documents to be submitted to Client/PMC.	

Note:-
1. The bidder shall indicate in his reply in this space in the Technical compliance. In case space provided is not adequate, the reply may be furnished separately under suitable numbered annexure/attachments duly referred against the comments/query.

2. The compliance Statement /Queries are required to be categorically confirmed/answered by the bidder and the completely filled in Technical questionnaire shall be submitted together with the bid.

Bidder's signature
&
Stamp

Annexure-B
TECHNICAL CONFIRMATION LIST

(SME - PACKAGED EQUIPMENT)

COOLING TOWER PACKAGE

TENDER No. C050-1U68-81-45-PB-T-8010

PROJECT	**:**	**EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL**
OWNER	**:**	**NUMALIGARH REFINERY LIMITED (NRL)**
EPCM	**:**	**ENGINEERS INDIA LIMITED**
EIL JOB No.	**:**	**C050**

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
0	18.08.2025	ISSUED WITH TENDER	AS	VMG	PD

Bidder shall furnish duly filled and signed technical confirmation list and deviation list, if any, alongwith bid which will form the basis for technical evaluation of bid.

Bidder is required to give categorical reply to each point of this technical confirmation list so that bidder's offer could accordingly be evaluated.

Bidder's reply "Not Confirmed" is not warranted and may lead to technical rejection of their bid. However, Bidder may provide certain clarification, incase absolutely necessary, without deviating to bid requirement.

Sl. No.	Description	BIDDER'S ANSWER (Confirmed / Not Confirmed)
1.	The scope of work and battery limits shall be in compliance with the tender document. All other equipment, materials and work not explicitly mentioned but nevertheless required to fulfil the system and functional requirements shall be deemed to have been included in the scope of Bidder with no additional cost and time implication to the Owner. Please Confirm.	
2.	Bidder to note that no deviations are allowed from the tender specifications. However, if it is inevitable, clause-wise deviation, against the tender specifications shall be duly consolidated at one place, under Exceptions / Deviations List in the format enclosed with the tender and shall be submitted with the bid. In case, no exception / deviation list is furnished, it will be presumed that all requirements of tender are fully complied with. Any exceptions /deviations made by the Bidder elsewhere in their offer shall not be taken cognizance of and all such exceptions / deviations shall be deemed as null and void. Confirm compliance.	
3.	Technical Amendments, if any, on the Tender Specifications shall be considered part of Tender Specifications itself and shall be strictly adhered to by the Bidder. Confirm compliance.	
4.	Bidder to note that data sheets, drawings and other technical details are not required with offer and the same, if submitted with bid, shall be treated as preliminary and retained for records only. Vendor's documents/ drawings shall be reviewed as per the "Vendor Data Requirements (Doc. No. C050-1U68-80-42-VDR-8010)" during post order stage for checking/ ensuring compliance with Tender specifications / Contract requirements. Owner/EIL comments shall be binding on Contractor without any commercial implication to the Owner. Confirm compliance.	
5.	Bidder to confirm that in the event of order, all drawings, documents and data shall be furnished in accordance with Vendor Data Requirements (Doc. No. C050-1U68-80-42-	

Sl. No.	Description	BIDDER'S ANSWER (Confirmed / Not Confirmed)
	VDR-8010).	
6.	Bidder to confirm that all the documents/drawings shall be duly checked and approved by Contractor before submission of the same for OWNER/ EIL review/approval.	
7.	Bidder to confirm that makes of all equipment shall be as per approved Vendor List attached with the tender documents. For any item, where no vendor list is provided in the tender document, the vendor proposed by Contractor shall have sufficient Proven Track Record (PTR) and shall be subject to Owner / EIL review & approval during detailed engineering without any commercial implication to Owner/EIL.	
8.	Bidder to confirm that the material of construction of equipment/ components shall be same or superior to those specified in the Tender Documents.	
9.	Bidder to confirm categorically that following have been included by them in their quoted lump sum price. a. Commissioning spares, as required, for all equipment b. Special tools and tackles for all equipment, as required. c. Training services to the OWNER's personnel at site for all equipment	
10.	Bidder to confirm that all consumables, lubricants, hydraulic oils, refrigerants etc. for initial charge and replenishment of any loss of these during commissioning, trial runs & PG testing for all equipment have been included in the bidder's proposal.	
11.	Bidder to confirm that the list of recommended spares for two (2) years of normal operation & maintenance with itemized price along with quantity (as recommended by the Original Equipment Manufacturer) shall be provided for all equipment after placement of order.	
12.	Bidder to confirm that the Inspection & Testing requirements as specified in the tender shall be complied. All necessary equipment as required for carrying out Inspection and Testing as stipulated in Tender documents shall be in the scope of the Bidder.	
13.	Bidder to confirm that the Performance Guarantee requirements as specified in the tender Specifications shall be complied.	

Bidder's Seal with date

Signature of Authorised Representative

TECHNICAL COMPLIANCE

FOR

COOLING TOWER PACKAGE

PROJECT : **EPCM SERVICES (PART-A) FOR 360 KTPA PPU AT NRL**

OWNER : **M/s NUMALIGARH REFINERY LIMITED**

JOB NO. : **C050**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	03.09.2025	ISSUED FOR BIDS	SJ	VMF	GYAS

Notes:-

1. The Bidder shall indicate his reply in the space provided in the Technical Questionnaire. In case space provided is not adequate, the reply may be furnished separately under suitably numbered annexes / attachments duly referred against the comment / query.

