MECHANICAL COMPLETION
&
COMMISSIONING GUIDELINES

REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	AUTHORIZED
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0	16-10-2019	ISSUED FOR INFORMATION	NVK	PKP	LA	JMC

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1. INTRODUCTION:

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

2. DEFINITIONS & ABBREVIATIONS:

Abbreviation	Definition /Expanded form
IOCL/ CLIENT	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit

3. GENERAL

3.1 LSTK CONTRACTOR shall be responsible to carry out the mechanical completion / commissioning activities, planning and organizing commissioning & performance guarantee test run of the entire facility.

3.2 LSTK CONTRACTOR shall submit organization chart of proposed commissioning team indicating the positions. The team shall have the required qualifications and experience. LSTK CONTRACTOR shall deploy adequate manpower in each shift to carry out mechanical completion / start up /commissioning activities without interruption. CV's of key personnel comprising the commissioning team shall be provided to Owner/PMC for approval. In case the member of the commissioning team as proposed is not available at the actual time of commissioning then the LSTK CONTRACTOR shall ensure a replacement with personnel of equivalent qualification and experience.

3.3 Facilitate various audits such as OISD audit and implement observations, if any.

3.4 Pre-start up Safety Review (PSSR) to be carried out and observation / recommendation (if any) to be implemented by LSTK CONTRACTOR. PSSR team will have members from PMC / Owner / Licensor.

3.5 The scope of work for LSTK CONTRACTOR will comprise of but not limited to the following:

3.5.1 Develop, review and implement the start-up plan. Same must be approved by PMC / Owner.

3.5.2 Develop the plan, procedure and schedule for mechanical completion & commissioning, same must be approved by PMC/Owner.

3.5.3 Develop standard procedures for start-up, normal operation, shut down and emergency condition.

3.5.4 To develop the punch list and generate the daily status report on punch point generated and liquidated.

3.5.5 Pre-start up inspection of all the equipment and its proper functioning.

3.5.6 To develop the plan and conduct safety audits of the complete plant / system before starting of mechanical completion activities.

3.5.7 Ensure adequate manpower, special tools and spare parts necessary for assisting commissioning activities such as operational tightness testing, pre-start up inspections, chemicals and catalyst loading etc.

3.5.8 LSTK CONTRACTOR to follow formats for handing over of sub- systems, systems and plant to the PMC/Owner including all the required documents, completion certificates, test / inspection reports etc.

3.5.9 Estimate the quantities of raw material, air, water, nitrogen required for mechanical completion.

3.5.10 Make provision for disposal of contaminated water during mechanical completion activities.

3.5.11 LSTK Contractor to provide all tools and tackles, studs, anti-seize compounds, fuel, tail blinds for box up, gaskets, hoses for flushing, measuring equipment like RPM meter, vibration meter etc.

3.5.12 LSTK CONTRACTOR shall complete mechanical completion, Start-Up, Commissioning and Performance Tests activities in accordance with the Project programme leading to a Provisional Acceptance of each of the plants.

3.5.13 All activities related to DCS Graphics, Cause and Effect diagram, process control narratives defining philosophy, detailed requirements for logic, fire and gas detector location and CCTV shall be completed by LSTK CONTRACTOR.

4. MECHANICAL COMPLETION

4.1 DEFINITION

"Mechanical Completion" mean the installation of all equipment and facilities and the completion of all Works required to complete the Unit(s) in all respects, and thereafter the completion of all activities as listed in API-700 to be performed by the CONTRACTOR including Pre-commissioning and Start-up activities, completion of all punch list items as provided by OWNER/PMC and/or Process Licensor and/or Statutory bodies like OISD, CCE, TAC, Factory Inspector, Pollution Control Authorities etc., and insulation of hot lines/ Steam lines, but excluding for the limited purpose of enabling milestone payment due upon commissioning of the Unit(s), insulation of other lines, final painting, Alkali Boil Out, furnace drying, Catalyst loading and punch list items which, in the sole opinion of the Owner/PMC, do not affect Commissioning.

4.2 Completion of ALL ACTIVITIES AS LISTED in THIS DOCUMENT (BUT NOT LIMITED TO) TO be performed by the LSTK contractor

4.2.1 Attending to all punch list items as provided by OWNER/PMC and/or Process Licensor and/or Statutory bodies like OISD, CCE, TAC, Factory Inspectorate, Pollution control authorities etc., other than in minor respects which do not prevent commissioning

4.2.2 All civil works is completed

4.2.3 All equipment and machinery are installed and aligned

4.2.4 All tankages works completed & hydro tested

4.2.5 All piping and instrumentation work is completed

4.2.6 All hydrostatic/ pneumatic testing is done

4.2.7 Alkali boil-out, refractory dry out is completed

4.2.8 Insulation & painting is completed

4.2.9 All electrical work is completed

4.2.10 Speed and direction of rotation of all prime movers is checked

4.2.11 Relays are set and all scales, meters, measuring devices and recorders are calibrated, all instrumentation jobs are completed in all respect as per requirements

4.2.12 All the loops and interlocks are tested.

4.2.13 Catalyst loading though included in the LSTK contractor's scope, is excluded from mechanical completion. Catalyst loading is included in RFSU stage.

4.3 ACTIVITIES

4.3.1 The following section represents the work, which has to be performed by LSTK CONTRACTOR prior to commissioning of the facilities. This is however not intended to be a complete list of activities required to be carried out. Detailed list of activities along with its plan shall be developed by the LSTK CONTRACTOR.

4.3.2 Manufacturer's / Vendor's instructions for mechanical completion, testing must also be followed for all equipment / packages / facilities.

4.3.3 LSTK CONTRACTOR shall prepare the list of systems / sub-systems; mechanical completion activities including flushing, blowing procedure of systems / sub-systems; detailed flushing, mechanical completion and commissioning schedule along with scheme and procedures and

submit to PMC / Owner at least 6 months before the start of mechanical completion activities. LSTK CONTRACTOR shall carryout all the mechanical completion activities of project in accordance with the established procedures and scheduled program as detailed below to make the plant ready for commissioning.

4.3.4 **General Activities for Mechanical Completion**

The general activities listed below outlines the works to be carried out by LSTK CONTRACTOR for ensuring completion of the respective mile stone. Procedures applicable to specific systems of items of equipment are covered separately.

4.3.5 **Installation of Seals and Packing**

4.3.5.1 Installation of mechanical seals, permanent packing and accessories, wherever required.

4.3.5.2 Adjustment and replacement of mechanical SEALS, PACKING and ACCESSORIES, AS necessary during mechanical completion / commissioning period.

