HINDUSTAN PETROLEUM CORPORATION LIMITED  
MUMBAI REFINERY  

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SECTION – 7.0  
TITLE: SCOPE OF WORK PRE-COMMISSIONING AND COMMISSIONING  

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</tbody>
</table>
## CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>PRE-COMMISSIONING AND COMMISSIONING</td>
</tr>
<tr>
<td>2.0</td>
<td>SCOPE OF WORK</td>
</tr>
<tr>
<td>3.0</td>
<td>DEFINITIONS</td>
</tr>
<tr>
<td>4.0</td>
<td>DOCUMENT FOR PRE-COMMISSIONING /COMMISSIONING</td>
</tr>
<tr>
<td>5.0</td>
<td>OTHER REQUIREMENTS</td>
</tr>
<tr>
<td>6.0</td>
<td>REVIEW/CHECKLISTING/INSPECTION CO-ORDINATION</td>
</tr>
<tr>
<td>7.0</td>
<td>COMMISSIONING</td>
</tr>
<tr>
<td>8.0</td>
<td>PERFORMANCE GUARANTEE RUN</td>
</tr>
<tr>
<td>9.0</td>
<td>SPARES AND CONSUMABLE</td>
</tr>
<tr>
<td>10.0</td>
<td>SAFETY</td>
</tr>
<tr>
<td>11.0</td>
<td>CLIENT’S OBLIGATIONS</td>
</tr>
<tr>
<td>12.0</td>
<td>ATTACHMENTS</td>
</tr>
</tbody>
</table>
1.0 PRE-COMMISSIONING & COMMISSIONING

1.1 PRE-COMMISSIONING NETWORK

The CONTRACTOR shall submit the pre-commissioning schedule in the form of network detailing therein the sequence of all the pre-commissioning activities and time taken by each individual activity to be carried out in each sub-system of the unit. This shall be handed over to OWNER/PMC prior to start of Pre-commissioning activities. CONTRACTOR shall also submit to OWNER/PMC weekly progress reports of the status of pre-commissioning activities, likely slippage and measures being taken by CONTRACTOR to contain that slippage.

1.2 PRE-COMMISSIONING ACTIVITIES

1.2.1 The CONTRACTOR shall submit the list of systems and prepare list of pre-commissioning activities to be performed for all applicable disciplines against each systems including flushing schemes for the piping sub-systems.

1.2.2 The above details will be prepared and submitted to OWNER/PMC at least 90 days before start of the Pre-commissioning activities. The CONTRACTOR will also prepare formats for each pre-commissioning activities for recording data of successful pre-commissioning tests to be duly checked and signed by OWNER’s/PMC and representatives. The above documents will form a part of overall pre-commissioning documents to be submitted by the CONTRACTOR to the OWNER with a copy to PMC.

1.3 COMMISSIONING

It shall be the responsibility of the CONTRACTOR to carry out commissioning activities of the unit / plant after achieving successful mechanical completion and completing pre-commissioning activities (dually witnessed by OWNER). The CONTRACTOR shall depute trained operating team (with experience in similar plant / unit) comprising of commissioning coordinator, shift-in-charge control room and field operators. Mechanical, electrical and instrumentation engineers / foreman / technicians etc to carry out plant start-up and commissioning. Commissioning shall be considered to be commenced from the day of charging feed to the Unit/Plant.

1.4 MANPOWER REQUIREMENT FOR COMMISSIONING

The CONTRACTOR shall depute trained operating team Comprising minimum of but not limited to the following experts

- Commissioning coordinator
- Shift in-charge
- Control Room Coordinator
- Field Supervisor
- Trained Operators
- Technicians for equipment and instrument trouble shooting

2.0 SCOPE OF WORK

The CONTRACTOR shall be responsible to carry out mechanical completion, pre-commissioning and commissioning of all the units, tankages and all interconnecting piping in association with OWNER’s operating personnel. (The operating manual based on guidelines provided in this document shall be prepared by the CONTRACTOR). A procedure for detailed mechanical completion, pre-commissioning, commissioning and start-up shall be developed by CONTRACTOR based on the guidelines provided in this document and this shall be reviewed and approved by OWNER / OWNER’s representatives. The CONTRACTOR shall be
responsible for preparing and supplying pre-commissioning and commissioning documents and carrying out pre-commissioning and commissioning activities listed below:-.

2.1 FOLLOWING SHALL BE ENCLOSED BY THE BIDDER IN HIS OFFER

2.1.1 An Organisation chart of bidder’s proposed commissioning team indicating the positions with the required qualifications and experience. It shall also indicate the position that the bidder proposed to fill from personnel engaged from back up agency whenever bidder proposed to engage such an agency in his offer. A proposed organogram for commissioning team is attached as Attachment 12.4.