2. The Compliance Statements/Queries are required to be categorically confirmed / answered by the bidder and the completely filled in Tech Questionnaire shall be submitted together with the Bid.

S.NO.	COMPLIANCE STATEMENT / QUERY	BIDDER'S CONFIRMATION / ANSWER
1.	Please confirm that the area has been physically surveyed by Bidder. Bidder is well acquainted with the area and collected relevant site information.	
2.	Please confirm that all approaches (from main road around battery limit) for construction, erection, maintenance, emergency evacuation etc. have been considered in Bidder's scope of work.	
3.	Please note that graded area shall be handed over to Contractor. Final micro grading / pavement after completion of works to the final desired level for Cooling Tower as per bid is in bidder's scope of work.	
4.	Please note and confirm that required earth for filling under pavement/ micro-grading shall be arranged by the bidder and borrow areas shall be arrange by bidder from outside refinery. Bidder shall also dispose debris etc. outside the refinery complex.	
5.	The thermal design of Cooling Tower should be such that the difference between temperature of outgoing mixed air and hot water shall not be less than 4°C. Bidder to confirm.	
6.	Please confirm that commissioning spares and mandatory spares have been included in the offer.	
7.	Bidder to confirm the submission of filled in data sheets C050-IU68-81-45-DS-1852 & C050-IU68-81-45-DS-1853 along with the offer.	
8.	Please note and confirm that all temporary fencing/ barricading required during construction activities shall be provided by the bidder.	
9.	Confirm that the entire work shall be executed as per contract document. No deviation is acceptable and Bidder shall confirm the same in Technical Deviation form attached with the bid. Deviations/ exceptions mentioned elsewhere in bidder's offer shall not be taken any cognizance. Confirm compliance.	

Bidder's Signature and Stamp	

TECHNICAL CONFIRMATION LIST
STATIC & MACHINERY EQUIPMENT
(ROTATING EQUIPMENT)

COOLING TOWER PACKAGE
TENDER No.: C050-1U68-81-45-PB-T-8010

PROJECT : **EPCM SERVICES FOR POLYPROPLENE PROJECT AT NUMALIGARH REFINERY**

UNIT : **RECIRCULATING COOLING WATER SYSTEM**

CLIENT : **M/s NUMALIGARH REFINERY LIMITED(NRL)**

EPCM : **M/s ENGINEERS INDIA LIMITED (EIL)**

JOB NO. : **C050**

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
A	26.08.2025	ISSUED WITH TENDER	RPT	ME	TK

Bidder's Signature and Stamp	

ROTATING EQUIPMENT

Bidder to note that **bidder's quotation shall be evaluated (technically) based on bidder's reply/confirmation to this technical checklist only**. **Bidder's offer shall be considered incomplete and may not be considered for technical evaluation by purchaser if duly filled-in, signed & stamped check list is not submitted along with bid.** Bidder is required to give categorically confirmed / answered to each point of this technical checklist, so that bidder's offer can be properly evaluated.

Bidder's reply "Not Confirmed" is not warranted and may lead to technical rejection of their bid. However, Bidder may provide certain clarification, in case absolutely necessary, without deviating to bid requirement. Written confirmation shall have precedence over any clarification whatsoever.

Sl. No.	Description	BIDDER'S ANSWER (Confirmed / Not Confirmed)
1.	Please note that this is a **"NO DEVIATION"** bid. Hence no deviation to the tender specification/ technical amendment (if any) is acceptable. Bidder to submit all their clarification during the pre-bid stage only. No further deviation/ clarifications shall be allowed in the technical offer. Bidder to confirm that there is no technical deviation in their offer w.r.t. the tender specification/ technical amendment (if any). Any deviations/deletions/corrections made by the Bidder elsewhere in the body of the Bidder's proposal will not be taken cognizance of and all such deviations shall be deemed to have been withdrawn by the bidder. Confirm compliance.	
2.	In case of any ambiguity in the requirements specified in tender, the stringent of the same shall be applicable. The Bidder shall bring out the same to the notice of Owner/PMC and shall ask for clarification. Owner/PMC decision on the subject matter shall be FINAL & BINDING in this regard and to be complied by the Bidder without any cost / time implications. Confirm compliance.	
3.	Bidder to confirm that all the documents before submission to OWNER/PMC review shall be duly checked and approved by Bidder. Confirm compliance.	
4.	It shall be the prime responsibility of Bidder to ensure completeness of information in the documents in the first & initial submissions itself. Owner/PMC shall not be liable for any delay/implications due to multiple revisions/submissions by bidder, lack of complete information in initial submissions by the bidder, not obtaining prior approvals (as required) by bidder, time to resolve the issues by bidder, etc. and there shall not be any cost/time implications to Owner/PMC. Confirm compliance.	
5.	Owner / PMC review does not absolve Bidder of his total responsibility of meeting the tender requirements, process requirements, standards and technical specifications/codes, environmental & local norms, safety, etc. and other conditions as stipulated in the tender document. Confirm compliance.	
6.	Bidder to note that, if any comment arises during detail engineering from Owner/PMC to ensure compliance with Tender	