4.3.6 **Removal of Temporary Bracing**

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

4.3.7 **Rotation and Alignment**

4.3.7.1 Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.

4.3.7.2 Ensure cold alignment to the manufacturer's tolerances. Maintain all the alignment readings records.

4.3.7.3 Check all lubricants and their quality, fill etc. before operating the equipment.

4.3.7.4 No load run of motors and interlock checks completed. Relay protection setting is implemented.

4.3.7.5 Check bearing temperatures, vibration, over speed trips function of for various equipment and other relevant tests. Carry out adjustments as required.

4.3.7.6 Ensure hot alignments and any adjustments required for all equipment (wherever applicable).

4.3.7.7 Arrange for manufacturer representative for equipment as required during installation and / or mechanical completion and commissioning.

4.3.8 **Tie-ins at Unit Battery Limits**

Ensure preparation of all systems for safe tie-ins with utilities and auxiliary system. LSTK CONTRACTOR shall be responsible for safety during tie-ins.

4.3.9 **CONSULTANT System Check / Inspection**

LSTK CONTRACTOR to check that installed facilities conform to Licensor's requirement, approved Process and Instrumentation diagrams, construction drawings, vendor drawings and specifications approved for construction, verify and approve the facility check.

4.3.10 **Site Modifications**

4.3.10.1 LSTK CONTRACTOR to carry out site modifications as found necessary/suggested by Licensor / PMC / Owner during system check / inspection from viewpoint of operability, maintenance and safety of the plant.

4.3.11 **Flushing and Blowing**

4.3.11.1 Flushing schemes for various systems / subsystems / equipment should be prepared well in advance.

4.3.11.2 Ensure flushing using fresh treated water and blowing using air of all above ground and underground piping to remove dirt, welding slag, etc. after hydro testing (along with gasket / sheet blasting).

4.3.11.3 Arrange for cleaning media for carrying out flushing / blowing and disposal of the cleaning media in accordance with procedures.

4.3.11.4 Adequate arrangements to handle flushed streams to be created.

4.3.11.5 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 licensor / vendor is to be kept under inert pressure.

4.3.12 **Temporary Spools, Strainers, Screens and Blinds**

4.3.12.1 LSTK CONTRACTOR to supply and ensure provision and installation of all strainers, both temporary and permanent.

4.3.12.2 LSTK CONTRACTOR to supply and ensure cleaning of strainers as required during mechanical completion and commissioning.

4.3.12.3 LSTK CONTRACTOR to supply and ensure provision, installation and removal of all blinds required for flushing or operation. (Install and dismantle temporary pipe spools as and when required for mechanical completion and commissioning).

4.3.13 **Leak, Vacuum and Pressure Tests**

4.3.13.1 Ensure non-operating leak tests and pressure tests on piping and all equipment, including field fabricated equipment.

4.3.13.2 Ensure all tests in accordance with applicable statutory / safety / other applicable design codes and specifications. Leak tests up to 5 kg/cm2g pressure to be carried out after flushing. Detailed procedure for leak and pressure tests on piping and field-fabricated equipment including Leak test time limit shall be developed by LSTK CONTRACTOR. Disposal of test media should also be included in procedures. LSTK CONTRACTOR to provide circuit wise drawings to PMC for review.

4.3.13.3 For systems which are required to be vacuum tested, a detailed vacuum test procedure shall be developed by the LSTK CONTRACTOR.

4.3.13.4 Provide any special media required for test purpose and provide facilities for disposal.

4.3.13.5 Ensure all operational tightness testing.

4.3.14 **Safety Devices**

4.3.14.1 LSTK CONTRACTOR shall ensure that all safety devices like Safety Valves, emergency shutdown valves are tested and witnessed by PMC / Owner.

4.3.14.2 LSTK CONTRACTOR to develop a list of proper for all safety devices. All safety devices (including pressure relief valves) shall be installed on the equipment after calibration test and adjust all safety device and seals wherever necessary or desirable.

4.3.14.3 Commissioning performance testing of safety system installations shall be completed before mechanical completion activities.

4.3.15 **Purging**

To install necessary purge connections including installation of temporary purge piping or hoses to equipment connection and carry out system purging with inert gas.

4.3.16 **Drying Out**

To develop drying out procedure and guidelines including the material required for carrying out drying of heaters and major equipment, wherever dry out is necessary.

4.3.17 **House Keeping**

4.3.17.1 Ensure continuous clean-up of the construction and operational area.

4.3.17.2 Ensure removal of excess materials, temporary facilities and scaffolding and pick-up trash.

4.3.17.3 Ensure washing for clean up as required.

4.3.18 **Equipment Protection and Spare Parts**

To protect equipment from normal weather conditions, corrosion, or damage before commissioning.

4.3.19 **Chemical Cleaning / Pickling / Passivation**

To perform special chemical cleaning or pickling of the piping as required by specification. LSTK Contractor shall prepare and submit Chemical cleaning procedure to Owner / PMC for Approval.

4.3.20 **Packing / Filling of Columns**

4.3.20.1 To carry out cleaning of tower internal surface, distributors, supports etc.

4.3.20.2 LSTK CONTRACTOR shall also ensure for cleaning of packing material to remove grease/rust, dirt etc. before loading of the packing using water fill method. In case the packing is to be stacked, install hold down grating and remove the same after completing filling job.

4.3.21 **Trays of Columns**

4.3.21.1 Tray Installation

The tray installation in the column is checked for tray levelness, weir height, down comer clearance, seal pan leak test, overlay between tray and TSR, number of holes per tray in case of sieve trays, functioning and freeness of valve in case of valve trays.

4.3.21.2 Following general guidelines can be followed while checking trays

4.3.21.2.1 The outlet weir height, under down-comer clearances, Seal Pan Height to be attached with specification.

4.3.21.2.2 All internals to be fitted as per the required specifications and orientation.

4.3.21.2.3 The final levelness check during tray installation is to be made using an optical or laser level. Where there are focusing restrictions, a manometer may be used for checking levelness.

4.3.22 **Miscellaneous**

4.3.22.1 Charging of lube oil and other chemicals. Procedure for filling chemicals to be developed by LSTK CONTRACTOR and issued to PMC/Owner for review & approval.