2.1.2 Bio-Datas of key personnel comprising the commissioning team.
In case the member of the commissioning team as mentioned in the offer is not available at the actual time of commissioning then the CONTRACTOR should ensure a replacement with equivalent qualification and experience. The format of bio-data is enclosed as Attachment 12.2

2.1.3 Track record of bidder in respect of related commissioning experiences.

2.1.4 Clause wise list of deviations, if any, from the chapter on commissioning. In absence of this it shall be taken that the bidder has no deviations.

2.1.5 Questionnaire as given in Attachment 12.3 duly filled by the bidder.

3.0 DEFINITIONS

3.1 Mechanical Completion

3.1.1 Mechanical Completion of systems shall mean that all installation works of the system have been completed in accordance with approved construction drawings, approved specifications, applicable code as defined in the bid package and following accepted International good engineering practices and all the activities have been completed in a comprehensive manner by the CONTRACTOR and witnessed by OWNER/OWNER’s representatives and the standard pre-commissioning forms have been duly filled and signed by OWNER/OWNER’s representative/CONTRACTOR’s Commissioning Representative/ Vendors as a witness of successful completion of the said activity. Certificates of various statutory bodies for relevant portions of the work completed shall be available as a part of mechanical completion. Once the system / equipment of all the units, off sites, utilities are ready for pre-commissioning, CONTRACTOR has to issue a certificate to the effect that terminal/system/equipment is ready for pre-commissioning.

3.2 Pre-commissioning activities

3.2.1 Pre-commissioning activities (as given in Attachment 12.1) are defined as those activities which are required to be performed after completion / installation, inspection, hydro testing etc of an equipment / system to make ready for commissioning. This shall include but not be limited to activities such as system checking as per P&ID’s, site modifications, internal inspection of tank / equipment / vessel, flushing, air blowing of pipelines including gasket blowing, purging of system using nitrogen, leak test both for low pressure and high pressure systems, calibration of instruments, checking of the electrical equipment for proper earthing, continuity, insulation resistance, secondary inspection of relays after insulation resistance, conducting operability test on individual equipment / systems, charging of lubes and other chemicals. Fabrication and supply of temporary facilities such as temporary bypasses, spools, blind, jump over, vents etc which will be required to carry out pre-commissioning activities will be the responsibility of the CONTRACTOR. All the pre-commissioning activities are to be carried out by the CONTRACTOR including catalyst and catalyst support material loading in the reactors as applicable. Mechanical check list prepared by OWNER / OWNER’s representatives is also to be liquidated by the CONTRACTOR.
3.3 Ready for commissioning

3.3.1 The units shall be considered “Ready for Commissioning” when all the facilities have been completed along with its auxiliaries and support facilities in every respect including charging of lubes, chemicals, preparation of solution for smooth and safe start-up and normal operation and ease of maintenance. All temporary structures, scaffolding etc used for carrying out the pre-commissioning works have been removed, all the blinds have been put into position as required by process, all systems as recommended by process licensors have been purged and pressurized, all the pre-commissioning and other documents including blinds list, set pressures of PSV’s have been handed over to the OWNER and the terminal has reached a stage of ready for commissioning and acceptable to OWNER / OWNER’s Representative.

3.3.2 The CONTRACTOR shall issue a certificate of ready for commissioning of all units, utilities, offsite for acceptance by the OWNER in standard format; with all exceptions resolved

3.3.3 After all the units, utilities and offsite has been declared as Ready for Commissioning, the CONTRACTOR shall not carry out any hot work without prior permission of the OWNER.

3.4 The CONTRACTOR to carry out all activities essential for pre-commissioning / commissioning even if not specifically mentioned in this document including arrangement of equipment / temporary facilities / connections / fittings / spools / consumables / tools and tackles / special equipment for loading of catalysts etc.

3.5 Start up and operate

3.5.1 The start-up activities are to be carried out by the CONTRACTOR along with the OWNER / PMC. Responsibility for the start up activity lies with the CONTRACTOR.

3.5.2 At least three months in advance of starting the commissioning, the CONTRACTOR shall submit a proposal to the OWNER / PMC giving details of the time schedule and manpower deployment to be followed during commissioning. This shall be checked by OWNER / OWNER’s Representative. The CONTRACTOR shall provide trained operation team (with experience in similar plant / unit) comprising of commissioning manager, shift in charge, main control room coordinator (DCS and local panels) and Field Operators, Mechanical, Electrical and Instrument Engineers / Foreman etc to carry out terminal start-up and commissioning and normal operations and maintenance.