	Specifications/Contract requirements, the same shall be incorporated by Bidder without any time and cost implication to Owner/PMC. Confirm compliance.	
7.	**Vendor List:** Bidder to confirm that all equipment/packages shall be sourced from vendors as per Project Master Vendor List (Project MVL) attached with the tender document / technical amendments. Vendor as per NRL holiday list shall not be considered. *Note: The selected vendor (within any vendor list) shall comply with all the technical & qualification requirements stated in the tender. Appearance of vendor name in any vendor list shall not be construed as a pre-qualified vendor w.r.t. technical & qualification requirements stated in tender.* Confirm compliance.	
8.	**Single Point Responsibility Vendor for Complete Package:** Bidder shall procure complete Rotating Equipment Package consisting of driver, driven equipment, all associated auxiliary systems, instrumentation & controls etc. from the Single Point Responsibility Vendor defined for various Rotating Equipment in Engineering Design Basis- Rotating Equipment (**Doc. No**. **C050-999-80-42-EDB-1001**). No separate procurement of driver/driven equipment, coupling, seal & sealing system, lube oil system, auxiliaries, ancillaries, or any other critical items of the package by bidder is allowed. Confirm compliance.	
9.	**Scope of Supply/Services:** Bidder to confirm that the bidder has quoted for the total scope of supply & services for all equipment/ package as specified in the tender, including the Scope of Work/Supply specified in **Doc. No. C050-1U68-80-42-SOW-8010.** Bidder scope shall include but not limited to the responsibility for execution, coordination of all technical aspects of equipment and its auxiliary systems, their selection & integration into a complete package/plant constituting total order. It shall be the prime responsibility of the bidder to furnish a safe operating units complying to complete tender requirements, process requirements, standards, specifications, international codes, suitability as per installation location, environmental & local norms, safety, etc. For this purpose, in case bidder envisages additional equipment / instruments / control and safety devices, the same shall be offered by the bidder. *Note: In case of any deviation to this requirement, the bid shall be considered as incomplete and liable for technical rejection.* Confirm compliance.	
10.	**Mandatory Spares:**	

	Bidder to confirm that Mandatory Spares as mentioned in tender EDB Doc. No. **C050-999-80-42-EDB-1001** & Mandatory Spares List Doc. No. **C050-1U68-80-42-SL-8010**, etc. have been quoted and included by the bidder in his proposal. Confirm compliance.	
11.	**Erection & Commissioning Spares:** Bidder to confirm that Erection & Commissioning Spares for all equipment/ packages, as required have been quoted and included by the bidder in his proposal. Bidder to confirm that in case during commissioning, additional spares are required over and above the quoted commissioning spares, then the same shall be supplied by bidder without any time and commercial implication to OWNER. Any leftover spares after commissioning shall be handed over to the OWNER. Confirm compliance.	
12.	**Two (2) Years Normal O&M Spares:** Bidder to confirm that the list of recommended spares for two (2) years of normal operation & maintenance with itemized price along with quantity (as recommended by the Original Equipment Manufacturer) for all equipment/ packages shall be provided after placement of order. Confirm compliance.	
13.	**Special Tools and Tackles:** Bidder to confirm that special tools and tackles for each equipment / package required (one set per item tag as a minimum), for erection, commissioning, ease of maintenance; normal operation, etc. have been quoted and included by the bidder in his proposal. Confirm compliance.	
14.	**Consumables:** Bidder to confirm that all consumables, chemicals, lubricants, sealing fluids (buffer/ barrier), start-up fluids, etc. for initial charge and replenishment of any loss of these during commissioning for all equipment/ packages have been quoted and included by the bidder in his proposal. Complete details/specifications with regard to consumables/lubricants along with equivalent Indian make grades of IOCL/NRL shall be furnished by the bidder during detail engineering. Confirm compliance.	
15.	**Inspection & Testing Requirements:** Bidder to confirm that the Inspection & Testing requirements as specified in the tender documents, data sheets, job specifications, standards, specifications, ITPs, referred codes and standards shall be complied. Confirm compliance.	
16.	**Requirements to be met prior to placement of Purchase Order / Purchase Requisition:** Bidder to confirm that bidder shall ensure the following requirements	

	while placing the orders of rotating equipment: (a) Ensuring that equipment meets the specified service operating & design conditions and meets the stipulated technical specifications, enclosed with the tender document. (b) Ensuring equipment meeting the past supply reference/ qualification requirements / experience criteria (EC) as specified in the tender document & obtaining approval of the same. **Note:** For the finally selected equipment make and model, Bidder shall submit the document "**Final Vendor Selection Data (FVSD)**" duly approved by Bidder with the documents as specified in Scope of Work (**Doc. No. C050-1U68-80-42-SOW-8010**) & Vendor Data Requirements (**Doc. No. C050-1U68-80-42-VDR-8010**). Confirm compliance.	
17.	**Process Data Sheets with FVSD:** PMC approved Process Datasheet (PDS) issued for engineering / procurement shall be part of FVSD. FVSD document(s) shall be submitted by bidder to Owner/PMC review only after Process Hydraulics of respective equipment is complete and the PDS is duly approved by PMC and shall not have any HOLDs. Confirm compliance.	
18.	**Purchase Requisition (PR):** PR documents shall be submitted to Owner/PMC only after final approval of FVSD. PMC final approved FVSD document shall be part of PR and shall not be modified. PR shall include the documents as specified in Scope of Work (**Doc. No. C050-1U68-80-42-SOW-8010** & Vendor Data Requirements (**Doc. No. C050-1U68-80-42-VDR-8010**). Confirm compliance.	
19.	**Vendor Documents/Drawings:** Bidder to note that data sheets, drawings and other technical details are not required to be submitted along with his offer. In the event of order to bidder, all vendor's documents/drawings shall be reviewed & approved by the bidder during detailed engineering stage ensuring compliance to complete tender requirements, process requirements, standards, specifications, international codes, suitability as per installation location, environmental & local norms, safety, etc. Bidder to confirm that, during post order stage, vendor documents duly reviewed and approved by Bidder which are required to be reviewed by Owner/PMC shall be submitted by bidder after final approval of Bidder without any HOLDs as per the "Vendor Data Requirement (**Doc No. C050-1U68-80-42-VDR-8010**)". Applicable Vendor drawings/documents are to be submitted to Owner/PMC only after final approval of Purchase Requisition and shall not have any HOLDs. Confirm compliance.	
20.	**Material of Construction:** Bidder to confirm that the material of construction of equipment/	