4.3.22.2 LSTK CONTRACTOR has to ensure availability of spares for mechanical completion and commissioning.

4.3.22.3 To carry out any other check / test as required and develop all test certificates.

4.3.22.4 LSTK CONTRACTOR has to carry our specific mechanical completion activity (if any) as specified / suggested by Licensor or given in any of his operating manuals or specified by any vendor in particular.

4.3.22.5 LSTK CONTRACTOR to furnish the base data for predictive and preventive maintenance of Equipment.

4.3.22.6 Load tests / certification of lifting devices / elevators have to be done by LSTK CONTRACTOR before completion of mechanical completion activities.

4.3.23 **LSTK CONTRACTOR is responsible to arrange for services of vendor's installation / commissioning engineer at site during mechanical completion & commissioning of all major equipment and systems as listed under but not limited to:**

4.3.23.1 All critical pumps i.e. hydrocarbon pumps, chemical injection (metering) pumps etc.

4.3.23.2 All blowers, agitators etc.

4.3.23.3 All package type items, all types of compressors / chemical injection facilities, etc.

4.3.23.4 Specialist for supervision of cooling water system passivation.

4.3.23.5 Gas (hydrocarbon and H_2S) detection system, fire detection systems and safety equipment.

4.3.23.6 DCS

4.3.23.7 HV VFD, Power Transformer, PMS System, Telecom System.

4.3.23.8 Any other critical/proprietary equipment, for which it is felt necessary to call Vendor's representative for proper commissioning.

4.3.23.9 All gaskets used should have proper colour coding visible from outside.

4.3.24 **Operability Test for a System / Equipment**

4.3.24.1 Each system / equipment shall be given operability test for sufficient duration (not less than 4 hours) to demonstrate worthiness of the system for normal operation.

4.3.24.2 LSTK CONTRACTOR shall develop procedures for carrying out the operability test of each equipment / system to prove that the equipment system installed meets the design specification. This shall also include the maintenance of log sheets wherein the operating parameters shall be recorded hourly. The operability test shall be carried out in presence of PMC / Owner's representative and the Vendor representative wherever applicable.

4.3.24.3 The necessary checks, adjustments, repairs required for normal operation of the system / equipment shall be made.

4.3.24.4 All the safety devices shall be tried for their proper operation.

4.3.24.5 Upon completion of the operability test the log sheet with all observations shall be signed by the LSTK CONTRACTOR, Vendor, PMC/Owner 's representatives. The performance shall be evaluated based on the data and observations made during the operability test.

4.3.25 **Estimation of consumables & utilities**

LSTK CONTRACTOR shall provide estimated quantities of all utilities like steam, power,

fuel, inert gas, flushing fluids, chemicals etc. that will be required during mechanical completion and commissioning.

4.3.26 **Specific Procedures for Mechanical Completion**

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

4.3.27 **Vessels, Columns, Tanks**

4.3.27.1 In Vessel/Columns, internals shall be inspected before and after installation. Ensure opening of both internal and external manways for inspection of equipment & box up after proper execution of closure permits. Vessel/Columns, internals shall be inspected as per the respective OISD checklist. Additional check may also be required as per the requirement of equipment type and site condition.

4.3.27.2 NOTE: Vessels that have been pressure tested in the shop may require retesting, if felt necessary. They shall, however, be included in the testing of attendant piping systems whenever practical.

4.3.28 **Shell and Tube Heat Exchangers**

4.3.28.1 To perform internal inspection / testing as required by specifications or drawings.

4.3.28.2 To perform separate field-testing, as desired, of exchangers that have been shop tested.

4.3.28.3 All heat exchangers shall be tested for all three tests i.e. shell, tube and assembly at site before commissioning.

4.3.28.4 NOTE: Shell and tube exchangers that have been pressure tested in the shop may require retest as felt necessary. They shall, however, be included in the testing of attendant piping systems whenever practical. 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.

4.3.29 **Air Coolers**

4.3.29.1 To perform inspection / testing as required by specifications or drawings.

4.3.29.2 To perform separate field-testing, as desired, of air cooler that have been shop tested.

4.3.29.3 All air coolers shall be tested for tube and assembly at site before commissioning.

4.3.29.4 Air Cooler fans shall be organized for mechanical completion as listed in point 4.3.30 i.e. Pumps, Compressor, Fans, Agitators and Drivers.

4.3.29.5 NOTE: Tubes of the air cooler that have been pressure tested in the shop may require retest as felt necessary. They shall, however, be included in the testing of attendant piping systems whenever practical. If an air cooler is taken in piping system test and the air cooler is designed for differential pressure, proper care shall be taken to ensure that differential pressure between air and tube side is not exceeding beyond the maximum recommended differential pressure during the testing.

4.3.30 **Pumps, Compressors, Fans, Agitators, and Drivers**

4.3.30.1 Ensure proper levelling of base plates and sole plates. Check any excess piping stresses that may be imposed on pumps, compressors and drivers & take corrective Dispose of waste and cleaning media.

4.3.30.2 Check alignment and ensure that levels of supports, etc. are in order.

4.3.30.3 For all the rotating equipment, alignment shall be carried out with laser alignment and the soft data must be submitted to Owner / PMC with one set of hard copy.

4.3.30.4 Ensure charging of lube oil, seal oil and cooling systems with flushing oil and circulate for cleaning purposes. Dispose of any flushing oil in accordance with the approved procedure.

4.3.30.5 Ensure charging of correct lube oil, grease, seal oil and oil cooling system as recommended by the manufacturer.

4.3.30.6 Ensure that all fittings supplied by vendor are installed in proper condition.

4.3.30.7 Ensure that there is no unacceptable vibration after equipment is put on rotation.

4.3.30.8 Vibration (velocity, displacement, acceleration, FFT spectrum) must be recorded and maintained for no load trial of rotating equipment till handing over to Owner along with the soft data.

4.3.30.9 All other parameters like bearing temperature, noise etc. must be measured, recorded and data must be handed over to Owner / PMC.

4.3.30.10 Call service engineer for technical assistance during installation and / or mechanical completion and commissioning as specified.