3.5.3 This team will co-ordinate correction of defects during start-up including acquiring necessary parts and interface with vendors. The commissioning manager will co-ordinate support by vendor representatives.

3.5.4 The CONTRACTOR also will be required to provide on the job training to OWNER’s operation personnel by associating them in all the day to day pre-commissioning, commissioning, maintenance activities and process operations, however responsibility for adequately manning the terminal / units / plant shall be that of CONTRACTOR.

3.5.5 Upon successful commissioning of the terminals, the same shall be taken over by the OWNER for day to day operation and maintenance only, the final takeover subject to compliance to all the contractual obligations by the CONTRACTOR.

3.6 Manufacturer’s representative

3.6.1 It shall be the responsibility of the CONTRACTOR to arrange to get services of manufacturer’s installation/commissioning engineer at site during mechanical completion/pre-commissioning and commissioning of all the major equipment and systems for the terminal listed as under:
Scope of work for Commissioning and Precommissioning

4.0 DOCUMENT FOR PRE-COMMISSIONING/COMMISSIONING

4.1 OPERATING MANUAL

4.1.1 The CONTRACTOR shall prepare draft Operating Manuals for the complete plant systems and submit to OWNER/OWNER’s Representatives at least 150 days prior to mechanical completion in five copies of draft operating manual. In particular the operating manual shall be prepared in four separate documents in which following information shall be covered.

4.1.2 Operating reference

- Detailed process / system description
- Normal startup and operation procedure
- Effect of operating variables on the process
- Operating parameters and set points of different alarms and trips
- Operating conditions of different cases of operation
- Detail of interlock logic etc.
- Functional description of safety shut down systems
- Normal Shutdown procedure
- List of emergencies and emergencies handling procedures
- Laboratory Analysis Requirement and Procedure
- Dosage rate of chemicals used and other related operating information
- Safe handling precaution for chemical used including MSDS (Material Safety Data Sheet)
- Any other special conditions / instructions / information etc
- Hydrocarbon detection and associated safety system
- Use of life saving devices
- Fire and Safety system
- Fire and Safety system

4.1.3 Vendor Catalogue

Vendor instructions for all equipment for start-up, shutdown, normal operation and troubleshooting.

4.1.4 Review of operating manual shall be done by the OWNER / OWNER’s Representative within 30 days after receipt of draft and all the changes, additions, deletion required by the OWNER/PMC shall be discussed with the CONTRACTOR and shall be incorporated in the final start-up and operating manual by the CONTRACTOR. Twenty copies of final operating manual is to be submitted by the CONTRACTOR. The same shall also be forwarded in CDs / DVD’s. This manual shall be furnished to OWNER at least 90 days prior to Mechanical Completion. This operating manual shall be followed during start-up and commissioning of the terminals. Vendor operating manual shall not form a part of operating manual. In case of any revisions due to any reasons, the same should be submitted as revised sheet during the start-up and commissioning stage. However, the same shall be incorporated and submitted as final total manual within one month after the commissioning has been completed.
4.2 Pre-commissioning and Commissioning network

4.2.1 The CONTRACTOR shall submit the pre-commissioning and commissioning schedule in the form of network detailing therein the sequence of all the pre-commissioning and commissioning activities and time taken by each individual activity to be carried out in each equipment sub-system of the terminal. This shall be submitted to OWNER prior to start of pre-commissioning activities for review and approval. CONTRACTOR shall submit weekly progress report and the status of pre-commissioning and commissioning activities, likely slippage’s and action being taken by the CONTRACTOR to contain this slippage.

4.3 Pre-commissioning documents

4.3.1 It shall be the responsibility of the CONTRACTOR to prepare detailed format of check list of pre-commissioning and commissioning activities for each equipment, subsystem, system and terminal as a whole. The CONTRACTOR shall submit the said format for approval to the company. This check list to indicate the checks / test to be carried out on each equipment / system and shall also indicate the sequence and schedule of the activities.

4.3.2 Checklists will be prepared by OWNER / OWNER's representative. Representative of CONTRACTOR shall be available and assist the OWNER / OWNER's representative for carrying out the checks as per the check lists. All the check lists points shall be liquidated by the CONTRACTOR. System readiness for pre-commissioning shall be determined based on completion of relevant portion of checklist as per the approved format and all balance works completed by the CONTRACTOR.