	components shall be as per Process Package attached with tender document and shall ensure that the materials offered for the equipment / components shall be suitable for the specified service, operating & design conditions, location and environment. Confirm compliance.	
21.	**Site Location:** Bidder to confirm that Bidder had carried out site survey to familiarize themselves with the site condition, space availability and the quantum of work involved. Bidder to note that failure to carry out site survey prior to bidding shall not relieve them from the responsibility of carrying out the work as per this tender specification. Confirm compliance.	
22.	**Erection and Commissioning:** Bidder to confirm that erection and commissioning of all Rotating Equipment shall be as per tender requirements & applicable codes and standards. Confirm compliance.	

BIDDER's SEAL WITH DATE

SIGNATURE OF AUTHORISED REPRESENTATIVE

Annexure-A

TECHNICAL CONFIRMATION LIST

COOLING TOWER PACKAGE

(SMED - STATIC EQUIPMENT)

TENDER No. C050-1U68-81-45-PB-T-8010

PROJECT	**:**	**EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL**
OWNER	**:**	**NUMALIGARH REFINERY LIMITED (NRL)**
EPCM	**:**	**ENGINEERS INDIA LIMITED**
EIL JOB No.	**:**	**C050**

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
0	19.11.2024	ISSUED WITH TENDER	RR	SC	TKh

Bidder to note that **bidder's quotation shall be evaluated (technically) based on bidder's reply/confirmation to this technical confirmation list (duly filled-in, signed & stamped) only**.

Bidder's reply "Not Confirmed" is not warranted and may lead to technical rejection of their bid. However, Bidder may provide certain clarification, incase absolutely necessary, without deviating to bid requirement. Written confirmation shall have precedence over any clarification whatsoever.

S. No.	Description	BIDDER'S ANSWER (Confirmed / Not Confirmed)
1.	Bidder to note that data sheets, drawings and other technical details are not required with offer, however if submitted with bid shall be retained for information only. Vendor's documents/ drawings shall be reviewed as per the "Vendor Data Requirement (Doc No. C050-IU68-80-42-VDR-8010)" during post order stage for checking / ensuring compliance with Tender specification / Contract requirement. Confirm compliance.	
2.	Confirm that all equipment shall be procured from the approved vendors listed elsewhere in the bid package.	
3.	Confirm that for all equipment wherever hot forming and subsequent heat treatment is involved, adopted procedure shall not impair the mechanical properties of the material beyond the limits specified in respective material specification.	
4.	Confirm that for all equipment non-destructive testing like radiography, ultrasonic testing, magnetic particle/dye penetrant examination etc. shall be conducted as per specifications / bid package / code.	
5.	Confirm that there are no technical deviations to Bid Document with respect to Static Equipment Part.	
6.	If answer to S.No.5. is "No", confirm that list of technical deviations if any w.r.t Static Equipment Part, have been filled in Deviation Schedule format attached with the tender. Beside these deviations, confirm that the offer is in total conformity with the Specification for all equipment.	
7.	Bidder to confirm that he has included mandatory spares as specified in the bid package for all the Static Equipment have been included in the bidder's scope.	
8.	Confirm inclusion of Commissioning spares, Special tools & tackles and drawings & documents as specified in the Bid Document.	
9.	Confirm any additional spares, over and above mandatory spares for all Static Equipment required for 2 years normal operation have been indicated along with item wise price separately for Purchaser's consideration and not included in base price.	

Bidder's Seal with date

Signature of Authorised Representative

TECHNICAL COMPLIANCE FORMAT (Construction)

COOLING TOWER PACKAGE

PROJECT	:	POLYPROPYLENE (PP) UNIT PROJECT
OWNER	:	M/s NUMALIGARH REFINERY LTD.
LOCATION	:	NUMALIGARH, ASSAM
EIL JOB No.	:	C050

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	12.08.2025	ISSUED FOR BIDS	JK	AC	GGM (C)

Bidder must furnish answers/clarifications/confirmations of all the following queries and submit along with offer.

SL. NO.	COMMENT/QUERY	BIDDER'S CONFIRMATION/ ANSWER
1.	Bidder to confirm that requirement of Health, Safety and Environment (HSE) as per specification 6-82-0001 are taken into consideration.	
2.	Bidder to confirm that required construction equipments to meet the contract schedule shall be mobilized by him without any time & cost implications.	
3.	Bidder to confirm that required construction personnel for supervision to meet the contract schedule shall be deployed by him meeting the requirement of qualification and experience (refer Doc. No 7-82-0003 in this regard) without any time & cost implications.	
4.	Bidder to confirm that Construction Management of this job shall be done by him and shall not be sub-contracted to any other agency.	