4.3.31 **Air Heater**

4.3.31.1 Check all nozzles are free and no blockage.

4.3.31.2 Check all refractory properly applied.

4.3.31.3 Ensure all instruments are working.

4.3.32 **Reactor riser**

4.3.32.1 Ensure reactor riser is clean and without any debris

4.3.32.2 Ensure all nozzles are clean

4.3.32.3 Ensure refractory & insulation application is complete.

4.3.32.4 Ensure riser is properly supported with bellows wherever required

4.3.32.5 Ensure blast steam connections are provided on riser bottom which are clean and without any debris

4.3.33 **Reactor, Regenerator**

4.3.33.1 Ensure reactor is clean and without any debris

4.3.33.2 Ensure all nozzles are clean

4.3.33.3 Ensure refractory & insulation application is complete.

4.3.33.4 Ensure reactor is properly supported.

4.3.33.5 Ensure cyclones are properly installed and meets all vendor specifications.

4.3.34 **Piping System**

4.3.34.1 Make ready hydro test schedule well in advance, system by system during mechanical construction stage.

4.3.34.2 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.

4.3.34.3 Piping system shall be thoroughly flushed and cleaned.

4.3.34.4 Hydrostatically or pneumatically test all piping as required by the drawings or specifications.

4.3.34.5 After testing, drain and ensure disposal of the test media.

4.3.34.6 All the piping shall be dried using air and boxed up.

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

4.3.34.8 Reinstallation of control valves and all inline instruments after line flushing.

4.3.34.9 Ensure installation of seals on valves where necessary. Dry up graphite seals shall be replaced by fresh ones.

4.3.34.10 Ensure correctness of supports, vibration and thermal expansion problems detected during commissioning.

4.3.34.11 The format checking of the underground piping systems shall be completed before backfilling.

4.3.34.12 The insulation application shall be after format checking before commissioning.

4.3.35 **Instrument System**

4.3.35.1 LSTK CONTRACTOR shall make all non-operating checks that shall ensure instrument operability

4.3.35.2 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.

4.3.35.3 Ensure cleaning of all impulse lines (etc.) by blowing with cooled and filtered clean air compatible with instrument components.

4.3.35.4 Ensure cleaning of all air supply headers by blowing with clean air and check them for tightness.

4.3.35.5 To leak test pneumatic control circuits.

4.3.35.6 Functional check of all instrument and controllers to be performed.

4.3.35.7 Check all loops for proper functioning.

4.3.35.8 Checking and recording positions of all valves.

4.3.35.9 Checking and recording positions of all slide valves.

4.3.35.10 Line-up of purge medium to required instruments

4.3.35.11 Check piping from instruments to process piping for tightness.

4.3.35.12 Checking of orifice plates and their installation after line flushing.

4.3.35.13 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.

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

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

4.3.35.16 Identify orifice plates by tagging and check for proper installation of upstream side of plates.

4.3.35.17 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.

4.3.35.18 Check bore of orifice plates and install these plates after completion of flushing operations.

4.3.35.19 Ensure calibration of instruments with standard test equipment and make all required adjustments and control point settings. Fully pressurize and energize the transmitting and control signal system by opening process connections at primary sensors and final regulators and by making control mode settings for automatic operation of equipment as the plant is charged and brought on stream.

4.3.35.20 Check setting of all alarm and shutdown switches.

4.3.35.21 Check all the interlocks of control & shutdown systems.

4.3.35.22 Check all shutdown systems before commissioning.

4.3.35.23 To arrange for testing and recalibration of all the safety valves settings at site. Ensure that safety valve isolation valves are locked open as per drawings.

4.3.36 **Electrical System**

4.3.36.1 Check of all electrical equipment for proper earthing continuity, insulation resistance etc.

4.3.36.2 All check sheet / test reports and charging protocols are completed and signed by respective agencies.

4.3.36.3 No Load check for all Motors and measurement of current, Vibration

4.3.36.4 All protection relays are set as per Relay coordination

4.3.36.5 Interlock and Interface check with DCS for all consumers

4.3.36.6 Check for all safety systems (Aviation lighting, Lightning Protection, wind sock etc.) Including emergency / critical lighting is installed, tested and available.

4.3.36.7 Mechanical completion activities are considered to be completed, when the LSTK CONTRACTOR has demonstrated all no load / mechanical / water run test and all the flushing and leak test activities have been completed and certified by PMC / Owner.

5. TYPICAL APPROACH TO WITNESS / INSPECTION OF MECHANICAL COMPLETION ACTIVITY BY PMC / OWNER

Sr. No.	Activities	Witness / Inspection
1	Installation of safety device	Complete
2	Provision of temporary strainers and blind at critical locations	Complete
3	Water flushing and air blowing of pipelines	Random
4	Instrumentation interlock checks	Complete
5	Operability test for a system/equipment	Complete
6	Blind list as per start up requirement / normal operation	Complete
7	Heater refractory dry out	Complete
8	Installation & cleaning of columns and its internals including trays, flushing of columns, Leak tests/tightness test of system	Complete
9	Chemical cleaning of compressor suction line & lube oil circuit	Complete
10	Alkali boil out of steam generation systems	Complete
11	Mechanical Completion checks as suggested by vendor for all critical rotating equipment and packages	Complete

6. SPECIFIC ACTIVITIES TO BE PERFORMED BY LSTK CONTRACTOR FOR MECHANICAL COMPLETION

6.1 DEVELOPMENT OF MECHANICAL COMPLETION PROCEDURES:

6.1.1 General System identification throughout the Plant for Piping & Equipment, Electrical, Instrumentation, Civil, Packages, Safety system installations and all others items like (but not limited to) Lifting tools, Elevators etc.

6.1.2 Definition of Subsystems

6.1.3 Marked-up P&ID's, Electrical Single line diagrams

6.1.4 Engineering Databases

6.1.5 General System Scheduling

6.1.6 Preparation of Construction Packages

6.1.7 Progress Tracking

6.1.8 Sign-off of READY FOR COMMISSIONING CERTIFICATES

6.2 System Identification and Sequencing

6.2.1 **General System Identification**

LSTK CONTRACTOR shall define the Systems by P&ID mark-ups and description. LSTK CONTRACTOR representatives and Owner/ PMC representatives shall review these system definitions. If during the review process it is determined that the Systems are too broad or narrow, adjustments shall be made and agreed upon at that time by all parties.

6.2.2 **Definition of Subsystems**

Based on Systems defined as above, LSTK CONTRACTOR shall evaluate each System to determine if it should be divided into subsystems. LSTK CONTRACTOR shall prepare a written description of each subsystem. If subsystems are created, the completion status of each subsystem shall be tracked as if it were a System to facilitate overall System tracking. Subsystems are to be reviewed by the Owner/ PMC operations representative prior to preparation of written description.