4.3.3 For the purpose of execution of these pre-commissioning activities, the units and offsite shall be divided into system and sub-systems. The pre-commissioning document shall contain the following:

- Process System identification on P&ID
- Detailed procedure for the various pre-commissioning activities i.e. flushing, blowing, purging, leak checking, system tightness and equipment operability test with forms to record the observation of each of the activities carried out.
- Procedure and forms for operability tests of equipment and system as a whole where applicable.
- Lube schedule indicating manufacture (Indian equivalent to lubes, quality, initial fill recommended and frequency of changing the Lube oil).
- Detailed procedure for carrying out passivation of compressor circuit (wherever applicable) shall be approved before implementation. Requirement of tank, pumps, chemical dosing arrangement and apparatus for chemical analysis shall be detailed out by CONTRACTOR and shall be in CONTRACTOR's scope.
- Detailed heater refractory dry out procedure / passivation of heater tubes.
- Pickling and chemical cleaning

4.3.4 The CONTRACTOR shall submit the draft of above-mentioned pre-commissioning documents 180 days before the activities are to be carried out. The OWNER's/PMC representative shall review the document. The CONTRACTOR shall submit 120 days prior starting of activities, a revised document after incorporating OWNER's/PMC comments. The documents shall be updated till the Project is completed and handed over to the Company.

4.3.5 At the end of the Mechanical Completion (which includes pre-commissioning) the CONTRACTOR shall submit a request to the OWNER for issue of Mechanical Completion Certificate. Along with it the CONTRACTOR shall enclose all construction completion documents and the complete pre-commissioning documents duly filled and signed. These documents shall be completed by the CONTRACTOR System wise and copy of the same shall be submitted to the OWNER / OWNER's Representative.
4.3.6 Commissioning of the facility will not be permitted till the CONTRACTOR has submitted all the documents. Any delay in commissioning on this account shall be considered as a delay in commissioning by the CONTRACTOR.

5.0 OTHER REQUIREMENTS

CONTRACTOR to ensure that all safety devices like pressure safety valves (PSV), emergency shut down valves are tested; the tests are witnessed and certified by representative of CONTRACTOR / OWNER. These certificates are to be handed over to OWNER prior to start-up of the terminal. The CONTRACTOR along with Ready for Commissioning Certificate shall submit to the OWNER/PMC the master blind list and record of set pressures of all PSV provided in the complex. The CONTRACTOR shall also provide "No Smoking" boards and boards for other designated areas for installing in unit / offsite areas. CONTRACTOR is required to maintain and follow all safety practices; equivalent or better than those being practiced by OWNER for the complex during pre-commissioning and commissioning.

6.0 REVIEW/CHECKLISTING/INSPECTION REQUIREMENTS

6.1 A general guideline on OWNER / OWNER's Representatives interaction with respect of terminal Pre-start up activities is given below. However, OWNER reserves their right to witness all works at any stage

6.1.1 Review of Pre-commissioning Documents and Network (As detailed in Section 4.2 and 4.3 above).

6.1.2 Review of Operating Manual (As detailed in Section 4.1 above)

6.1.3 Check listing (System-wise)

- Preliminary Checklist on System Completion
- Final Checklist before start of Pre-commissioning activities

6.1.4 A Typical Approach to Witness / Inspection of Pre-Commissioning Activity

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<th>Witness/Inspection</th>
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<tr>
<td>a) Installation of Safety Device</td>
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<tr>
<td>b) Provision of Temporary Strainers and Blind Critical Locations</td>
<td>Complete</td>
</tr>
<tr>
<td>c) Water Flushing and Air Blowing of Pipelines</td>
<td>Random</td>
</tr>
<tr>
<td>d) Cleaning of Internals Flushing of vessels, Leak Tests / Tightness Test of System</td>
<td>Complete</td>
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<tr>
<td>e) Instrumentation Interlock checks</td>
<td>Complete</td>
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<tr>
<td>f) Operability test for a system / Equipment</td>
<td>Complete</td>
</tr>
<tr>
<td>g) Blind List as per start up requirement / normal operation</td>
<td>Complete</td>
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Witness/Inspection/Approval by OWNER/PMC is not an obligation but a right with no change in CONTRACTOR’s liabilities.
6.2 Final Inspection before Start-of Commissioning

6.2.1 OWNER / OWNER’s representative shall carry out a final inspection of the terminal before permitting entry of hydrocarbon into the new facility.

7.0 COMMISSIONING

7.1 It shall be the responsibility of the CONTRACTOR to commission the process unit. Commissioning of the unit will be carried out once mechanical completion is over successfully, all pre-commissioning activities are carried out and system is ready for commissioning under necessary guidance and overseeing of OWNER / OWNER’s Representative. OWNER will supply all operating manpower and they will work with the CONTRACTOR. Process designers of the CONTRACTOR will provide necessary coordination during startup and technical clarification will be furnished by them. It will be the responsibility of the CONTRACTOR to provide assistance to OWNER’s operating crew by way of manpower, tools and tackles, consumable etc to carry out the activities as per process designers.