Bidder's Signature and Stamp	

TECHNICAL CONFIRMATION LIST (ARCHITECTURAL)

FOR

EPC TENDER FOR COOLING TOWER PACKAGE

TENDER NO. C050-1U68-81-45-PB-T-8010

JOB NO. : **C050**

PROJECT : **EPCM SERVICES FOR POLYPROPYLENE (PP) PROJECT, NUMALIGARH REFINERY**

CLIENT : **M/S NUMALIGARH REFINERIES LIMITED**

Bidder's signature and stamp	

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	11.08.25	ISSUED FOR TENDER	KT	SS	GJK

Sl. No	COMPLIANCE STATEMENT / QUERY	BIDDER'S CONFIRMATION / ANSWER
1.	Confirm that the entire work shall be executed as per contract document. No deviation is acceptable. The scope of work for architectural works shall be complied in all respects as specified in the BID document and all the equipments, materials and work not explicitly mentioned but nevertheless required to fulfill the functional requirements shall be deemed to be included in the scope of BIDDER with no additional cost and time implication to the owner.	
2.	A detailed list of drawings / documents shall be submitted to OWNER/ OWNER'S representative for review. The drawing list and quantity statement shall be updated every month and submitted to OWNER/ OWNER'S representative.	
3.	Confirm that all deliverables (document index /documents, drawings/ specifications/ drawings for statutory approval, as-built drawings, list of sub vendors/authorized applicators for specialized items/ Monthly/Weekly report showing status of submitted documents/ schedule of submission, category of submitted documents, etc.) as elaborated in scope of work & supply shall be submitted by the contractor.	
4.	Confirm that the design and drawings for each independent facility/ building/ structure/ system shall be submitted by the BIDDER in one lot so as to facilitate an overall systematic review.	
5.	Note and confirm that all statutory approvals are in BIDDER'S scope of work. Any modifications, alterations/ additions required to meet statutory regulations are in BIDDER'S scope of work and no extra amount shall be paid on this account.	

Notes: -

1. The BIDDER shall indicate his reply in the space provided in the Technical confirmation. In case space provided is not adequate, the reply may be furnished separately under suitably numbered annexure/ attachments duly referred against the comment / query.

2. The confirmation statements/ Queries are required to be categorically confirmed/answered by the BIDDER and the completely filled in Technical confirmation shall be submitted together with the Bid.

TECHNICAL CONFIRMATION LIST (INSTRUMENTATION) FOR COOLING TOWER PACKAGE

TENDER No: C050-1U68-81-45-PB-T-8010

PROJECT : **EPCM SERVICES FOR POLYPROPYLENE UNIT AT NRL**

UNIT/UNIT NO. : **PROPYLENE UNIT (PP) / 1U68**

OWNER : **NUMALIGARH REFINERY LIMITED (NRL)**

CONSULTANT : **M/s ENGINEERS INDIA LTD.**

JOB NO. : **C050**

Contractor's Signature and Stamp	

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	07.08.2025	ISSUED WITH TENDER	SS	RK	NK

S.NO.	COMPLIANCE STATEMENT / QUERY	CONTRACTOR'S CONFIRMATION / ANSWER
	Please note that it is mandatory to furnish replies to the technical queries listed below, without which contractor's offer will be considered as incomplete and is liable for rejection.	
1	Please confirm that deviation, if any, against the applicable specifications and codes/ standards shall be duly consolidated at one place (under Exceptions / deviations list). In case "no deviations" are furnished, it will be presumed that all requirements are fully met and complied with, by the contractor. Any deviations/ deletions/ corrections made by the contractor elsewhere will not be taken cognizance of and all such deviations shall deem to have been withdrawn by the contractor.	
2	Please confirm categorical compliance to the scope of work, job specifications, various technical specifications, drawings and documents, relevant control & instrumentation specification in the bid package. Also, confirm that all other equipment, materials and work not explicitly mentioned but nevertheless required to fulfill the functional requirements shall be deemed to be included in the scope of contractor with no additional cost and time implication to the owner.	
3	Confirm that all instrumentation items, their accessories etc. supplied shall be of one of the approved makes given in the VENDOR LIST attached with tender.	
4	Please confirm compliance to Instrumentation Drawings/ Documents and specifications/ standards requirements.	
5	Please confirm compliance to Mandatory Spare Parts requirements.	

Notes: -

1. The Contractor shall indicate his reply in the space provided in the Technical Confirmation List. In case space provided is not adequate, the reply may be furnished separately under suitably numbered annexure / attachments duly referred against the comment / query.

2. The Compliance Statements / Queries are required to be categorically confirmed / answered by the contractor and the completely filled in Technical Confirmation List shall be submitted together with the Bid.

MANDATORY SPARES LIST
FOR
COOLING TOWER PACKAGE

PROJECT	**:**	**EPCM SERVICES FOR 360 KTPA PPU AT NRL**
OWNER	**:**	**M/s NUMALIGARH REFINERY LTD.**
LOCATION	**:**	**NUMALIGARH, ASSAM**
JOB No.	**:**	**C050**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	22.08.2025	ISSUED FOR TENDER	SJ	VMF	GYAS

1.0 SPARES

1.1 Mandatory Spares

The following mandatory spares shall be included by the bidder in the quoted base price:

Sl. No.	Part Description	Quantity Required
1	½" Mesh Screen	1 set for tower (covering complete width & height)
2	10 Mesh Screen	1 set for tower (covering complete width & height)

1.2 Erection/Commissioning Spares

The bidder shall include all erection/commissioning spares in the quoted price. The list of such items shall be furnished along with the offer.