6.3 PREPARATION OF DATABASE

6.3.1 LSTK CONTRACTOR shall provide a database file or index to identify within each System/ Subsystem the following type of information:

6.3.1.1 Line Lists (with associated piping isometric drawings)

6.3.1.2 Instrument Index (with associated Instrument Loop Diagrams)

6.3.1.3 Equipment Lists; Motor Lists

6.3.1.4 P&ID's

6.3.1.5 Electrical Single line diagrams, Electrical Consumers

6.3.1.6 Chemical Cleaning / flushing / nitrogen dry out / steam blowing P&ID's

6.3.1.7 Hydro-test P&ID's

6.3.2 LSTK CONTRACTOR shall transmit the specifics that have been included in their database(s) to Owner/ PMC for information and subsequent use.

6.4 MECHANICAL COMPLETION SYSTEM SEQUENCE SCHEDULING

The Mechanical Completion System Sequence Schedule shall include all systems and subsystems. It shall include agreed upon start dates for mechanical completion, commissioning, and start-up. This schedule shall also indicate anticipated durations for commissioning and start-up activities.

6.5 PACKAGE IDENTIFICATION AND PREPARATION

6.5.1 After identification of systems and subsystems, LSTK CONTRACTOR shall prepare individual construction System Mechanical Completion Packages. Each System Mechanical Completion Package shall include, but not be limited to, the following:

6.5.1.1 System Description in narrative format.

6.5.1.2 A copy of all Mechanical Completion documents to be used.

6.5.1.3 Mark-ups of Plot Plans, P&ID's, Electrical Single line diagrams, piping drawings and any other drawings that may be useful in defining the System boundaries.

6.5.1.4 "System Summary Status Report" - To indicate the overall completion status of the System (e.g. total hydro tests vs. complete vs. restored; total instrument loop checks vs. complete, total chemical cleaning flushing, dry out, steam blowing etc.)

6.5.1.5 A Piping and Mechanical Equipment section containing the following: "Piping Line List" – a listing of line numbers included in the system or subsystem.

6.5.1.5.1 "Chemical cleaning, flushing, steam blowing, and drying" - A spreadsheet showing the different cleaning loops and the various stages and status of line/equipment cleaning/flushing until final completion. Calculations and equipment required to obtain minimum flushing velocities to ensure adequate flushing.

6.5.1.5.2 "Hydrostatic Test Checklist" - A spreadsheet showing the status of all System hydro-tests (e.g. construction complete, hydro-test complete, punch lists prepared, restoration complete, punch list complete, etc.)

6.5.1.5.3 "Equipment Installation Checklist" - A spreadsheet showing the various stages of equipment installation from setting to sign-off.

6.5.1.5.4 "Misc. Equipment Checklist" - A spreadsheet showing the completion status of misc. mechanical components (e.g. PSV's, Orifice plates, check valves, spring supports, etc.)

6.5.1.5.5 "Material Certificate of Compliance Checklist" - A spreadsheet confirming status of material certificates per project specifications.

6.5.1.6 An Instrumentation section containing the following:

6.5.1.6.1 "Instrument Index" - A listing of instruments contained in the System, extracted from the Project Instrument Index.

6.5.1.6.2 "Instrument Summary Sheet" - A spreadsheet showing the completion status of all instruments from receipt thru final functional loop checkout.

6.5.1.6.3 "Junction Box Schedule" - A pdf document showing the wiring details of all the instruments connected to Junction box/ Local Panel.

6.5.1.6.4 "Cable List" - A spreadsheet showing the details like cable type, cable length etc. of all the cables.

6.5.1.6.5 Control Narrative and Interlock Logic diagram

6.5.1.7 An Electrical section containing the following:

6.5.1.7.1 "Electrical Index" - A listing of all major Systems electrical components.

6.5.1.7.2 "Electrical Summary Sheet" - A spread sheet showing the completion status of all electrical components contained in the System (e.g. Motors, MCC's, Switchgear, Motor starters, Cables, Cable tray, Power panels, Lighting, Earthing, Receptacles, etc.)

6.5.1.8 Special instructions and procedures including specific safety instructions and lockout procedures that is required.

6.5.1.9 Vendor information including summaries as necessary from vendor manuals, equipment / facilities operating and maintenance manuals, as-built specifications, and recommended safety procedures.

6.5.1.10 Blind List -A listing of all BLINDS left in the system or subsystem.

6.5.1.11 A listing of all punch list Items per each system (if any) that are to be completed Mechanical Completion.

6.6 PACKAGE PROGRESS

LSTK CONTRACTOR personnel shall maintain a status of the progress on the completion of package activities. LSTK CONTRACTOR personnel shall report to PMC/Owner weekly on the progress of package completion as required by PMC/Owner. More frequent meetings may be required by PMC/Owner as the overall Plant comes to completion. Reports shall be in an agreed upon format in either tabular or graphical formats, or both. These System Mechanical Completion Packages shall be used by LSTK CONTRACTOR personnel on a daily basis to document and track the completion of various constructions, inspection, and other activities in order to be able to quickly determine the completion status of any given Package.

6.7 PROJECT PUNCH LIST

6.7.1 LSTK CONTRACTOR shall prepare the System punch lists that shall list items that are incomplete, not in conformance with the construction documents, or require modification.

6.7.2 Each punch point should be classified as

6.7.2.1 To be completed before Hydro Test

6.7.2.2 To be completed before READY FOR MECHANICAL COMPLETION

6.7.2.3 To be completed before READY FOR COMMISSIONING

6.7.3 LSTK CONTRACTOR shall prepare and maintain these punch lists for each System & Sub-System (in an automated format) and shall issue the punch lists to Owner /PMC along with the as they are developed.

6.8 Procedure for System Readiness declaration:

6.8.1 LSTK CONTRACTOR's competent representative shall check the system/sub-system so that plant/ system/sub-system meet the process requirement and is constructed as per the approved drawings. After liquidating the checklist LSTK CONTRACTOR shall submit certificate Format-I stating system/sub-system, which is mechanically completed. Checklist generated by LSTK CONTRACTOR representative and test certificates connected with the system/sub-system shall form a part of the certificate.

6.8.2 OWNER /PMC/ Licensor representative shall check the system along with LSTK CONTRACTOR's representative and shall issue FORMAT-II which includes deficiencies / modifications required for the portion of the work that is declared by the LSTK CONTRACTOR as mechanically complete.

6.8.3 LSTK CONTRACTOR shall raise FORMAT – III which certifies that all checklist points are liquidated and the plant /system/sub-system is ready for mechanical completion. LSTK CONTRACTOR shall start mechanical completion after acceptance of FORMAT-III by PMC/OWNER/Licensor.

6.8.4 The LSTK CONTRACTOR shall issue a certificate of ready for commissioning of process unit for acceptance by the OWNER/PMC/Process Licensor in standard format, FORMAT-IV with all exceptions resolved.

6.8.5 Upon successful commissioning of the plant the same shall be taken over by the OWNER for day to day operation and maintenance only. Final takeover shall be subject to compliance to all the contractual obligations by the LSTK CONTRACTOR. Once the plant is successfully commissioned LSTK CONTRACTOR shall issue FORMAT-V to OWNER for takeover of the unit from LSTK CONTRACTOR.

6.9 DOCUMENTS FOR MECHANICAL COMPLETION

6.9.1 OPERATING MANUAL

6.9.1.1 The LSTK CONTRACTOR shall prepare plant specific operating manual of the unit. This should include procedure related with Package items (if any) and submit to OWNER / PMC for review at least 6 months prior to start of mechanical completion. In particular, following information shall be covered as a minimum.

6.9.1.1.1 Design basis of unit.

6.9.1.1.2 Chemistry of the Process.

6.9.1.1.3 Detailed Process / Plant Description.

6.9.1.1.4 Pre-start checks.

6.9.1.1.5 Mechanical completion procedures

6.9.1.1.6 Start-up Procedure

6.9.1.1.7 Normal Operating Procedure
6.9.1.1.8 Shutdown Procedure (normal & emergency).
6.9.1.1.9 Plant Trouble shooting procedure.
6.9.1.1.10 Operating Parameters and set points of alarms and trips.
6.9.1.1.11 Operating conditions of different cases of operation.
6.9.1.1.12 Effect of operating variables on the Process.
6.9.1.1.13 Functional description of all complex control schemes.
6.9.1.1.14 Details of interlock logic, trip etc.
6.9.1.1.15 Functional Description of safe shutdown systems.
6.9.1.1.16 List of emergencies and emergency handling procedure.
6.9.1.1.17 Dosage rate of chemicals used and other related operating information.
6.9.1.1.18 Initial requirement of chemical for first start-up.
6.9.1.1.19 Safe handling precautions for chemicals used (MSDS).
6.9.1.1.20 List of equipment and their major details.
6.9.1.1.21 Relief valve schedule, tag numbers, location, set pressure, capacity basis, Failure scenarios considered etc.
6.9.1.1.22 List of blinds for shut down & start-up.
6.9.1.1.23 Approved / Final PFDs / P&IDs, Plot Plan, equipment Layout and equipment datasheets etc.
6.9.1.1.24 Any other special conditions / instructions / information, etc.
6.9.1.1.25 Summary of chemical consumption.
6.9.1.1.26 Summary of utility consumption.
6.9.1.1.27 Lubrication schedule (with equivalent lubricant available in India)
6.9.1.1.28 Gas detection and associated safety system.
6.9.1.1.29 Use of life saving devices.
6.9.1.1.30 Fire & safety system.
6.9.1.1.31 Laboratory analysis requirement and procedure with sampling schedule.
6.9.1.1.32 Procedure for preparation of equivalent hand over.
6.9.1.1.33 Work permit procedure.
6.9.1.1.34 Chemical solution preparation procedure (if any)
6.9.1.1.35 Safe handling of chemicals.
6.9.1.1.36 Vendor Catalogues for all package items.

6.9.1.2 All the changes / additions, deletions required by the OWNER / PMC shall be discussed with the LSTK CONTRACTOR and shall be incorporated in the final operating manuals by the LSTK CONTRACTOR. These operating manuals shall be followed during start-up and commissioning of the Plant. Instructions in operating manuals provided by equipment suppliers shall not form a part of this operating manual.

6.9.1.3 In case of any revisions due to any reason, the same shall be incorporated and submitted as revised sheets during the start-up and commissioning stage. However, revised operating manual incorporating changes shall be submitted within one month after the commissioning has been completed.

6.10 MECHANICAL COMPLETION DOCUMENTS

6.10.1 It shall be the responsibility of the LSTK CONTRACTOR to prepare detailed checklist of mechanical completion and commissioning activities for each equipment, subsystem, system and plant as a whole. The LSTK CONTRACTOR shall submit the format for approval to the OWNER/PMC. This checklist shall indicate the checks / test to be carried out on each equipment / system and shall also indicate the sequence and schedule of the activities.

6.10.2 For the purpose of execution of these mechanical completion activities, the unit shall be divided into system and sub-systems so that mechanical completion activities of each system/sub-system can be progressively carried out along with the construction activities. The mechanical completion document shall contain the following as a minimum:

6.10.2.1 System identifications on P&IDs.

6.10.2.2 Mechanical completion and start-up schedule

6.10.2.3 Detailed procedure for the various mechanical completion activities i.e. flushing, blowing, purging, drying, leak checking, system tightness, equipment operability test with forms to record the observation of each of the activities to be carried out.

6.10.2.4 Procedure and forms for operability tests of equipment and system as a whole, wherever applicable.

6.10.2.5 Lube schedule indicating manufacturer (Indian equivalent to lubes, quality, initial fill recommended, and frequency of changing the lube oil).

6.10.2.6 Detailed procedure for carrying out passivation of cooling water system/compressor circuit, when and if required, shall be approved before implementation. Requirement of tanks, pumps, chemical dosing arrangement and apparatus for chemical analysis shall be detailed out be LSTK CONTRACTOR and shall be in the scope of LSTK CONTRACTOR.

6.10.2.7 Detailed heater refractory dry out procedure / passivation of heater tubes (if any).

6.10.2.8 Detailed procedure for catalyst loading. (catalyst loading activity to be done during RFSU phase)

6.10.3 LSTK CONTRACTOR shall submit the draft of above mentioned mechanical completion documents 6 months before the activities are to be carried out. The document shall be reviewed by the OWNER / PMC. The LSTK CONTRACTOR shall submit 60 days prior starting of activities, a revised document after incorporating OWNER /PMC's comments. The documents shall be followed till the project is completed.

6.10.4 Commissioning of the facilities shall not be permitted till all the documents have been submitted by the LSTK CONTRACTOR to the OWNER. Any delay in commissioning on this account shall be considered as a delay in commissioning by the LSTK CONTRACTOR.

6.11 OTHER REQUIREMENTS

LSTK CONTRACTOR shall ensure that all safety devices like pressure safety valves, emergency shutdown valves are tested, witnessed and certified in the presence of representatives of OWNER/PMC. These certificates are to be handed over to OWNER/PMC prior to start-up of the plant. The LSTK CONTRACTOR shall install 'No Smoking' boards & boards for other instructions at designated areas. LSTK CONTRACTOR is required to maintain and follow all safety practices, equivalent or better than those being practiced by OWNER for the complex during mechanical completion and commissioning.

6.12 SPECIAL REQUIREMENT

All the utilities like air, cooling water, steam, power, instrument air etc. shall be provided at the conditions and locations given in the package and drawings. Any upgrade, if required, either for mechanical completion or commissioning shall be carried out by the LSTK CONTRACTOR at his own cost. Hook-ups required between various LSTK CONTRACTORs shall be provided by the LSTK CONTRACTOR wherever it is shown in his scope.

6.13 SAFETY

LSTK CONTRACTOR shall follow OWNER's safety practices during execution of mechanical completion / commissioning works. LSTK CONTRACTOR is required to maintain and follow all safety practices equivalent or better than those being practiced by OWNER for the complex during mechanical completion and commissioning.

6.14 PLANT STAFFING

6.14.1 LSTK CONTRACTOR to identify and submit manning requirement (category) and the plant operation

6.14.2 Organization structure to OWNER / PMC for effective operation and maintenance of the unit. The proposed manning requirement and organization structure to take into account the Indian condition.

6.15 READY FOR START-UP

6.15.1 DEFINITION

6.15.1.1 The plant is said to have achieved Ready for Start-Up (RFSU) status
6.15.1.1.1 when Catalyst is loaded in the reactor regenerator.

6.15.1.1.2 After RFSU stage the plant is ready for hydrocarbon cut-in.

6.15.2 ACTIVITIES

6.15.2.1 Following catalyst loading activities to be done during RFSU phase.

6.15.2.1.1 LSTK CONTRACTOR shall develop catalyst loading procedure as per the recommendations of the catalyst supplier and submit the same to OWNER/PMC for review/approval.

6.15.2.1.2 LSTK CONTRACTOR to ensure Catalyst transportation from store, handling and preservation till loading in the system as per the recommendations of the catalyst supplier.

6.15.2.1.3 LSTK contractor to provide catalyst screening arrangement to avoid loading of catalyst lumps in the system.

6.15.2.1.4 Screening of the catalyst shall be carried out in a dust free environment. LSTK CONTRACTOR shall also ensure that the dust generated during the screening process shall be removed promptly to ensure dust free environment.

6.15.2.1.5 LSTK contractor to make necessary arrangement for Disposal of catalyst lumps / reject catalyst found during catalyst screening operation as per the recommendation of the catalyst supplier.

6.15.2.1.6 LSTK contractor to make necessary arrangement of Disposal of catalyst bags after transferring catalyst to hoppers.

6.15.2.1.7 Precaution should also be taken to keep the catalyst dry during the loading process.

6.15.2.2 The points to be checked Prior to loading are –

6.15.2.2.1 Cleanliness and dryness of the hoppers

6.15.2.2.2 Ensure that all necessary safety and personnel protection equipment as well as means of communication are available.

6.15.2.3 Make sure that the catalyst is gathered near the catalyst loading station.

6.15.2.4 Ensure flow of purge air to instruments of Reactor Regenerator system so as to make sure that none of the instruments get clogged and are working properly.

6.15.2.5 Fresh catalyst needs to be charged from catalyst loading station to Fresh catalyst hoppers at a rate of charging as per the recommendations of the catalyst manufacturer.

6.15.2.6 LSTK contractor to ensure vacuum in the respective catalyst hopper as per the recommendation of the Licensor/catalyst supplier before transfer of catalyst from loading station to hopper.

6.15.2.7 LSTK contractor to ensure adequate supply of appropriate carrier air for transfer of catalyst from loading station to hoppers.

6.15.2.8 6.15.2.8 LSTK CONTRACTOR will have to start the main air blower and maintain the regenerator pressure as per Licensor requirement which may be less than the normal operating value to avoid catalyst loss to atmosphere.

6.15.2.9 Start Air Heater to reach the temperature sufficient to ignite torch oil.

6.15.2.10 LSTK contractor to ensure adequate supply of appropriate carrier air for loading catalyst from hoppers to regenerator.

6.15.2.11 Ensure rate of increase in temperature of the regenerator and holding time and temperature is as per requirements of the Licensor. This should be achieved by modulating the outlet temperature of hot air from air heater.

6.15.2.12 Recommendation of the refractory supplier in terms of permissible rate of increase in temperature, holding time and temperature should also be taken cognizance of.

6.15.2.13 Availability of dispersion Steam up to Riser for transferring catalyst from regenerator to reactor to be ensured. After getting sufficient level in Regenerator start dry catalyst circulation from Regenerator to Reactor. After getting sufficient level in Reactor start dry catalyst circulation from Reactor to Regenerator.

6.15.2.14 These activities performed systematically, will ensure that the reactor regenerator system is ready for commissioning.

6.16 COMMISSIONING

6.16.1 DEFINITION

6.16.1.1 The plant is said to have achieved commissioning when

6.16.1.1.1 Pressing into service the unit(s), equipment(s), vessels, pipeline(s), Machinery and systems & sub systems comprised within the Plant in accordance with procedures as approved in plant specific Operating Manual and as per the requirement of process Licensor which is the subject matter of the contract after successful testing and trial run of the plant.

6.16.1.1.2 Commissioning shall, to the extent necessary, be carried out under the supervision of Licensor, Engineer-in- Charge.

6.16.1.1.3 LSTK Contractor shall, within his responsibilities for and the scope of Commissioning the Unit, train Owner's personnel at the site of the Unit, in such number and for such period as the Contractor considers reasonably necessary for running of the Plant.

6.16.2 **ACTIVITIES**

6.16.2.1 OWNER/PMC/Licensor shall carry out a final inspection of the plant.

6.16.2.2 LSTK CONTRACTOR to submit all the record of liquidation of checklist points, test records etc., to OWNER / PMC. Any deficiency / changes required in the offered system shall be liquidated by the LSTK CONTRACTOR.

6.16.2.3 Three months' prior to start of commissioning, LSTK CONTRACTOR shall submit proposal to the OWNER/ PMC giving details of the programme to be followed during commissioning. This shall be reviewed by OWNER / PMC.

6.16.2.4 LSTK CONTRACTOR shall arrange trained operation team comprising of commissioning manager, shift in-charge, main control room operators (DCS and local panels), field operators, mechanical, electrical and instrument engineers / foreman etc. to carry out plant start-up and commissioning and for process operations and maintenance.

6.16.2.5 LSTK CONTRACTOR shall prepare Organization Chart showing the number and qualification of commissioning personnel including that of Vendors and sub-contractor and show the interaction & co- ordination procedure with owner, PMC and Licensor. This will be reviewed & approved by Owner / PMC.

6.16.2.6 LSTK CONTRACTOR shall ensure that representative of equipment supplier as required continue to be at site to prove that the equipment meet the individual performance test during the commissioning.

6.16.2.7 LSTK CONTRACTOR is also required to provide on the job training to OWNER's operation personnel by associating them in all the day to day mechanical completion, commissioning and maintenance activities and process operations, however, responsibility for adequate manning the plant shall be that of LSTK CONTRACTOR.

6.16.2.8 Commissioning of process unit means the taking of hydrocarbon feed and delivering the stated product sustaining operation of appropriate product grade at a through put not lower than the turn down through put.

6.16.2.9 LSTK CONTRACTOR shall carry out the commissioning with technical support of the Licensor personnel.

6.16.2.10 In commissioning, LSTK CONTRACTOR shall prove the performance of the plant for which it is designed and constructed as per design basis and all the technical documents of PMC & Licensor.

6.16.2.11 In performing the commissioning and test runs of the plant, LSTK CONTRACTOR takes full responsibility of the complete plant with respect to their scope of work and make good for deficiencies.

6.16.2.12 LSTK CONTRACTOR to monitor the check-up and calibration of instruments used in plant commissioning and testing and should assist all the activities for commissioning and testing of various system in accordance with the start-up schedule.

6.16.2.13 LSTK CONTRACTOR to develop the check list to list out and liquidate all the deficiencies found and must be reviewed & approved by Owner / PMC.

6.16.2.14 LSTK CONTRACTOR to furnish the formats for initial and final system handover and Owner acceptance.

6.16.2.15 LSTK CONTRACTOR to develop the report of the test results obtained during testing and commissioning to represent the actual performance of the equipment /units and furnish to PMC / Owner.

6.16.2.16 Additional procedure developed by LSTK CONTRACTOR shall largely comprise the following.

6.16.2.16.1 Detailed Test conditions for the unit / Pre-test run period, if any

6.16.2.16.2 Recording of operating data in Log sheet format

6.16.2.16.3 Sampling scheme / Lab test requirement

6.16.2.16.4 Methods of calculations & Analytical methods

6.16.2.16.5 Measurement and analysis of test

6.16.2.16.6 Logging of operating data and its frequency

6.16.2.17 In case of any constraint in achieving the process parameters in the plant for which the plant has been designed, the same shall be communicated by the LSTK CONTRACTOR to the OWNER in writing. This shall be reviewed jointly by OWNER / PMC and Licensor to arrive at a decision on whether the constraint is on account of reasons attribute to LSTK CONTRACTOR or not. The action in either case shall be according to the relevant provisions provided elsewhere in the contract.

6.17 PERFORMANCE GUARANTEE TEST RUN (PGTR)

6.17.1 DEFINITION

The plant is said to have achieved PGTR when the following are met

6.17.1.1 PLANT performance guarantees in terms of product quality and rated capacity including turn down capacity of each Unit and/ or facility and/ or systems so far as relate to or depend upon or arise out of any Residual Process Design, Hazop Study performed and/ or done and/ or designs, drawings and/ or specifications furnished or approved by the LSTK Contractor and to detailed Engineering or other work performed, done or approved by the LSTK Contractor.

6.17.1.2 The guarantees of mechanical performance for related equipment efficiencies and their performance as laid down in the Process Package and guarantees committed by the vendor.

6.17.1.3 The guarantee of performance of the measurement and control systems as a whole.

6.17.1.4 Although the LSTK Contractor is not responsible for process guarantees for the process units of the Process LICENSOR, the LSTK Contractor shall conduct all activities necessary for collecting required data during guarantee performance test runs of these units / facilities to identify problems of non-performance for further analysis and modifications required to meet process performance parameters.

6.17.2 ACTIVITIES

6.17.2.1 After the plant has been completed, put into operation and steady state operation is established, LSTK CONTRACTOR shall carry out Performance Test Run in accordance with Professional Engineering Practices, Plant safety and Operating standards in presence of Licensor, PMC and Owner. The objective of performance test is to demonstrate that the unit meets all the guarantees as required and specified by licensor. Before carrying out of the performance test of units, LSTK CONTRACTOR shall develop a procedure/protocol and schedule in consultation with the PMC/OWNER and submit to PMC/OWNER for their approval. The performance test is to be carried out under normal operating conditions as soon as practicable after the commissioning but the exact date of the performance test shall be mutually agreed upon among the PMC, Owner, and Licensor.

6.17.2.2 LSTK CONTRACTOR must furnish the format for recording of all the operating conditions, figures and actual performances for proper test evaluation / for PMC/ Owner approval.

6.17.2.3 LSTK CONTRACTOR to furnish the independent report on performance of each unit and shortfalls to Owner /PMC within five days of successful completion of test run.

6.17.2.4 LSTK CONTRACTOR to provide Measuring methods, tolerances, instructions for analysis and calculations shall be as per accepted practices and shall be mutually agreed upon to the owner /PMC before the start of performance test.

6.17.2.5 LSTK CONTRACTOR shall be held accountable for any shortcoming noted during performance test run which is attributable to his activities during project execution and shall be dealt as per the applicable condition of the contract.

6.17.2.6 If performance test of units is carried out successfully for a period as specified in General Conditions of Contract document of the tender, then the performance test shall be deemed to have been successfully completed.

6.17.2.7 The duration of performance test shall be as defined in General Conditions of Contract (GCC) document of the tender.

6.17.2.8 In case the first performance test fails to meet LSTK / PMC / Licensor's guarantees the authorized representatives of LSTK / PMC / Licensor and OWNER shall mutually discuss and determine the causes of failure of the test. LSTK Contractor must carry out all the necessary modifications required (suggested by PMC / Licensor) in a time to be agreed upon mutually between LSTK / PMC / Licensor /Owner. LSTK / PMC / Licensor /Owner shall mutually establish a date by which the second performance test can be commenced after the modification. If required, a third performance test or more will be mutually decided.