7.2 Commissioning of the Process Unit shall mean taking the feed, passing it through the normal route, establishing the process control parameters first at turn down and then at design value stipulated in the process package along with supplementary instructions if any from process OWNER/OWNER’s representative.

7.3 The process unit shall be considered to be commissioned successfully when all the units with instrumentation / control systems for process, utilities and support system have been on uninterrupted stable operation for not less than 72 hours. Whether the 72 hours operation has been successful or not, shall be decided by the OWNER based on observations recorded during 72 hours. The countdown for 72 hours operation shall start only after Unit has been on stable operation with all controls and safety system in normal operation for a period of not less than 48 hours.

7.4 Three months in advance of starting the commissioning, the CONTRACTOR shall submit proposal to the Company / Company’s Representative giving details of the programme to be followed during commissioning. This shall be checked by Company / Company’s Representative. The CONTRACTOR shall arrange trained operation team comprising of commissioning manager, shift in-charge main control room (DCS and Local Panels) coordinator and Field Operators, Mechanical, Electrical and Instrument Engineers / Foreman etc to carry out plant start-up and commissioning and process operations and maintenance under the overall guidance of OWNER’s Representative.

7.5 The CONTRACTOR in his offer shall submit the Organisation manpower chart of commissioning team and the bio-data of key persons who shall be present at the time of commissioning. The CONTRACTOR shall also specify the planned duration of stay of these personnel.

7.6 The CONTRACTOR also is required to provide, on the job training to company operation personnel by associating them in all the day to day pre-commissioning, commissioning, maintenance activities and process operations, however responsibility for adequate manning the plant shall be that of CONTRACTOR. After successful commissioning of the process units as above the same shall be handed over to the company for operation. In case of any constraint in achieving the above process parameters in the Process Unit by the CONTRACTOR, the same shall be communicated by the CONTRACTOR to the company in writing. This will be reviewed jointly by the company to arrive at a decision on whether the constraint is on account of reasons attributable to the CONTRACTOR or not. The action in either case will be according to the relevant provisions / provided elsewhere in the Contract.
8.0 PERFORMANCE GUARANTEE RUN

8.1 After the Commissioning has been completed, put into operation and steady state operation is established, performance test of each unit shall be conducted. Before carrying out the performance test of each unit, CONTRACTOR shall develop a procedure and schedule in consultation with the designer and submit to OWNER / PMC for their approval. The performance test is to be carried out as soon as practicable after the commissioning but not later than 12 months.

8.2 The CONTRACTOR shall provide the services of his chief Commissioning Engineer who was associated with the commissioning of the process units at site during this performance guarantee run period. CONTRACTOR shall be held responsible for any defects attributed to him and shall be dealt as per the relevant provision of the contract.

8.3 The performance test shall be carried out by operating the units for a minimum period as specified elsewhere. The results obtained during that period will form the basis of comparison between the actual performance and Units process guarantees.

8.4 Measuring methods, tolerances, instructions for analysis and calculations shall be as per accepted practices and shall be mutually agreed upon before the start of performance test.

8.5 Any interruption in the running of the PLANT for less than five minutes during a performance test shall be ignored.

8.6 If a performance test of each unit has been carried out successfully for a period as specified continuously, guarantees are met, then the performance test shall be deemed to have successfully completed.

8.7 Until guarantees have been met additional performance test shall be conducted, in the same manner as the first performance test.

8.8 Always after completion of a performance test, all relevant operating and production figures shall be recorded in a protocol to be signed by authorized representatives from OWNER / consultant and Licensor.

8.9 Within 15 (fifteen) days after the completion of each performance test, CONTRACTOR shall determine and submit to OWNER / consultant in writing the results thereof, indicating whether the guarantee relating to such performance tests have been met. Such a guarantee shall be deemed to have been met if OWNER / consultant indicates that the performance test was successful and if OWNER / consultant within 20 (twenty) days after notification of the results of such performance test does not specify in writing to CONTRACTOR in what respect, in OWNER’s / consultant’s opinion, such guarantee has not been met.

8.10 In case the performance test fails to meet guarantees, the authorised representative of both CONTRACTOR and OWNER/consultant shall mutually discuss and determine the causes of failure of the test. Necessary modifications required will be suggested by CONTRACTOR in writing and if the cause of failure is attributable to CONTRACTOR, cost of these modifications shall be borne by CONTRACTOR.