1.3 Special Tools and Tackles

The bidder shall include all required special tools and tackles in the quoted price. The list of such items shall be furnished along with the offer.

NOTES:

1. Wherever %age is identified, Bidder shall supply next rounded figure.
2. The terminology used under 'Part Description' is the commonly used name of the part and may vary from manufacturer to manufacturer.

MANDATORY SPARE LIST

STATIC & MACHINERY EQUIPMENT
ANNEXURE-C: ROTATING EQUIPMENT

COOLING TOWER PACKAGE
TENDER No.: C050-1U68-81-45-PB-T-8010

PROJECT : **EPCM SERVICES FOR POLYPROPLENE PROJECT AT NUMALIGARH REFINERY**

UNIT : **RECIRCULATING COOLING WATER SYSTEM**

CLIENT : **M/s NUMALIGARH REFINERY LIMITED(NRL)**

EPCM : **M/s ENGINEERS INDIA LIMITED (EIL)**

JOB NO. : **C050**

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
A	13.08.2025	ISSUED WITH TENDER	RPT	ME	TK

MANDATORY SPARES AS SPECIFIED IN ENGINEERING DESIGN BASIS (STATIC & MACHINERY EQUIPMENT DEPARTMENT) DOC. NO. C050-999-80-42-EDB-1001 SHALL BE PROCURED ALONG WITH THE MAIN EQUIPMENT.

Annexure-A

MANDATORY SPARE PARTS

COOLING TOWER PACKAGE

(SMED - STATIC EQUIPMENT)

TENDER No. C050-1U68-81-45-PB-T-8010

PROJECT	**:**	**EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL**
OWNER	**:**	**NUMALIGARH REFINERY LIMITED (NRL)**
EPCM	**:**	**ENGINEERS INDIA LIMITED**
EIL JOB No.	**:**	**C050**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	22.08.2025	ISSUED WITH TENDER	CK	PKP	TK

(A) MANDATORY SPARE PARTS (Included in Quoted Price)

1. PRESSURE VESSELS & STORAGE TANKS

Sl. No	Part Description	Quantity Required
1	Bolting for each nozzle with blind/ companion flange and for each pad nozzle	10 % (Min. 2 nos.) for each nozzle
2	Gaskets for each nozzle with blind/ companion flange and for each pad nozzle	Two sets for each installed gasket.
3	Bolting for internal flanges	10 % (Min. 2 nos.)
4	Gasket for internal flanges	Two sets for each installed gasket.
5	Bolts, nuts, clamps, spares for demister	10 % (Min. 2 nos.) for each size / type
6	Sight/light glasses assembly complete with bolting and gasket	4 sets for each installed glass.

2. AGITATORS (As applicable)

Gasket for Agitator Mounting nozzle - 400 % for each flanged / bolted connections for Agitator/ motor assembly.

Bolting for Agitator Mounting nozzle - 10 % (minimum 2 sets) for each flanged / bolted connections for Agitator/ motor assembly.

Agitator- Oil Seal for Gear Box - 2 Set.

Wear parts for mechanical seal -One set for each Tag No.

Mechanical seal -100% of installed quantity.

Bearing for Gear reducer - One set for each Tag No.

Agitator Bearing - 100% of installed quantity.

Internal Bolting for Agitator - 10 % (minimum 2 nos.) for each installed fasteners.

Filter for Oil Lubrication System - 25% (Min. 1 no.) for each installed filter for Oil Lubrication system.

The above supersede the Mandatory spares listed in standard specifications

(B) COMMISSIONING SPARES (Included in Quoted Price)

Commissioning Spare Parts shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended spares shall be obtained along with the offer. Any commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost by the equipment vendor. Any leftover (unused) spares after commissioning, out of those included by vendor in his offer, shall be handed over to the owner.

(C) TWO YEARS OPERATIONAL SPARES (Itemised price to be given; not to be included in quoted price)

Any additional spares required over and above mandatory spares for 2 years operation and any special tools and tackles required for maintenance shall be quoted separately along with details. List of such spares and tools and tackles along with unit price shall be submitted along with the offer.

(D) Special Tools and Tackles shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended special tools/tackles shall be submitted along with the offer.

MANDATORY SPARE LIST

(ELECTRICAL)

FOR

COOLING TOWER PACKAGE

(TENDER NO.: C050-1U68-81-45-PB-T-8010)

PROJECT : EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL

CLIENT : M/s NRL, NUMALIGARH

PMC : ENGINEERS INDIA LIMITED

JOB NO : C050

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	11.08.2025	ISSUED WITH TENDER	MS	AKG	VK

Mandatory Spares:

The following mandatory spares for electrical equipment shall be supplied by the CONTRACTOR as a minimum:

Sl. No.	Part Description	Quantity Required
1.0	**MV induction motors 37 kW & above (one set of spares for each rating & type)**	
1.1	Bearing set (DE & NDE)	1 Set
1.2	Terminal studs/ bushing assembly	1 Set each
2.0	**HV induction motors (One set of spare for each rating & type)**	
2.1	Bearing (DE & NDE)	1 set
2.2	Terminal studs/bushing assembly	1 set each
3.0	**415V Power Distribution Board (One set of spares for each switchboard)**	
3.1	Control fuses / MCB	10 Nos. each rating & type
3.2	Indicating lamps covers	5 Nos. of each colour
3.3	Indicating lamps	20% or 3 Nos. (min.), whichever is more
3.4	Contactor contacts	1 set for each rating and type

NOTES:

1. Wherever %age is identified, Contractor shall supply next rounded figure.
2. The terminology used under ‘Part Description’ is the commonly used name of the part and may vary from manufacturer to manufacturer.
3. The word ‘TYPE’ means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.
4. The terminology used under ‘Part Description’ is the commonly used name of the part and may vary from manufacturer to manufacturer.
5. Mandatory spares as indicated above do not cover commissioning spares.
6. Mandatory spares as indicated above do not cover two year O&M spares.
7. Mandatory spares shall be applicable for electrical items of motors / sub-packages as per mandatory spares philosophy specified elsewhere in the bid document.