9.0 SPARES AND CONSUMABLES

9.1 The CONTRACTOR shall be responsible for the supply of all spares and consumables for start-up and commissioning. These spares shall be handed over by the CONTRACTOR to the company. The CONTRACTOR shall also be responsible for supply of all lubes, chemicals, desiccant and other similar materials for first charge and six months normal consumption unless specified as a free issue material.
9.2 It shall be the CONTRACTOR’s responsibility to repair any damage to the system occurred during storage, installation, pre-commissioning and commissioning stage. The CONTRACTOR shall submit catalogues for all the lubricants and chemicals being charged for commissioning.

10.0 SAFETY

10.1 The CONTRACTOR shall follow OWNER’s safety practices during execution of pre-commissioning / commissioning works. CONTRACTOR is required to maintain and follow all safety practices equivalent or better than those being practiced by company for the complex during pre-commissioning and commissioning.

11.0 OWNER’S OBLIGATIONS

11.1 The utilities, power & fuel required for pre-commissioning & commissioning activities shall be provided by OWNER. However, the temporary piping / fittings required to be done for drawing these utilities shall be in the scope of CONTRACTOR.

12.0 ATTACHMENTS

12.1 PRE COMMISSIONING ACTIVITIES

12.2 FORMAT FOR BIO DATA

12.3 QUESTIONNAIRE

12.4 ORGANOGRAM-COMMISSIONING TEAM
ATTACHMENT 12.1
PRE-COMMISSIONING ACTIVITIES

1.0 The checklist represents the absolute minimum work which has to be performed by the CONTRACTOR prior to commissioning of the facilities. However, it is not intended to be a complete list of activities required to be carried out by the CONTRACTOR.

2.0 Manufacturer's/Vendors instructions for pre-commissioning checks, testing must also be followed for all equipment.

3.0 GENERAL PROCEDURE FOR COMMISSIONING
The general work procedures listed below outline the work to be performed by the CONTRACTOR. Procedures applicable to specific system or items of equipment are covered separately.

3.1 Packing the Seals
3.1.1 Install mechanical seals, permanent packing and accessories, wherever required. Adjust and replace mechanical seals, packing and accessories, as necessary during pre-commissioning / commissioning period.

3.2 Removal of Temporary Bracing
3.2.1 Remove all temporary supports, bracing or other foreign objects that were installed in vessel transformers, piping rotating machinery or other equipment to prevent damage during shipping, storage and erection.

3.3 Rotation and Alignment
3.3.1 Check rotating machinery for correct direction and for freedom of moving parts before connecting driver.
3.3.2 Make cold alignment to the manufacturer’s tolerance along with OWNER / OWNER’s Representative. Provide all the alignment readings records to Company.
3.3.3 Check all lubricants and their quality fill etc before operating the equipment.
3.3.4 Carry out no load run of motors, check bearing temperatures, vibration, over speed trips function of different safety devices and other relevant tests. Carry out adjustments as required.
3.3.5 Make hot alignment and any adjustments required after equipment has been put in operation. Arrange for manufacturer representative for equipment as required during installation and / or pre-commissioning and commissioning.

3.4 System Checks / Inspection
3.4.1 Provide inspection facilities to the OWNER / OWNER’s Representative to check that created facilities conform to the approved process and instrumentation drawings, construction drawings, vendor drawings and specifications approved for construction. Verify and approve the facility check. Note exceptions, if any on a separate work order list.

3.5 Site Modifications
3.5.1 Carry out site modifications as found necessary during system check / inspection from viewpoint of operability, maintenance and safety of the terminal.

3.6 Flushing
3.6.1 Flushing schemes for various systems / subsystems / equipment should be prepared well in advance and to be submitted to OWNER for review and approval. Perform flushing using fresh treated water and blowing using air or as advised by OWNER / OWNER’s representative of all above ground and underground piping to remove dirt, welding slag etc after hydro testing (along with gasket / sheet blasting). Arrange for cleaning media for carrying out flushing / blowing and disposal of the cleaning media in accordance with procedure to be adopted by the CONTRACTOR and approved by OWNER / OWNER’s representative.
3.6.2 Following rates of cleaning media to be maintained:
   Air         - 8-9 ft/sec
   Water      - 3-4 ft/sec.

3.6.3 Adequate arrangements to handle flushed streams to be created by CONTRACTOR without
   causing flooding of existing facilities.

3.6.4 System flushed with water shall be followed by blowing with air for removal of free water.
   System required to be kept under inert pressure as recommended by vendor. Steam blowing,
   whenever required, shall be carried out.

3.7 Temporary Spools, Strainers and Blinds
3.7.1 Provide and install all strainers, both temporary and permanent
3.7.2 Clean strainers as required during pre-commissioning and commissioning.
3.7.3 Provide install and remove all blinds required for flushing or operation. (Install and dismantle
   temporary pipe pools as and when required for pre-commissioning and commissioning)

3.8 Leak, Vacuum and Pressure Tests
3.8.1 Make non-operating leak tests and pressure tests on piping and all equipment including field-
   fabricated equipment. Conduct all tests in accordance with applicable statutory / safety / other
   applicable design codes and specifications. Leak tests up to 5 kg/cm² pressure to be carried
   out after purging / flushing. Further leak test at higher pressure shall be carried out in steps of
   5/10 kg/cm² of gas. Detailed procedure for leak and pressure tests on piping and field-
   fabricated equipment shall be submitted to the company for approval. Notify the OWNER of
   test schedule at least two days in advance. All the tests are to be witnessed and the test
   record on satisfactory completion of the test to be signed by OWNER / OWNER's
   representative.

3.8.2 Provide 4 copies of all the test records to the OWNER.
3.8.3 Provide any special media for test purpose and provide facilities for disposal.
3.8.4 Conduct all operational tightness testing.

3.9 Safety devices
3.9.1 Provide the OWNER with a list of proper setting for safety devices.
3.9.2 Install all safety devices (including pressure relief valves) on the equipment after calibration
   test and adjust all safety device and seals wherever necessary or desirable.

3.10 Purging
3.10.1 Install necessary purge connections and carry out system purging with inert gas.

3.11 Drying Out
3.11.1 Provide operating procedure and guidelines to carry out drying of heaters and major
   equipments.

3.12 Operating Supplies and Chemicals
3.12.1 Procure and supply initial fill of all chemicals, resins, desiccant and other similar materials.
   Replenish the chemicals consumed during pre-commissioning and commissioning.

3.13.2 Provide continuous clean up of the construction and operational area. Remove excess
   materials, temporary facilities and scaffolding and pick-up trash. Perform washing for further
   clean-up as required.

3.14 Equipment Protection and Spare Parts
3.14.1 Protect equipment from normal weather conditions, corrosion or damage before
   commissioning.
3.15 Chemical Cleaning / Pickling
3.15.1 Perform special chemical cleaning or pickling of the piping etc. as required by specification. Full specification shall be submitted to the OWNER/PMC. All necessary temporary piping as required shall be provided by the CONTRACTOR.

3.16 Packing / Filling of tanks / vessels
3.16.1 To carry out cleaning of internal surface, distributors, supports etc. The CONTRACTOR shall also arrange for cleaning of packing material to remove grease / rust, dirt etc before loading of the packing using water fill method. In case the packing are to be stacked, the CONTRACTOR shall install hold down grating and remove the same after completing filling job.

3.17 Miscellaneous
3.17.1 To carry out any other check / test as required by OWNER / OWNER's Representative and provide all test certificates as required by the OWNER / OWNER's Representative and provide all test certificates as required by the OWNER / OWNER's Representative.

3.18 Operability Test for a System / Equipment
3.18.1 Each system / equipment shall be given operability test for sufficient duration (not less than 4 hours) to provide worthiness of the system for normal operation.
3.18.2 The CONTRACTOR shall provide his proposal / procedures for carrying out the operability test of each equipment / system to prove that the equipment system installed meet the design specification.
3.18.3 This shall also include the supply of log sheets wherein the operating parameters shall be recorded hourly.
3.18.4 The operability test shall be carried out by the CONTRACTOR in presence of OWNER / OWNER's Representative and the Vendor representative wherever applicable.
3.18.5 The CONTRACTOR shall make necessary checks, adjustments, repairs required for normal operation of the system / equipment. All the safety devices shall be tried for their proper operation.
3.18.6 Upon completion of the operability test the log sheet with all observation shall be signed by the CONTRACTOR, Vendor, OWNER's Representative. The performance shall be evaluated based on the data and observations made during the operability test.

4.0 SPECIFIC PROCEDURES
In addition to the work to be performed in accordance with the above, the detailed procedures outlined below further define the work responsibilities of the CONTRACTOR for specific systems and items of equipment.

4.1 Vessels
4.1.1 After vessels / columns have been erected and put in place, any internals requiring field installations are to be installed. These internals shall be inspected before and after installation. Open both internal and external man ways for inspection of vessel by the OWNER / OWNER's Representative. Box up after proper execution of closure permits.

Note:
Vessels that have been pressure tested in the shop may require retesting if felt necessary by the OWNER. They shall however be included in the testing of attendant piping systems whenever practical and approved by the OWNER.

4.2 Shell and Tube Heat Exchangers
4.2.1 Perform internal inspection / testing as required by specifications or drawings. Perform separate field testing, if desired by OWNER, of exchangers that have been shop tested.
4.2.2 Cross leakage for exchanges may be tested at OWNER’s discretion.

Note:
Shell and tube exchangers that have been pressure tested in the shop may require retest if felt necessary by OWNER. They shall however be included in the testing of attendant piping system whenever practical and approved by the OWNER. If a shell and tube exchanger is taken in piping system test and the exchanger is designed for differential pressure, proper care shall be taken to ensure that differential pressure between shell and tube side is not exceeding beyond the maximum recommended differential pressure during the testing.

4.3 Pumps and Drivers
4.3.1 Level base plates and sole plates. Alleviate any excess piping stresses that may be imposed on pumps, compressors and drivers. Chemically clean complete lube and seal oil system as specified. Dispose of waste and cleaning media as per OWNER instructions.

4.3.2 Charge the oil, seal oil and cooling systems with flushing oil and circulate for cleaning purposes. Dispose of any flushing oil in accordance with the OWNER’s approved procedure. Charge the lube oil, seal oil and oil cooling system with operating oil recommended by the manufacturer.

4.3.3 Obtain service engineer for technical assistance during installation and/or pre-commissioning and commissioning as specified.

4.4 Piping System
4.4.1 Notify the OWNER of hydro test schedule at least two days in advance system by system during mechanical construction stage.

4.4.2 Orifice plates, control valves and any other online instruments should not be installed before testing and flushing. If installed, they shall be removed and necessary spool pieces shall be provided in their place wherever required during flushing to avoid damage.

4.4.3 Piping system shall be thoroughly flushed and cleaned to the satisfaction of the OWNER / OWNER’s Representative. Hydrotestically or pneumatically test all piping as required by the drawings or specifications. After testing, drain and dispose of the test media as per the company’s instructions. All the piping will be dried using air and boxed up.

4.4.4 Check pipe hangers, supports, guides and pipe specialties for hot settings and make minor adjustments as necessary.

4.4.5 Install seals on valves where necessary replacing dry up graphite seals with fresh ones shall be in CONTRACTOR’s scope of work.

4.4.6 Correct support, vibration and thermal expansion problems detected during commissioning.

4.5 Instrument System
4.5.1 The CONTRACTOR will make all non-operating checks that will ensure instrument operability i.e. remove all shipping stops, check pointer travels and verify instrument capability to measure, operate and stroke in the direction and manner required by the process application.

4.5.2 Clean all impulse lines (etc.) by blowing with cooled and filtered clean air compatible with instrument components.

4.5.3 Clean all air supply headers by blowing with clean air and check them for tightness. Leak Test pneumatic control circuits.

4.5.4 Check piping from instruments to process piping for tightness.

4.5.5 Install and connect all system components and verify their conformance to specifications and design criteria for functional and range using dummy transmission signals as needed.

4.5.6 Check all electrical signals and alarm wiring for continuity, correct source of power and polarity.

4.5.7 Check thermocouple for proper joining of wires, position of elements in wells, proper polarity and continuity of receiving instruments.

4.5.8 Identify orifice plates by tagging and check for proper installation of upstream side of plates.
4.5.9 Isolate or remove if necessary, the components such as control valves, positive displacement meters and turbine meters for pressure testing. Reinstall these items after testing the system.

4.5.10 Check bores of orifice plates and install these plates after completion of flushing operations.

4.5.11 As dictated by the Company's specifications, calibrate instruments with standard test equipment and make all required adjustments and control point settings.

4.5.12 Fully pressurize and energize the transmitting and control signal system(s) by opening process connections at primary sensors and final regulators and by making control mode settings for automatic operation of equipment as the terminal is charged and brought on stream.

4.5.13 Check setting of all alarm and shutdown switches.

4.5.14 Check all shutdown system before commissioning.

4.5.15 The CONTRACTOR shall arrange for testing and re-calibration of all the safety valves settings at site. Ensure that safety valve isolation valves are locked open as per drawings.

5.0 DELETED
FORMAT FOR BIO-DATA OF KEY PERSONNEL FOR COMMISSIONING

1. PROPOSED POSITION IN ORGANISATION CHART

2. NAME

3. QUALIFICATION

4. TOTAL YEAR OF EXPERIENCE IN PLANT OPERATION / COMMISSIONING

5. DETAILS OF COMMISSIONING EXPERIENCE

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<tr>
<th>SI No</th>
<th>Project Description</th>
<th>Capacity</th>
<th>Licensor/Manufacturer</th>
<th>OWNER</th>
<th>Year of Commissioning</th>
<th>Duration of stay at site</th>
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### ATTACHMENT 12.3

#### QUESTIONNAIRE

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Note: Technicians shall include, Technicians and semi skilled personnel.