MANDATORY SPARE PARTS LIST
(INSTRUMENTATION)
FOR
COOLING TOWER PACKAGE
(TENDER No: C050-1U68-81-45-PB-T-8010)

PROJECT : **EPCM SERVICES FOR POLYPROPYLENE UNIT AT NRL**

UNIT/UNIT NO. : **PROPYLENE UNIT (PP) / 1U68**

OWNER : **NUMALIGARH REFINERY LIMITED (NRL)**

CONSULTANT : **M/s ENGINEERS INDIA LTD.**

JOB NO. : **C050**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	07.08.2025	ISSUED WITH TENDER	SS	RK	NK

MANDATORY SPARE PARTS LIST (INSTRUMENTATION)

Following spares (as a minimum) shall be supplied by the Contractor:

S. No.	Part Description	Quantity Required	Quoted yes/no
	Mandatory spares shall be quoted and included in base price as follows:		
1	**FIELD INSTRUMENTS**		
1.1	Mandatory Spares	10% of quantity or minimum one number of each type of complete instrument (whichever is higher) with respect to range, type & material of construction for each instrument. Exclusions are flame arrester, breather valve, level gauge, desuperheater, reactor skin thermocouple etc..	.
1.2	Mandatory Spares	One complete valve should be considered as mandatory spare for critical valves like Emergency depressurization valve, Anti-surge Control Valve etc. Also, for actuator of all types of valves, following spares to be considered: Piston & rod assembly, Diaphragm, complete soft parts, complete spring set: 10 % of the total quantity of each type of item of same make, model, Type & range, subject to minimum 1 set, whichever is higher.	
1.3	Mandatory Spares	For control valves/On-off Valves: SOV, Limit switches, AFR and positioner spares shall be provided as 10% of each type/ model or 1 number minimum, whichever is higher. Soft parts like gasket, Oring, seal ring, packing material shall be considered as mandatory spares for each control valve, pressure relief valve, self actuated control valve (diaphragm also) etc	
1.4	Mandatory Spares	For each Process analyser / Gas Chromatograph (except transmitter typed Analyser like pH, Conductivity etc) 1) Electronics, Source, detectors, modules, internal components: 10% subject to minimum 1 number of each type (whichever is higher) of same specification. 2) Sample handling & conditioning system:	

		Regulators, flowmeters, pressure gauges ,temp. gauges, solenoid valves, pumps, tubes, fittings, switches, set of fuses, O-rings : 10% subject to minimum 1 number of each type (whichever is higher) of same specification for each analyser. 3) Consumables like filters, seals, reagents, calibration gas cylinders, Fuel and carrier gas cylinders: 2 sets for each type of item for each process analyser.	
2	Startup and Commissioning	Required	As per contractor recommendation
3	Consumable spares for six months operation	Required (for DCS/PLC, analyzers / Chromatographs, Machine Monitoring systems, Local / Main Control Panels)	
4	DCS, PLC, Machine Monitoring System, Anti-surge Control System, Speed Governor Control, Overspeed Protection System Spare Philosophy		
4.1	System Spares (Control Room wise)	Bus Capacity- 40% Number of nodes- 30%	
4.2	Installed Spares	I/O Level- 20% Marshalling Level- 20%	
4.3	Spare Space	I/O Level- 10% Marshalling Rack- 10%	
4.4	Mandatory Spares	10% or minimum one of each type of modules/ items and system cables including processor modules, whichever is higher.	

NOTES:- Spares shall be supplied for instruments as applicable in Contractor's Scope of Supply and Work

1. All spare items required for commissioning shall be supplied by contractor like spare fuses, lamps, terminals etc.
2. Next rounded figure to be considered wherever % is specified.

   Example: For total 11 Nos. Instruments with 10% spares basis, 2 Nos. spares shall be provided.

3. Above-mentioned mandatory spares list defines the minimum requirement. Additional items as recommended by manufacturers of equipment / instrument vendors, system oriented items (if any) based on his experience shall also be considered by contractor.

4. Mandatory spares shall include spares required for instrumentation items of sub –packages as per mandatory spare philosophy.

GENERAL CIVIL

VENDOR LIST

FOR

COOLING TOWER PACKAGE

PROJECT : EPCM SERVICES FOR 360 KTPA PPU AT NRL

OWNER : M/s NUMALIGARH REFINERY LTD.

LOCATION : NUMALIGARH, ASSAM

EIL JOB No. : C050

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	04.09.2025	Issued for Bids	SJ	VMF	GYAS

1. GENERAL

1.1. CONTRACTOR shall necessarily procure all the material / equipment forming permanent part of the unit / plant from OWNER / PMC approved vendors only. This shall include sub-ordered items / components also. The "Approved Vendors" shall be item specific.

1.2. OWNER / PMC approved vendor list for the various items is enclosed in this section.

1.3. CONTRACTOR may procure material from any of OWNER / PMC approved vendors. However, current validity, holiday status and range of approval as per EIL enlistment letter, workload, stability and solvency need to be verified by the CONTRACTOR with vendor before placement of order. CONTRACTOR is also required to ensure that equipment qualification criteria, specified elsewhere in the bid document, are also simultaneously met.

1.4. Vendors on OWNER / PMC holiday list shall not be considered for ordering. CONTRACTOR shall comply with this requirement without any time or cost implication to the OWNER. If a vendor is put on OWNER / PMC's holiday list subsequent to CONTRACTOR placing an order, it shall be CONTRACTOR's responsibility to ensure quality work and timely supply from the vendor.

1.5. CONTRACTOR shall make an independent assessment of capability of all the vendors for timely deliveries of material / equipment. Any delays in deliveries by vendor(s) shall not be a cause of schedule and cost implication.

1.6. At any stage of the project, if it comes to the notice of OWNER / PMC that CONTRACTOR has procured material / equipment, intentionally or unintentionally whatsoever, from an unapproved vendor and / or items not falling in approved range of vendor(s), the same shall be rejected fort with and CONTRACTOR shall be liable to replace such material / plant / machinery without any schedule and cost implication to the OWNER.

1.7. List of vendors appearing anywhere else in the contract document in case of duplication of the items at two or more places shall not be considered by CONTRACTOR and shall be superseded by the vendor list enclosed herewith. And if in this vendor list also, items seem to be duplicated / repeated then CONTRACTOR shall get clarified the issue by OWNER / PMC before proceeding ahead for procurement activity.

1.8. It is understood that should the name of vendor be changed due to change in their company or corporate shareholding, OWNER may accept such vendors under its new name with prior approval.

It is understood that should the name of vendor be changed due to change in their company or corporate shareholding, OWNER may accept such vendors under its new name with prior approval.

2. GENERAL CIVIL:

For General Civil item supplier List refer as per attachment:

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 05AA		**Description :** FIRE EXTINGUISHERS		
Approved Suppliers				
1	K181	KANEX FIRE SOLUTIONS LIMITED	INDIA	
2	I205	INTIME FIRE APPLIANCES PVT LTD	INDIA	
3	3781	NATIONAL FIRE FIGHTING MANUFACTURING (GOVERNMENT FIRM)	UNITED ARAB EMIRATES	
4	3785	ASKA EQUIPMENTS PRIVATE LIMITED	INDIA	
5	S060	SAFEX FIRE SERVICES LTD.	INDIA	
6	B033	BHARAT ENGG. WORKS	INDIA	
7	M191	MINIMAX GmbH & Co KG	GERMANY	
8	I212	INTEGRATED FIRE PROTECTION PVT. LTD.	INDIA	
9	U185	UNITED FIRE EQUIPMENTS PVT. LTD.	INDIA	
10	V072	VIMAL FIRE CONTROLS PVT LTD	INDIA	
11	S081	SUPREMEX EQUIPMENTS	INDIA	
12	F202	FIRE SAFETY DEVICES PVT. LIMITED	INDIA	

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 05AB		**Description :** SAFETY SHOWER & EYE WASHER		
Approved Suppliers				
1	F005	FRANCIS LESLIE & CO.	INDIA	
2	U019	UNICARE EMERGENCY EQPT	INDIA	
3	C215	CREATIVE ENGINEERS	INDIA	
4	4063	SAFETY SERVICES	INDIA	

VENDOR LIST
FOR
COOLING TOWER PACKAGE

PROJECT : EPCM SERVICES FOR POLYPROPYLENE PROJECT AT NUMALIGARH REFINERY

CLIENT : NRL

JOB NO. : C050

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	14/08/2025	ISSUED WITH MR	AV	AV	LSJ

1. GENERAL:

a) Package vendor shall procure all the piping material from EIL approved vendors only.

b) Current validity, holiday status and range of approval as per EIL enlistment letter need to be verified by the Package vendor with vendors before placement of order.

c) Vendors on Owner/EIL holiday list shall not be considered for ordering, which need to be verified by the Package vendor prior to placement of order.

d) In case any vendor is registered with EIL as an approved vendor subsequent to release of this vendor list, the same may also be considered by the Package vendor with prior intimation to Owner/EIL and obtain their concurrence prior to placement of order.

e) Items not covered in the approved vendor list, the Package vendor shall propose the suppliers/vendors and submit the necessary documents/ credentials/ past track record for Owner/EIL's review/approval.

f) Piping item having Licensor specified mandatory vendor shall be from the same vendor. However, for recommended vendors by Licensor, Package vendor to take approval from Owner/EIL/Licensor, in case going for equivalent vendor.

g) Non acceptance of a particular proposed vendor due to any reason whatsoever shall not be a cause of schedule and cost implication.

h) Package vendor shall have an independent assessment of capability of all the vendors for quality & timely deliveries of material. Any delays in deliveries by vendor(s) shall not be a cause of schedule and cost implication.

i) At any stage of the project, if it comes to the notice of Owner/EIL that Package vendor has procured material, intentionally or unintentionally whatsoever, from an unapproved vendor and/or items not falling in approved product range of vendor(s), then the same shall be rejected forthwith and Package vendor shall be liable to replace such material within the contract price and without any time/schedule implication.

j) All approved vendors are deemed to have been freely chosen by the CONTRACTOR at his own risk.

2. SUPPLIER'S LIST: