

OIL AND GAS DEVELOPMENT COMPANY LIMITED (OGDCL)

SECTION - III Scope of Work



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1.0 Scope of Work

1.1 General

1.1.1 The Contractor shall be responsible for execution of the project on complete responsibility basis and accordingly carry out all activities necessary to have in place an operational TAY-03 GGS compression facility, Thora Deep-03 GGS Compression facility, TAY wells compression facility at GPP and KPD wells compression facility at GPP including vetting and endorsement of Basic Design for Compressor Packages, their suction & discharge headers, piping and associated tie in points for all required services & facilities, detailed design engineering, procurement (supply) of equipment and material, construction, installation/erection, testing and complete all the civil, mechanical, electrical and instrumentation works, hook-up, tie-ins, pre-commissioning, commissioning & startup until issuance of Final Acceptance Certificate. When completed, the works shall be fit for the purposes for which it is intended and as defined in the Contract.

1.1.2 OGDCL intends to have a complete workable safe and operable plant meeting all the performance parameters, guarantees and warranty requirements. The Scope of Work described in this document is to enable the EPCC Contractor to bid for KPD TAY Compression Project.

The EPCC Contractor's Scope of Work shall include, but not be limited to:

- Prior to performing Detailed Engineering of the project, EPCC Contractor shall vet and endorse the Basic Design of Compressors' Packages, their suction & discharge headers, piping and associated tie in points for all required services & facilities.
- Detailed Design Engineering of the project.
- Detailed HAZOP study of Compressors packages (KPD TAY Compression Project) and its associated equipment/items outside the compressors' packages. EPCC Contractor is required to critically review, validate and endorse HAZOP study conducted at FEED stage for associated equipment/items outside the compressors' packages and provide/identify further recommendations (if any). EPCC Contractor's scope includes incorporation, fulfillment and implementation of all the

recommendations (except which are to be acted by the Client i.e. OGDCL) of HAZOP studies for FEED stage and Detailed Engineering Stage. Furthermore, HAZOP study of new instrument air package (for Thora Deep-03 GGS and TAY-03 GGS) will be performed by the Vendor and accordingly Contractor will provide the HAZOP study for new instrument air packages at aforementioned locations.

- SIL study of Off Package instruments and I/Os outside the compressor packages.
- EPCC Contractor to measure the actual required lengths of new and modified piping/header and vet & endorse their hydraulic calculations.
- Material selection study for entire project is in EPCC Contractor scope of work which includes new compressor packages, lines, equipment, instrumentations etc. EPC Contractor will ensure metallurgy of compression packages, its associated equipment/items/system and all allied accessories to be in-line / compliance with fluid composition and operating parameters of the system.
- EPCC Contractor shall provide proper double block & bleed and positive isolation for all process piping tie-ins.
- Procurement (Supply) of all equipment / material including preparation and placement of Purchase Orders, expediting, inspection, quality control, shipping, delivery and offloading at site for KPD TAY Compression project.
- Deployment of all construction/erection, equipment, materials, tools/tackles consumable, manpower etc. for execution of the project.
- Pre-commissioning, commissioning, performance testing, Reliability Guarantee Test (RGT) of TAY-03 GGS compression facility, Thora Deep-03 GGS Compression facility, TAY wells compression facility at GPP and KPD wells compression facility at GPP and training of staff.
- Construction, fabrication, erection and hook-up/tie-ins to existing mechanical, electrical, instrument, civil and safety system of existing KPD TAY Gas processing plant (GPP), Thora Deep-03 GGS and Thora Deep-03 GGS.

- Project Management, Planning & Control of the whole project from contract award throughout to final acceptance by OGDCL.
- QA / QC.
- Health, Safety and Environment (HSE).
- Provision of detailed construction drawings.
- EPCC Contractor shall be responsible for providing softcopies (editable and pdf) of all engineering work/documents.
- Scheduling of project for material, procurement, fabrication, installation, construction of all the mechanical, civil, electrical and instrumentation with milestones, followed by monthly presentations on each discipline.
- Approvals from OGDCL/Consultant for all engineering, material, equipment & consumables.
- Arrange delivery of initial fills, consumables, lubricants, commissioning spares (including startup and operation during Performance Test and until successful completion of Reliable Guarantee Test).
- Supply of OEM recommended Consumables & spare parts for one (01) year operation.
- Item-wised price list of OEM recommended consumables & spare parts supply for two (02) years operation. (as optional price)
- Preparation of all documentation (including as-built drawings / documents and operations / maintenance manuals etc) and their submission to OGDCL in both hard & soft form.
- The EPCC Contractor shall be responsible for liaison and coordination with OGDCL/ENAR Consultant and other Suppliers. Liaising with certifying Local Authorities (provincial and federal government) to obtain the permissions and licenses

for executing the work and preparation of all the necessary documentation shall be in the EPCC Contractor's scope of work.

- Construction and maintenance of temporary site facilities warehouse & security arrangements.
- If EPCC Contractor is not complying with any requirement of tender document, it shall be explicitly mentioned under exceptions/exclusions section of the bid. Anything not mentioned in exceptions/exclusion will be considered in EPCC Contractor's scope of work and supply irrespective of scope of supply as may be given in the bid.
- During preparation of bid, if bidder feels that such piece of equipment can be optimized to reduce cost then EPCC contractor shall provide as an alternate option with justification.
- EPCC Contractor shall consider 25 years design life of the project and equipment.
- All the reference documents to be provided to OGDCL/Consultant for review and record.

The EPCC Contractor shall perform the work in an efficient manner with due diligence, high professional standards, and good industry's practices, internationally accepted codes/standards in accordance with the requirement set out in the Contract Documents.

The EPCC Contractor shall not be relieved of any of its obligations under the Contract as a result of any inspection, examination, review, instruction, approval, consent or certificate given / issued by OGDCL/Consultant. Review/comments of documents/drawings or any other related matters by OGDCL/Engineering Consultant, does not relieve the Contractor from their responsibility and accountability under the respective Contract. Contractor shall have sole responsibility to ensure all of the aspects of engineering, design, safety, reliability, integrity, operability, maintainability and overall scope completeness in combination with related design codes are captured in the relevant project Engineering/design deliverables/ documents.

The Contractor shall comply with all applicable laws including environmental regulations, OGDCL's HSE & Security requirements in the performance of the Contract and shall ensure that the Project is fully compliant with all applicable laws.

- 1.1.3** The Scope of Work is intended to cover the design and construction of the KPD TAY Compression Project described in the Tender documents in accordance with good engineering practice accepted in the Industry. Any work or detail, which is not expressly set forth, but which is necessary to complete the job to the true intent and meaning of this Scope of Work, shall be furnished by EPCC Contractor as though specifically noted herein, without extra charge to OGDCL.
- 1.1.4** EPCC Contractor shall furnish all materials and equipment (including initial charges of any lubricants, portable fire extinguishers and chemicals, tools, construction materials and consumable supplies required for the project and shall make the complete installation of TAY-03 GGS compression facility, Thora Deep-03 GGS Compression facility, TAY wells compression facility at GPP and KPD wells compression facility at GPP covered in this Scope of Work. The TAY-03 GGS compression facility, Thora Deep-03 GGS Compression facility, TAY wells compression facility at GPP and KPD wells compression facility at GPP when turned over to OGDCL shall be in a commissioned condition and successfully performance tested.
- 1.1.5** The EPCC Contractor shall provide all ordinary and special tools, test equipment, transport, labor, supervision and all other necessary arrangements regarding the execution of the specified work and arrangements for the security of its personnel, supply of equipment and materials. All material furnished by EPCC Contractor shall be approved by the OGDCL / Consultant before work is commenced. Only new, top quality materials from approved vendors/manufacturers will be acceptable to OGDCL.
- 1.1.6** The EPCC Contractor shall transport to Project site all (for EPCC's own use) materials, equipment, vehicles, consumables, labor and personnel necessary for the work.
- 1.1.7** The EPCC Contractor shall provide a temporary camp for his own personnel, equipment and materials in the vicinity but outside Thora Deep-03 GGS, TAY-03 GGS and KPD-TAY GPP (Gas processing Plant). The EPCC Contractor shall establish a fenced and guarded

ware-house/store inside Thora Deep-03 GGS, TAY-03 GGS and KPD-TAY GPP for secured storage (security to be in line with Clause 11.11 of Condition of Contract) of material and equipment procured for the project. The EPCC Contractor shall maintain stores record of all such equipment and material and handover the records to OGDCL after completion of the Project to facilitate reconciliation of consumed/installed and left over equipment/material.

- 1.1.8** The EPCC Contractor shall also establish all necessary workshops/fabrication shops inside the Thora Deep-03 GGS, TAY-03 GGS and KPD-TAY GPP for execution of Project construction activities. Demobilization of all equipment, camps stockyard, works shops, fabrication shops, etc. and clean and reinstate these areas, shall also be the responsibility of the EPCC Contractor.
- 1.1.9** The EPCC Contractor shall carryout the necessary temporary works, and construct, install and mechanically complete all the works and submit all documentation as required by this Scope of Work.
- 1.1.10** The construction, installation and mechanical completion activities shall take full account of other work being carried out. The EPCC Contractor should bear in his mind that all major construction activities shall be performed when the existing TAY-03 GGS and KPD-TAY GPP is in operation. During construction works the EPCC Contractor shall ensure, together with his own personnel and equipment the safety of the existing equipment and material at TAY-03 GGS and KPD-TAY GPP as well. The EPCC Contractor shall abide by the OGDCL's safety policies/procedures and shall ensure that his work in any way shall not affect normal plant operation of existing plant/facility. The EPCC Contractor shall clearly identify the areas of works inside the plant/facility in operation and shall make all arrangements required for safe execution of construction related activities. The EPCC Contractor shall also be responsible for obtaining all hot or cold work permits or any other permits as deemed necessary by the OGDCL on day-to-day basis.
- 1.1.11** The EPCC Contractor shall make all necessary work plans/procedures as required by the OGDCL and shall submit the same for approval prior to execution. It is also intended to specifically mention that all the final tie-ins/hookup works will be completed during Thora Deep-03 GGS, TAY-03 GGS and KPD-TAY GPP shutdown. The duration of plant/facilities

shutdown shall be limited but will be mutually agreed between the EPCC Contractor and the OGDCL. The EPCC Contractor shall ensure completion of all such works within the agreed time schedule with due diligence and shall make all necessary arrangements, thereof. A detailed schedule shall also be required prior to commencement of construction activities during shutdown.

- 1.1.12** The information and data given is not intended to be an exhaustive list of all the requirements of the Contract. The EPCC Contractor's scope of work must be read in conjunction with the Tender documents and all parts of the Contract. EPCC Contractor's scope of works shall comprise all activities necessary to complete the project in accordance with the requirements of all of these documents.
- 1.1.13** All work shall be carried out by EPCC Contractor under the supervision of experienced personnel in accordance with OGDCL procedures, and the best and latest approved practices in the oil and gas industry.
- 1.1.14** Health, Safety and Environment requirements and provisions shall be in accordance with the requirements of the Contract and shall fully comply with OGDCL's policies/ procedures and international standard.
- 1.1.15** The EPCC Contractor shall also comply with the QA/QC, Safety, Planning and Scheduling requirements of the Contract throughout the execution of the Project.
- 1.1.16** All documents/drawings/literatures/Manuals/POs etc. required to be produced in the Project shall be in English Language.

1.2 Design & Engineering

1.2.1 General

1.3 Prior to performing Detailed Engineering of the project, EPCC Contractor shall vet and endorse the FEED Package including Basic Design of Compressor Packages, their suction & discharge headers, piping and associated tie in points for all required services & facilities at Thora Deep-03 GGS, TAY-03 GGS and KPD-TAY GPP.

1.3.1.1 The Vetting and Endorsement of Basic-Design of Compressor Packages, their suction & discharge headers, piping and associated tie in points for all required services & facilities, shall include studies, calculations, etc to confirm and verify the process design and equipment sizing basis. The Design Vetting/Endorsement and Optimization Report shall be submitted to OGDCL/Consultant for approval. However, detailed engineering will include preparation of process data sheets, Heat and Material balance, review and updating of existing PFDs and development of new Process Flow Diagrams (PFDs), development of piping and instrument diagrams (P&IDs), development of operating control philosophy, startup/commissioning spares, emergency and shutdown system and details of first fills/consumables requirements.

The EPCC Contractor shall be responsible for the provision of all engineering and design services necessary to complete the project in conformity with the requirements indicated within this scope of work. The general requirement will also include but not be limited to:

- Verification of the provided design data. EPCC Contractor shall, by site visit (s) and otherwise, familiarize himself with existing facilities, field operation and site details, clarify any inconsistencies and obtain any additional information he may require to complete his work; and check, correct and supplement any existing drawings required as a basis for his work. Updating of all received data as a result of site visit, information received from OGDCL/Consultant shall be the responsibility of the EPCC Contractor.

EPCC shall have responsibility to collect all the necessary information from FIELD/PLANT and verify as-built of existing facility/plant/stations prior to commencing Brownfield related detail design work.

- EPCC Contractor shall develop all necessary Documents (including) for the procurement, fabrication, transportation, installation, construction, pre-commissioning, commissioning, performance test, Reliability Guarantee Test and start-up of the Plant/facilities.
- Performance of any additional studies or calculations required to further define equipment or system requirements, or to demonstrate the adequacy of the proposed design.
- Risk Studies (HAZOP, HAZID, SIL and Safety Assessment) due to installation of New Compressor Packages will be arranged by EPCC Contractor in the presence of OGDCL/Consultant which shall be chaired by the Third party chairman to find out any gaps / risks / hazards, by using a Systematic Approach.

After completion of RISK studies, all recommendations will be incorporated by EPCC Contractor in design/drawings and technical specifications.

- Preparation and updating on a regular basis of all drawings, specifications, requisitions and other documents required for the purchase, fabrication, testing and installation of all equipment, materials and facility defined herein.
- Provision of procurement, expediting and inspection services for all equipment, materials and skids/packages.
- Review of vendor data, drawings and other documentation to ensure compliance with specifications.
- The Detailed Design to be performed by the EPCC Contractor shall include but not limited to the following:
 - i. Updating, completing, (re-drawing if necessary) of the Design Documents provided by OGDCL / Consultant.

- ii. Preparation and issuance of all necessary MTO's, requisitions, and other technical documents for the procurement of Equipment and Bulk Material.
 - iii. Preparation and issuance of all design documents for construction, installation, pre-commissioning, commissioning and start-up procedures, approvals.
 - iv. Liaising with Certifying and Local Authorities to obtain necessary design appraisal reports, including preparation of all necessary documents.
 - v. Checking and co-ordinating for all Vendor's detailed Engineering and Final Documentation.
 - vi. Performance of all detailed studies, procedures, calculation notes and the like for the Vendors supplied items. Implementation of field mismatches and changes desired by Operation/Maintenance, etc.
 - vii. The Detailed Design shall include in particular but shall not be limited to the preparation and issue of the documents which require "Approval" prior to implementation for procurement, construction and/or installation.
 - viii. The Detailed Design Documents including all drawings, specifications, MTO's and Manuals shall contain all essential and adequate details in a manner that this project can be carried out independently without too much interdepartmental dependence and that start-up, commissioning, operation, safety and maintenance procedures can be implemented smoothly and without confusions.
- EPCC Contractor shall develop and submit to the OGDCL / Consultant a comprehensive list of drawings/documents with the Work Program for control purposes.
 - The EPCC Contractor shall ensure that the facilities to be implemented as part of this project shall be capable of continuous, safe and efficient operation at all anticipated conditions during the active life of the installation.

1.4 Project Management, Planning & Control

1.4.1.1 Management

1.4.1.1.1 The EPCC Contractor shall carry out all activities according to a pre-approved project plan. Contractor shall prepare and submit, for OGDCL's approval, procedures for all Works. These procedures shall strictly comply with the requirements of the Contract where applicable. After the approval, these procedures shall be strictly followed in the performance of the Works and any deviation will require prior approval of OGDCL.

1.4.1.1.2 As a minimum, management of the Works will include the means to ensure that:

- a. EPCC Contractor shall manage all internal coordination between Contractor departments involved in the execution of the Works such that the Works, and the transitions and interactions between all particular phases of the works, are executed in an efficient, safe, environmentally sound and timely manner and EPCC Contractor initiates and implements such procedures as are appropriate to achieve the execution of the Works in that manner.
- b. The EPCC Contractor shall manage and coordinate with all of its Sub-Contractors involved in execution of the Works in accordance with the requirements identified in this document.

1.4.1.1.3 The EPCC Contractor shall co-ordinate and control all major phases of the work including:

- Detailed engineering, design and specification of all equipment, materials and facilities in the EPCC Contractor's Home Office.
- Erection, construction and hook-up of the facilities at sites.
- Pre-commissioning, commissioning, performance testing, handover of the completed facility to OGDCL.
- Material reconciliation as required.
- Compilation and provision of a Completion File as well as a formal Closeout Report to OGDCL on completion of the EPCC Contractor's Scope of Work.

1.4.1.1.4 The primary project management function of the EPCC Contractor is to ensure that all parties, including Sub-contractors contributing to the project, comply with their established duties and responsibilities and take corrective action where necessary to ensure that the project is completed in a timely and satisfactory manner.

1.4.1.1.5 Where applicable Pakistani law and regulations conflict with Company's Specifications as detailed herein, Pakistani law and regulations shall govern. (EPCC Contractor shall promptly inform OGDCL in writing of any conflict, which arise for Company's comment before any design/procurement activities commence).

1.4.1.2 Planning

The EPCC Contractor shall plan and schedule all major activities listed above, prior to the commencement of that activity. Such plans and activities will be updated, at least monthly, and take into account the current status of proceeding activities. These detailed plans and schedules will be summarized in Master Schedules and Networks, etc. for approval by OGDCL.

1.4.1.3 Project Control & Administration

1.4.1.3.1 The EPCC Contractor shall develop and implement detailed project control procedures and effective systems applicable to all phases of the Works, covering all aspects of planning, scheduling, progress reporting, estimating, quality control, cost control, accounting and administration to be implemented under, and as part of, and in accordance with the Approved Project Plan.

1.4.1.3.2 As a minimum, the project control and administration works to be carried out pursuant to this section will include the following requirements:

- Project planning and progress measurement shall be in accordance with OGDCL's requirements as detailed in subsequent section of this document and shall be reported to OGDCL/Consultant.

1.4.1.3.3 The EPCC Contractor shall control all aspects of the project using network analysis, schedules, Gant charts, etc. Project controls will include:

- All aspects of estimating, cost control, planning, scheduling, change orders, extra works, and claims and back charges. An effective system for quantitative measurement of physical progress shall be incorporated.
- Details of computer programs to be used.
- Details of codes of accounts to be used.

The EPCC Contractor shall also submit Level-1 to Level-4 Schedule along with the bid.

1.4.1.4 Progress Measurement and Reporting

- 1.4.1.4.1 The EPCC Contractor shall maintain up to date networks, document control register procurement schedules, etc. to demonstrate day-to-day progress and control of the project. These documents will be supplemented by weekly and formal monthly reports covering all aspects of the project, and will be of sufficient detail to enable Company to satisfy itself that the project is proceeding in a timely manner.

1.4.1.5 Construction Planning

- 1.4.1.5.1 The EPCC Contractor shall pre-plan all construction activities to ensure full definition of an optimum construction plan, procedures and scope of work. Such plans will cover construction strategy, coordination and interfacing of all on-site activities, quality control and safety procedures. The plans will be subject to review and approval by OGDCL.

1.4.1.6 Quality Assurance and Control

- 1.4.1.6.1 The EPCC Contractor shall be responsible for ensuring that Approved Quality Assurance Procedures are complied with throughout the various phases of the project. The procedures will include but not be limited to:
- Identification of quality standards
 - Implementation of Quality Assurance procedures for design
 - Document controls
 - Procurement controls
 - Vendor surveillance programs including witnessing performance and run-in tests

- Implementation of Quality Assurance procedure during construction and Pre-commissioning
- Reviews and disposition of non-conforming items
- Maintenance of records
- Implementation of Quality Assurance

The EPCC Contractor shall ensure that all sub-contractors/suppliers he appoints comply in all respects with the approved Quality Assurance procedure.

1.4.1.7 General Services

1.4.1.7.1 Sub-Contractor

The EPCC Contractor shall be responsible for all the activities of its Sub-Contractors and shall arrange for necessary assistance and attendance of Sub-Contractors and their respective representatives at Site or at any as may be required for EPCC Contractor to execute the Works in accordance with the Contract.

2.0 **Process Engineering**

This section describes the general process related technical requirements of the KPD-TAY Compression Project to be provided by the EPCC Contractor for Thora Deep-03 GGS, TAY-03 GGS and KPD-TAY GPP. The cases for the compression packages are defined in: Design Basis (0258-A-1007), Compressor Data sheets (0258-DS-1000, 0258-DS-1001, 0258-DS-1002 and 0258-DS-1003) and Process Design Package in Volume-IIA.

***Note:** Compressors shall be designed in such a way that safe, continuous and trouble free operation shall be carried for both Rated and Normal Conditions as well as on Turndown conditions as stipulated in compressor datasheets.*

The EPCC Contractor's process engineering will include all studies, calculations, reports, documents/drawings etc for the adequate process design and equipment sizing. It will include the preparation of process data sheets, heat and material balances, utility balances, development of PFD's, UFD's and P&ID's for all systems, including preparation and implementation of the control, startup and shutdown philosophies and the detail engineering of tie-ins with existing facilities/systems. Development of the process and utility systems will take full account of environmental requirements in particular the safe disposal of liquid and vapor effluents to flare/vent or drain. The EPCC contractor's engineering team will also take part in the HAZOP and HAZID review, and perform any Hazards Analysis arising there from. The EPCC contractor's engineering team will review plot plans, layouts etc for safety, operability and ease of maintenance.

EPCC Contractor will perform hydraulic analysis of all piping of Thora Deep-3 GGS, TAY-03 GGS, TAY at GPP and KPD at GPP and finalize the line sizes considering the worst scenario.

Furthermore, to ensure accommodation of slug volume and slug flowrate at Compression facilities of Thora Deep-03 GGS, TAY-03 GGS, TAY at GPP, EPCC Contractor shall perform dynamic simulation of inlet separator and blowcase vessels and design the system in such a way that continuous, efficient, smooth and trouble free operation of compressor packages shall be done.

EPCC Contractor shall design all the systems/Units/modifications according to codes and standards and perform all the necessary works (i.e. detailed design engineering, procurement of equipment and material, construction, installation/erection, testing and technically complete all the civil, mechanical, electrical and instrumentation works, hookup Tie-ins, pre-commission and provide commissioning and startup) from all aspects so that safe, continuous and trouble free operation of the compression facilities is assured.

The EPCC Contractor's scope with respect to process engineering shall include but not limited to the following:

2.1 New Compressor Packages

The following compression packages would be installed for KPD-TAY Compression Project:

1. Nodal Compression at existing TAY-3 GGS, consisting of 02 operating & 01 standby Reciprocating Compressors packages with Blow-case Vessels.
2. Nodal Compression for Thora Wells at New Thora Deep-3 GGS, consisting of 01 operating & no standby Reciprocating Compressor packages with Blow-case Vessels.
3. Nodal Compression for TAY individual wells at GPP, consisting of 02 operating & 01 standby Reciprocating Compressors packages with Blow-case Vessels.
4. Front End Compression for KPD wells at GPP having Separate MP & LP Suction Headers, consisting of 03 operating & 02 standby Reciprocating Compressors packages.

Compressors shall be packaged with reciprocating compressors according to (API SPEC 11P) which is self-contained (on skid) and reduced the compressor occupied area/space, modular design, complete in all respects, machine supplied in pre-assembled, pre-wired conditions.

Typical P&IDs for compression packages are for indicative purpose only. Taking into account the requirements mentioned in data sheets of the respective compressor packages, EPCC Contractor will design the scheme of the compressor package (EITHER Single-Stage Operation for medium suction pressure mode (MP) & Multi-Stage operation for low

suction pressure mode (LP) along with the requirement of provision for isolation arrangement between single stage or multistage operation OR series operation of compression stages for both LP and MP mode of operations) in such a way that continuous, efficient, smooth and trouble free operation of compressor packages shall be ensured to fulfill all the process parameters & conditions as defined in the respective data sheets.

The above specific areas shall be addressed by the EPCC Contractor within his scope, as well as detailed design and engineering of KPD-TAY Compression Project along with interconnections/tie-ins in all respects with the existing systems.

2.2 New Process Equipment/Items

Following new process equipment/items will be installed at the project site:

Thora Deep-03 GGS

A new Separate Nodal compression station and gas gathering station with all necessary associated facilities and utilities at Thora Deep-03 well site shall be developed for Thora Deep wells (Thora Deep-1, 2 and 3). EPCC Contractor shall perform the detailed engineering design (for all disciplines i.e. Process, Mechanical, Instrumentation, Electrical and Civil) and supply, install, commission and startup the entire facilities with all other allied facilities and utilities as well.

- Compressor Package.
- Process Drain Pit and Pump.
- Raw Water Bore Pump
- Sand Filters
- Raw Water Tank
- Raw Water Supply Pump
- Vent K.O Drum
- Vent Stack
- Instrument Air Generation Package

TAY-03 GGS

EPCC Contractor shall perform the detailed engineering design (for all disciplines i.e. Process, Mechanical, Instrumentation, Electrical and Civil) and supply, install, commission and startup the entire facilities with all other allied facilities and utilities as well.

Following equipment/items shall be installed at existing TAY-3 GGS.

- Compressor Packages.
- Process Drain Pit and Pump.
- Raw Water Bore Pump
- Sand Filters
- Raw Water Tank
- Raw Water Supply Pump
- Vent K.O Drum
- Vent Stack
- Instrument Air Generation Package.
- Fire water tank.
- Fire water pumps (01 motor driven and 01 engine driven)
- Fire water jockey pumps.

KPD-TAY at GPP

Following equipment/items shall be installed at existing GPP.

- Compressor Packages for KPD wells.
- Thora Deep HP Slug Catcher.
- LP Slug Catcher (finger type).
- LP Condensate Pumps
- K Trim Cooler.
- Compressor Packages for TAY wells.
- T Trim Cooler.

Preliminary sizes/dimensions of the above equipment/items are mentioned in FEED package. However; EPCC Contractor will evaluate and finalize the sizes/dimensions/design of the above equipment/items during detailed engineering stage and will share detailed calculations of all the equipment, items, piping hydraulics, flare /relief & blowdown system, fire water system, NPSH calculations of pumps, utilities etc.

2.3 Modifications/Addition in the Existing Process System

Following modifications/additions in the existing process system of KPD-TAY Compression Project shall include in the EPCC Scope of work:

Thora Deep-03 GGS

1. A new Separate Nodal compression station and gas gathering station with all necessary associated facilities and utilities at Thora Deep-03 well site shall be developed for Thora Deep wells (Thora Deep-1, 2 and 3).
2. 01 Common Lube Oil Day Tank to be provided for Compressor Package if same oil is used for Engine, Compressor Frame and Forced feed lubricator. The capacity of day tank should be equivalent to at least 02 weeks cumulative consumption quantity of compressor package. In case of different lube oils used for Engine and Compressor, separate lube oil day tanks to be provided for Engine and Compressor.
3. 01 # Underground Metallic Tank shall be installed for collection of lube oil drain of engine & compressor. Drains from compressor and engine skids also will be routed to this tank for safe collection of oil in case of spill / leakage / seepage during operation to avoid soil contamination and ease of maintenance. Manway will be provided on tank along with connections to haul liquid using portable pump. The Capacity of this tank should (atleast) be equal to cumulative sump capacity of 01 compressor package.
4. Existing Thora Deep-2 flowline routing shall be in such a way that it is passing near through Thora Deep-3 GGS then passes near to Thora Deep-1 well then Thora Deep-1 and 2 flowlines is going via same route to the GPP.

For nodal compression of Thora Deep well 1, 2 and 3, existing Thora Deep-1 flowline (existing routing to GPP) will be utilized, since; flow line of Thora Deep-1 (TD-1) is approx. 900 meters away from well head facilities joins the common

corridor of Thora Deep-2 (TD-2) heading to GPP (existing KPD-TAY Gas processing Plant). From this junction point, Thora Deep-3 (TD-3) (Site for Proposed Nodal Compressor) is approximately 600-700 meter away. Therefore, piece of existing Thora Deep-1 flow line of approx. 0.7 km from the aforesaid junction to the proposed Thora Deep-3 GGS will be relocated/utilized. Existing Thora Deep-2 flowline (passing near through Thora Deep-3 GGS) will also be diverted to the proposed Thora Deep-3 GGS.

New gathering system at TAY-3 GGS includes the following Headers:

- HP Production Header
 - Testing Header
 - LP Compression Header
 - Blowdown Header
5. The three phase mixed streams (gas, condensate and water) from Thora Deep-1, 2 and 3 wellheads shall be routed to the inlet of the proposed Nodal Reciprocating Compression Package (with blow-case vessels) via new LP Compression Manifold at GGS.
- The mixed phase stream leaving the proposed Nodal Reciprocating Compression Package (with blow-case vessels) shall now be routed to GPP via existing Thora Deep-2 flowline approx. 9.56 km (shall be used as Thora Deep Trunk line) and then to new proposed Thora Deep slug catcher at GPP.
6. Compressor by-pass arrangement to be provided at Thora Deep-3 GGS, in case, any issue like maintenance / shut down occurs at Thora Deep-03 GGS Compressor then by-pass provision will be utilized for continuous flowing of Thora Deep Wells through KPD-LP headers at KPD-TAY Plant. In this context, the provision of Thora Deep-3 GGS Trunk Line tie-in option shall also be provided with KPD-LP header at GPP.
7. For testing of Thora Deep-1, Thora Deep-2 and Thora Deep-3 wells, a new test header and test separator will be installed at Thora Deep-03 GGS. The testing facility (test header, test separator etc.) will include all the allied accessories for the safe and smooth operation. The LP Test header will be routed through test separator. The Separator Gas & oil outlet tie-in with Thora LP Compression manifold (Suction

header) at Thora Deep-03 GGS, so that individual LP wells of Thora Deep1, 2, 3 testing can be remotely carried out as per operational requirement at Thora Deep-3 Nodal Compression facility. The separated produced water from test separator will be routed to the existing flare pit located in the vicinity of Thora Deep-03 GGS as mentioned in the survey plan/drawing (Drawing No. 0704423-PS-04).

TAY-03 GGS

1. Three (03) new Nodal compression packages with all necessary associated facilities and utilities at existing TAY-03 GGS site shall be installed. EPCC Contractor shall perform the detailed engineering design (for all disciplines i.e. Process, Mechanical, Instrumentation, Electrical and Civil) and supply, install, commission and startup the entire facilities with all other allied facilities and utilities as well.
2. 01 Common Lube Oil Day Tank to be provided for all Compressor Packages if same oil is used for Engine, Compressor Frame and Forced feed lubricator. The capacity of day tank should be equivalent to at least 02 weeks cumulative consumption quantity of all compressor packages. In case of different lube oils used for Engine and Compressor, separate lube oil day tanks to be provided for Engine and Compressor.
3. 01 # Underground Metallic Tank shall be installed for collection of lube oil drain of engine & compressor. Drains from compressor and engine skids also will be routed to this tank for safe collection of oil in case of spill / leakage / seepage during operation to avoid soil contamination and ease of maintenance. Manway will be provided on tank along with connections to haul liquid using portable pump. The Capacity of this tank should (atleast) be equal to cumulative sump capacity of 02 compressor packages.
4. Existing test manifold, blowdown manifold, LP manifold and HP production manifold are already installed at TAY-03 GGS. The tie in of suction header for compression packages will be taken from existing LP manifold. The discharge header of compression packages will be hooked up with existing HP production manifold. In this manner, HP streams from compression packages will be routed to the existing GPP via existing trunk line.

TAY at GPP

1. Three (03) new Nodal compression packages with all necessary associated facilities and utilities at existing GPP for TAY wells shall be installed. EPCC Contractor shall perform the detailed engineering design (for all disciplines i.e. Process, Mechanical, Instrumentation, Electrical and Civil) and supply, install, commission and startup the entire facilities with all other allied facilities and utilities as well.
2. 01 Common Lube Oil Day Tank to be provided for all Compressor Packages if same oil is used for Engine, Compressor Frame and Forced feed lubricator. The capacity of day tank should be equivalent to at least 02 weeks cumulative consumption quantity of all compressor packages. In case of different lube oils used for Engine and Compressor, separate lube oil day tanks to be provided for Engine and Compressor.
3. 01 # Underground Metallic Tank shall be installed for collection of lube oil drain of engine & compressor. Drains from compressor and engine skids also will be routed to this tank for safe collection of oil in case of spill / leakage / seepage during operation to avoid soil contamination and ease of maintenance. Manway will be provided on tank along with connections to haul liquid using portable pump. The Capacity of this tank should (atleast) be equal to cumulative sump capacity of 02 compressor packages.
4. Existing test manifold, blowdown manifold and HP production manifold are already installed at GPP for TAY wells. Existing blowdown manifold will be used as suction header of Compression facility for TAY well while the existing test manifold will be used for blowdown purpose. The tie-in of suction header for compression packages will be taken from existing blowdown manifold. The discharge header of compression packages will be hooked up with existing HP production manifold.
5. For blowdown purpose, a tie-in connection from existing test manifold will be provided and routed to the existing flare header.
6. Existing K-test separator for KPD wells is being used for both KPD and TAY wells at GPP. For TAY wells, the gas outlet line connection shall be tie-in with the new suction header of compression facility for TAY wells.

7. The existing LCV installed at water outlet line of T-slug catcher of TAY wells is found inadequate for revised conditions. In this regard, a new LCV-5103 will be provided and installed by Contractor to cater increased produced water flowrate.
8. New Trim cooler shall be Shell & Tube Heat Exchangers with cooling water at shell side. The trim cooler shall be designed considering 20% maximum oversize criteria on installed surface. Furthermore, the allowable pressure drop criteria for Heat Exchanger design is considered as 10 psi. Fouling Factor of cooling water will be 0.002 h-ft²-°F/BTU, for Trim Coolers Datasheet, refer Tender Document/Volume-IIA.
9. The cooling water supply and return connections will be taken existing cooling water supply and return headers.

KPD at GPP

1. Five (05) new compression packages with all necessary associated facilities and utilities at existing GPP for KPD wells shall be installed. EPCC Contractor shall perform the detailed engineering design (for all disciplines i.e. Process, Mechanical, Instrumentation, Electrical and Civil) and supply, install, commission and startup the entire facilities with all other allied facilities and utilities as well.
2. 01 Common Lube Oil Day Tank to be provided for all Compressor Packages if same oil is used for Engine, Compressor Frame and Forced feed lubricator. The capacity of day tank should be equivalent to at least 02 weeks cumulative consumption quantity of all compressor packages. In case of different lube oils used for Engine and Compressor, separate lube oil day tanks to be provided for Engine and Compressor.
3. 01 # Underground Metallic Tank shall be installed for collection of lube oil drain of engine & compressor. Drains from compressor and engine skids also will be routed to this tank for safe collection of oil in case of spill / leakage / seepage during operation to avoid soil contamination and ease of maintenance. Manway will be provided on tank along with connections to haul liquid using portable pump. The Capacity of this tank should (atleast) be equal to cumulative sump capacity of 02 compressor packages.

4. Existing test manifold, blowdown manifold and HP production manifold are already installed at GPP for KPD wells. Existing blowdown manifold size will be changed from 6" to 8" and shall be used as Thora Deep HP header. This change of existing header size is proposed considering space constraints at existing gathering area at GPP with consent of OGDCL.
5. The existing test manifold will be used for blowdown purpose. A tie-in connection from existing test manifold will be provided and routed to the existing flare header.
6. Connections from the following KAY wells shall be provided at New Thora HP header and deal in the new Thora HP slug catcher.
 - Kunner Deep-1.
 - Kunner Deep-2.
 - Kunner Deep-4.
 - Kunner Deep-5.
 - Kunner Deep-9.
 - Kunner Deep-11.
 - Thora Deep-02 (Trunk line of Thora Deep-03 GGS).
 - Moolan-1
7. Existing KAY production manifold/header will be used as Medium pressure (MP) header for Compression facility and accordingly existing KAY slug catcher will be used as MP slug catcher.
8. A new MP suction header for Compression facility will be installed from the gas outlet header of existing KAY slug catcher. The existing PDCV-4101 installed at slug catcher gas outlet line will be removed.
9. New LP suction header will be developed for Compression facility in which connections from all the KAY wells will be provided.
10. A New LP slug catcher (Finger type) will be installed.
11. New LP Condensate Pumps will be installed to transfer Condensate from the new LP slug catcher to the existing condensate header/system while produced water from New LP slug catcher will be routed to the existing produced water header/system.

EPCC Contractor shall perform NPSHa calculation of LP slug catcher pumps (P-4601 A/B) as per detailed engineering works to ensure minimum difference

- between NPSHa and NPSHr i.e. 1.0 m and accordingly select the suitable pumps such that safe, continuous and trouble free operation will be carried out. Furthermore, restriction orifice (RO) will be installed at discharge line of LP condensate pumps. Keeping in view optimize design, EPCC Contractor shall select and design LP condensate pumps (considering different impeller sizes for operating envelopes) & its discharge system (specially restriction orifice) in such a way that the operating envelopes of LP conditions i.e. 385 psig suction & 185 psig suction pressures taking into account operating conditions of existing flash separators (V-7101 and 7201) i.e. 425 psig at upstream of existing FCV-4212/4213.
12. The discharge line of the compression facility will be connected with the HP header gas outlet of new HP slug catcher.
 13. In existing scheme, separated gas and condensate are mixed again at downstream of existing slug catcher (SC-4101) and directed to 3-Phase KPD separator (V-4201). However, in proposed scheme, gas separated from the existing slug catcher will be routed to the MP suction header of proposed compressors packages while separated condensate and water shall be routed to their respective existing headers/systems. In this context, gas and condensate lines will be isolated.
 14. A New Thora HP slug catcher (Vessel type) will be installed.
 15. Condensate and water lines from the new Thora HP slug catcher will be routed to the existing condensate and produced water headers respectively.
 16. Existing K-test separator for KPD wells is being used for both KPD and TAY wells. For KAY wells, the gas outlet line connection shall be tie-in with the new MP suction and LP suction headers of compression facility for KAY wells.
 17. New Trim cooler shall be Shell & Tube Heat Exchangers with cooling water at shell side. The trim cooler shall be designed considering 20% maximum overdesign criteria on installed surface. Furthermore, the allowable pressure drop criteria for Heat Exchanger design is considered as 10 psi. Fouling Factor of cooling water will be 0.002 h-ft²-°F/BTU, for Trim Coolers Datasheet, refer Tender Document/Volume-IIA.
 18. The cooling water supply and return connections will be taken from existing cooling water supply and return headers.

2.4 Off-sites and Utility Systems

The following off-sites and utility systems shall be provided under the scope of work of this project.

2.4.1 Instrument Air System

Thora Deep-03 GGS

A new instrument air system will be installed at Thora Deep-03 GGS. EPCC Contractor will design the instrument air system as per codes & standards and worst case requirement. Instrument air is required to operate valves that regulate pressure, flow, temperature, liquid levels and Emergency Shutdown valves. Refer data sheet and P&IDs of Instrument air system in Volume-IIA. Supplier shall be responsible for the complete Engineering, Design, Procurement, supply, installation, commissioning & testing of complete package.

TAY-03 GGS

A new instrument air system will be installed at TAY-03 GGS. EPCC Contractor will design the instrument air system as per codes & standards and worst case requirement. Instrument air is required to operate valves that regulate pressure, flow, temperature, liquid levels and Emergency Shutdown valves. Refer data sheet and P&IDs of Instrument air system in Volume-IIA. Supplier shall be responsible for the complete Engineering, Design, Procurement, supply, installation, commissioning & testing of complete package.

TAY and KPD at GPP

EPCC shall provide instrument air connections from existing system to compression facilities of KPD and TAY wells as mentioned in respective P&IDs.

2.4.2 Raw Water System

Thora Deep-03 GGS

A New raw water system at Thora Deep-03 GGS will be installed which will consist of bore water pump, sand filters, raw water tank, raw water supply pump etc. Minimum sizes

of these items are mentioned in the FEED package (Volume-IIA). EPCC Contractor will finalize the design/sizing raw water system during detailed engineering stage. Refer data sheet and P&IDs of raw water system in Volume-IIA.

TAY-03 GGS

A New raw water system at TAY-03 GGS will be installed which will consist of bore water pump, sand filters, raw water tank, raw water supply pump etc. Minimum sizes of these items are mentioned in the FEED package (Volume-IIA). EPCC Contractor will finalize the design/sizing raw water system during detailed engineering stage. Refer data sheet and P&IDs of raw water system in Volume-IIA.

2.4.3 Fuel Gas System

In order to provide the fuel gas to the new compressor Packages (05 No. for KPD and 03 No. for TAY) of KPD and TAY wells for engine, the EPCC Contractor shall vet and endorse the existing fuel gas system of KPD-TAY GPP and finalize the tie in points in case the existing system found adequate to cater the additional load for the new compression facilities and resolve the bottlenecks (if any).

2.4.4 Fire Water System

Thora Deep-03 GGS

EPCC contractor will provide mobile foam trolleys, fire extinguishers etc. at Thora Deep-03 GGS.

TAY-03 GGS

A New Fire water system at TAY-03 GGS will be installed which will consist of fire water tank, one fire water motor driven pump, one fire water diesel engine pump, two motor driven fire water jockey pumps, hydrants, monitors, sprinklers system, mobile foam trolleys etc. Minimum sizes of these items are mentioned in the FEED package (Volume-IIA). Refer data sheets and P&IDs of Fire water system in Volume-IIA.

EPCC Contractor shall finalize the fire water requirement for the compression facility and finalize the design/sizing fire water system during detailed engineering stage. In order to provide the required fire water for the new compression facility, EPCC Contractor will determine number of Hydrants/monitors around Compression Facility considering finalized fire water requirement as per NFPA codes & standards and develop their specifications accordingly. Further, EPCC Contractor shall also provide fixed spray system in each Compressor package.

TAY at GPP and KPD at GPP

Existing fire water tanks, pumps and associated piping headers are adequate for the compression facilities of KPD and TAY firefighting. However, bidder shall take respective tie-ins from existing fire water header(s) for compression facilities of KPD and TAY at GPP and shall further design, procure, construct and install proper firefighting system for compression facilities of KPD and TAY based on international codes and standards.

EPCC Contractor shall finalize the fire water requirement for the compression facilities of KPD and TAY. In order to provide the required fire water for the new compressor Packages of KPD and TAY, EPCC Contractor will determine number of Hydrants / monitors around Compression Facilities of KPD and TAY considering finalized fire water requirement as per NFPA codes and standards and develop their specifications accordingly. Further, EPCC Contractor shall also provide fixed spray system in each Compressor package of KPD and TAY.

2.4.5 Flare/Vent System

Thora Deep-03 GGS

New Vent/Blowdown system at Thora Deep-03 GGS will be installed which will consist of Vent system piping/headers, Knockout drum, Vent stack etc. Minimum sizes of these items are mentioned in the FEED package (Volume-IIA) considering the block discharge scenario. EPCC Contractor will perform detailed vent/blowdown/relief system study considering the worst scenario (i.e. block discharge case, fire case etc.) and finalize the Vent system design/sizing accordingly. EPCC Contractor shall ensure that the

Vent/blowdown system study for compression facility shall be carried out as per API STD-521.

TAY-03 GGS

New Vent/Blowdown system at TAY-03 GGS will be installed which will consist of Vent system piping/headers, Knockout drum, Vent stack etc. Minimum sizes of these items are mentioned in the FEED package (Volume-IIA) considering the block discharge scenario. EPCC Contractor will perform detailed vent/blowdown/relief system study considering the worst scenario (i.e. block discharge case, fire case etc.) and finalize the Vent system design/sizing accordingly. EPCC Contractor shall ensure that the Vent/blowdown system study for compression facility shall be carried out as per API STD-521.

Furthermore, the existing vent stack installed at TAY-03 GGS will be demolished. The existing lines being routed to the existing vent stack shall be re-routed and tie-in with the new Vent/blowdown system at TAY-03 GGS.

TAY at GPP and KPD at GPP

EPCC Contractor shall design the KPD and TAY Compression Packages' flare and blow down system, not limited only to the Compression Packages Battery Limits, but also considering tie-ins required for the KPD-TAY compression project. Contractor shall also perform Plant (GPP) flare study considering its operation requirements and develop & implement the design fulfilling Compression Packages & new equipment, and Plant flaring & blow down requirement for all scenarios.

Existing flare system is adequate for the blow-down load of Existing and new Slug Catchers, however, EPCC shall perform the flare study for new TAY GPP Nodal Compression Packages, KPD FEC compression packages and PSVs, BDVs & Flare PCVs at new Slug Catchers. EPCC Contractor shall also be responsible to perform a flare study for flare header back pressure at PSVs, BDVs & PCVs with respect to flows & liquid accumulations.

Report of flare study shall be submitted by EPCC contractor for OGDCL's review and approval, however, as a minimum following additions / modifications are envisaged:

- Replacement of a RO-4100 with new one at existing K Slug-catcher.

The above additions / modifications are based on initial estimation, however, flare header system shall be designed, supply, installed and commissioned for flaring /blow down requirements as well as findings worked out during flare study considering new and revised loads.

The sizing of new ROs and PSVs along with blow-down study for the new equipment and compression packages, its associated equipment/piping and utilities shall be carried out and finalized by EPCC Contractor (considering the governing load of blow-down/PSV) based on international codes and standards. EPCC Contractor shall finalize the Flare load for the TAY GPP Nodal Compression Packages and KPD FEC compression packages considering the worst case scenario during detailed design Engineering Stage.

Vent and Blow-down Study of compression facility and its associated equipment, utilities and piping (i.e. inter-connecting piping within each package and suction/discharge piping among new equipment, compression packages and Plant) shall be carried out by EPCC Contractor. EPCC shall check the adequacy of flare systems of existing plant, according to the worst case of vent & blow-down. In case of any bottleneck, modification in existing flare systems of plant shall be the obligation of EPCC contractor during detailed design engineering stage.

EPCC Contractor shall ensure that the flare system study for KPD and TAY compression facilities and new equipment shall be carried out as per API STD-521, which guides that the system to be depressurize within a fire zone shall reduce the pressure of the equipment to 50% of the design pressure or 100 psig, whichever is lower within 15 minutes. Furthermore, the allowable Mach velocity of 0.5 in sub header/ header is acceptable for intermittent service. However, for tail pipe, 0.7 Mach velocities are allowed.

NEQS data is attached in the data sheet of compressors in **Volume-IIA** of the tender document.

2.4.6 **Drain system**

Thora Deep-03 GGS

A new closed drain system at Thora Deep-03 GGS will be installed in which drains from compressor package and new knockout drum will be handled. The system consists of process drain pit, drain pit pump and other allied accessories. The discharge piping (having sufficient length w.r.t safety distance) of pump will be provided with flexible hose connection. The drain pit pump will be used to empty the pit and fill the drains into the bowser/Truck.

Furthermore, separate drain handling system for oily/auxiliary drains from compressor package will be installed.

TAY-03 GGS

A new closed drain system at TAY-03 GGS will be installed in which drains from compressor packages and new knockout drum will be handled. The system consists of process drain pit, drain pit pump and other allied accessories. The discharge piping (having sufficient length w.r.t safety distance) of pump will be provided with flexible hose connection. The drain pit pump will be used to empty the pit and fill the drains into the bowser/Truck.

Furthermore, separate drain handling system for oily/auxiliary drains from compressor packages will be installed.

The existing open drain pit at TAY-03 GGS will be demolished. All the existing lines routing to the existing drain pit shall be re-routed and tie in with the new process drain pit.

TAY at GPP and KPD at GPP

The drains from KPD and TAY compression facilities, slug catchers etc. shall be routed to the existing closed drain system.

2.4.7 **Plant Air, Utility Water, Demin Water and Nitrogen**

EPCC Contractor shall provide Plant air, utility water, Demin Water and Nitrogen connections to compression facilities of KPD and TAY wells as mentioned in respective P&IDs.

2.5 **Design Review, HAZID & HAZOP Studies**

The EPCC Contractor shall be responsible for timely and adequate engineering and design reviews to ensure that a safe, operable and easily maintainable facility is designed and constructed. EPC Contractor shall be responsible to conduct a design review meeting in which OGDCL/Engineering Consultant shall participate. The EPCC Contractor will be responsible for a formal HAZID & HAZOP review of the proposed facilities at “Approved for Design” stage, to be conducted at Packager’s facility by third party approved by OGDCL/Consultant. EPCC Contractor is to justify his design at HAZID & HAZOP sessions, any modification as a result of HAZID & HAZOP, which EPCC Contractor cannot justify, shall be accommodated by EPCC Contractor at no cost to the OGDCL. After HAZOP study, EPCC Contractor will be responsible to carry out SIL study for all instruments and I/Os outside Compressor Skid. For design review meeting, HAZID & HAZOP sessions and SIL study, OGDCL/Consultant shall participate. Before the commencement of HAZID & HAZOP review, the EPCC Contractor shall submit a detailed procedure and methodology statement, and execution plan to OGDCL for approval.

OGDCL shall be given at least eight (08) weeks’ notice of the HAZID & HAZOP review such that OGDCL’s operations personnel should attend. EPCC Contractor shall make sure that all the recommendations of HAZID & HAZOP study are included in the design and implemented during installation of the project.

The following, but not limited to, documents must be reviewed in the HAZOP Study meeting:

- a. Basis of Design
- b. PFD(s) and H&MB
- c. Operating Control & Safeguarding Philosophy
- d. ESD and F&G system
- e. UFD(s)

- f. P&ID(s)
- g. C&E Matrix
- h. Plot Plan(s)
- i. Hazardous Area Classification Drawings

HAZOP study and documents will be reviewed in conjunction with other required document during SIL Study.

The EPCC contractor shall provide HAZID & HAZOP and SIL report for the OGDCL/Consultant review and approval. EPCC Contractor must ensure that all recommendations of HAZID & HAZOP and SIL study are implemented/ incorporated in the proposed design. The EPCC contractor shall incorporate all HAZID & HAZOP and SIL recommendations in P&IDs, C&E and any other design document and, provide close-out on HAZID & HAZOP and SIL recommendations provide final version of all the process design documents for the OGDCL/Consultant review and approval.

3.0 Mechanical Engineering

- 3.1** The Mechanical Engineering area shall include all design calculations, sizing, specification and selection of equipment including compressors, prime movers, vessels, exchangers, filters, piping, fittings, valves, insulation etc. of all Compression Stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP) as per Plot Plan. It will also include the development of requirements and specification for hoist, lifting beams, trolleys, etc., as required. EPCC shall have responsibility to collect all the necessary information from FIELD/PLANT and verify as-built of existing facility prior to commencing Brownfield related detail design work.
- 3.2** The Contractor shall review and approve all vendors' drawings and other documents to ensure compliance with specification, and witness testing of equipment in the vendors' works, prior to shipment. The Contractor shall review both the Supplier and Vendors' drawings to ensure that adequate operating and maintenance access is provided to all

equipment. Contractor shall ensure to provide proper access/approach for operator to operate any Isolating Valve/Control valve/ESDVs/BDVs/PSVs etc.

- 3.3** Contractor is encouraged to shop fabricate and skid mount as much of the equipment as practical to minimize field construction. The tropical weather conditions experienced in Pakistan may put a significant constraint on field construction work. The Contractor shall ensure to the extent possible that most of the processing unit can be shop fabricated and assembled, then the necessary disassembly done to permit shipment to the compression facility.
- 3.4** The Mechanical features shall incorporate high quality equipment in accordance with the best industry practices and shall embody the Specifications for the equipment included herein. The equipment and mechanical features specified are intended as a guide to the building of an economic, reliable and safe plant.
- 3.5** Contractor shall develop detailed 3D layouts of all compression stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP) with piping, which clearly show the skid mounted construction of the packages, layout of piping sleepers / supports, pipe rack, steel structures and piping of the compression facilities. The 3D layouts of all Compression Stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP) shall be submitted to the OGDCL/Consultant for their review and approval.
- 3.6** Mechanical engineering works shall include but not limited, to the following:
- a. Mechanical design philosophies
 - b. Provide equipment List including process and auxiliary equipment and long lead items.
 - c. Provide specification for piping, fittings, valves, insulation, etc.
 - d. Provide all equipment specification and mechanical design data sheets.
 - e. Sizing of mechanical equipment.
 - f. Establish fire Protection requirement for equipment, structure, etc and provide design, specification and data sheets for the same.
 - g. To perform material selection study based on corrosion management philosophy and expected life of compression facility. EPC Contractor will ensure metallurgy of

compression packages, its associated equipment/items/system and all allied accessories to be in-line / compliance with fluid composition and operating parameters of the system.

- h. Provide Tie-in schedule for tie-in of KPD –TAY Compression Project with the existing KPD-TAY GPP, Tay-03 GGS & Thora-deep-03 GGS) (wherever require) including tie-in methodology.
- i. Provide specifications of all equipment/systems of, but not limited to, the following:
 - Gas engine driven reciprocating compressors with blow case vessels
 - Instrument Air System (Instrument Air Dryer, Instrument Air Compressor etc).
 - Vent Stack & Knockout drum
 - Fire Fighting/Protection
 - Piping, pipe fittings, valves and all piping components
 - Raw Water & Fire Water Tank
 - Fire Water Engine/Motor Driven Pump & Jockey Pump
 - Raw Water Supply Pumps & Bore Pumps
 - Trim Coolers
 - LP/HP Slug catchers
 - LP Condensate Pumps
 - Any equipment's mentioned in Plot Plan of Compression Stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP)
- j. Provide design details of all skid specifications including sizing, fabrication, painting etc. and their mechanical drawings.
- k. Provide compression facility piping design documents such as, piping plans, piping layout tie-in study and design, drawings and material take off piping material and class specification, piping isometrics, 3D modeling, mechanical structures & foundations design, pipe supports MTO and weight estimates, fabrication, painting, insulation, stress analysis reports etc. Consultant shall provide list of applicable codes and standards.
- l. Any other aspect related to mechanical design and engineering.
- m. Provide details related to static and dynamic load stress analysis including piping for equipment such as compressors, vessels, heat exchangers etc.

3.7 Mechanical equipment design, sizing and arrangements shall provide for full compression facility capacity, unless otherwise specified. If Contractor is able to devise mechanical arrangements acceptable to OGDCL/Consultant, which will result in reduced costs, while retaining required features of dependable operation with proven equipment, OGDCL/Consultant may consider such improvements.

3.8 The attached plot plans show the minimum/stringent requirement with respect to spacing. However, Contractor has to ensure compliance with OGRA standards. All equipment, pipe racks, Pipe Bridge, pipe sleepers must be placed in aesthetical order with the intent of minimum piping routes, ease in maintenance and adequate vehicles (crane) movements.

A steel structure shed shall be provided on the compressor packages and Generator Shed along with lifting telfer system shall be designed considering the heaviest part of the Compressor/engine/Genset that shall be lifted for maintenance purpose. EPCC Contractor shall also include the design, supply & installation of fixed spray system in each Compression packages.

A steel structure shed shall also be provided on the new Instrument Air System, pumps and local control panel of Reciprocating Compressor Package.

3.9 EPCC Contractor shall also submit detailed calculation, native software file and software analysis report of all steel structure sheds for review.

3.10 Contractor shall provide detail structural & civil foundation calculation of Vent stack along with its native software files for our review and approval.

3.11 The attached fire water layout drawings show the minimum requirement of Fire hydrant & monitor. However, it shall be finalized by Contractor during detail engineering phase. Further please refer to General Specification of Fire Water System.

3.12 Contractor shall provide all details drawings and Vendor/Supplier drawings for OGDCL/Consultant review and approval.

3.13 Contractor shall provide walkways, crossover for easy operator movement wherever required in all Compressor Stations. Structural Analysis of pipe supports, sheds, platforms,

piperack & Vent stack shall be performed by EPC Contractor on Staad pro software and Contractor shall submit the detail report (along with the native staad file) to Consultant/OGDCL for review and approval.

- 3.14** Hard standing area for crane movement for KPD Compressors at GPP and Thora Deep-03 GGS shall be provided by EPCC.

4.0 Electrical Engineering

The Contractor shall be responsible for the design, procurement, storage, installation, commissioning and testing of the complete **KPD-TAY Compression Project** electrical system.

The Contractor shall be responsible for complete design and engineering works including but not limited to validation of design documents, performance/system study of Electrical Equipment, System and Selection for Power Distribution system, verification of the provided design data, electrical design calculations, specifications/ datasheets, drawings etc. The Contractor shall also be responsible to identify the complete requirement in order to ensure the reliable and safe continued operation of the electrical system of KPD-TAY Compression electrical system. Any work or detail, which is not expressly set forth, but which is necessary to complete the job to the true intent and meaning of this Scope, shall be furnished by Contractor as though specifically noted herein, without extra charge. For Electrical Works Package please refer **Volume-II.C**.

Any part or aspect of works not expressly detailed in the document furnished to the contractor or not specified in the tender but necessary for the proper execution and completion of works according to the provision of tender document and necessary to ensure that works are fit for the purpose for which they are intended (which shall include not only ensuring that the performance guarantee are satisfied but also that the facilities remains capable of satisfying the applicable performance and operating expectations throughout their intended life) shall be performed by contractor and are deemed to be included in, and to form a part of, the contractor scope of works.

The contractor shall visit and examine the site and has fully satisfied itself before signing this contract as to the location, physical condition, scope of work that involved, in general, it is

the responsibility of contractor to obtain all the additional information as to risks, contingencies and other circumstances, which may influence or affect the works. The Contractor shall also check and verify the design and data presented to him, clarifying any inconsistencies and obtain any additional information, by site visits that may be required to complete the works.

The contractor is fully aware that the works are to be performed in connection with existing facility, therefore, contractor shall ensure that works to be performed in such a manner as will ensure compatibility with the existing system and will further ensure that operations of existing facility are not disrupted in any manner and they are able to operate the fullest extent of their capabilities.

The contractor shall not be relieved of any of its obligation under the tender document/contract as a result of any act or omission, examination, review, inspection, approval or instructions, or consent or failure to examine, review, inspection, approve or instruct or consent, by the client (OGDCL) or Client representative. Where, any errors or omissions in Drawings/documents/design specification which may arise/surface at any stage of the project, they shall be made good by the contractor entirely at its own cost and time, irrespective of any consent, with the approval of Consultant and OGDCL.

Equipment sizing and design will be based on the individual “worst case” for each equipment. The detailed design shall comply with the requirements set forth in the design codes, recommended practices, safety design codes and other specification as provided in the Basic Design Package documents. Due care shall be exercised for the ease of construction and expansion, commissioning and start-up, repair and maintenance, and safety to operate under all conditions. Consideration shall be given to the design of facility in order that no environmental hazards are created to upset the ecology of the surroundings.

In general, the design shall include sizing of equipment, design for safe installation & operation, and preparation & issue of specifications, data sheets, calculations, design and construction drawings for the complete electrical system which shall include, but not be restricted to, the following.

- a. Calculation of electrical load and preparation of load list/ load schedule.
- b. Design, sizing, selection and supply of complete electrical system including

distribution and hookup scheme, IEC Type tested Low voltage Switchgears & Motor Control Centers (MCC), Gas and Diesel Generators, electrical motors, power & control cabling, Uninterruptible power supply system, Lighting & Small power outlets systems/distribution boards, Earthing system, Lightening protection, Electrical heat tracing, Cathodic Protection system, building electrification, package electrical equipment, etc. Complete in all respects.

- c. Design, supply and Installation of Low voltage Switchgear and Motor control Center.
- d. There shall be supply and installation of 400/230V, 50 Hz, on-line Dual redundant complete UPS system with separate battery banks for each unit, along with distribution board for load distribution. Each Battery bank will be sized for 60 minutes duty with 100% load for each unit. A UPS system shall be utilized for the Instrument Control System, various essential and critical services. 20% spare margin in UPS rating shall be provided to accommodate future additions.
- e. Lighting system activity including but not limited supply and installation of lighting distribution board, light fixtures, lighting poles, cables, cable glands, receptacles etc. for each facility shall be provided. Lighting study shall be carried out and provide the number, location and distribution of luminaries within the New compression and allied facility for a safe working environment for 24 hours plant operation. Lighting is to be provided as follows:
 - Area Flood Lighting
 - Skid Lighting
 - Emergency Lighting
 - Perimeter / Boundary wall lighting

Lux Level given in applicable API standards shall be followed.

- f. Power supply to luminaries shall be at 230V, 1-phase 50Hz, derived from strategically placed new lighting distribution boards (LDBs) supplied from the plant main distribution system.
- g. The emergency lighting design shall provide sufficient illumination to indicator safe escape routes for operating personnel from all plant areas, as well as providing illumination at essential control positions. Emergency lighting shall form a minimum of 30% of the total number of luminaries.
- h. Earthing system activity including but not limited to supply and installation of

Earthing electrode, earthing plates, cables, cable connectors for plant shall be provided.

- i. The Contractor shall also design, supply and install a comprehensive lightening protection system in accordance with IEC 62305. The lightning protection system shall be provided with separate ground rods, one for each down conductor irrespective of study results.
- j. Cabling activity including but limited to preparation of all cable trenches cable laying, backfilling required for all power and earthing works shall be performed at plant.
- k. Preparation of single line diagrams, schematic, cable termination drawings and Control circuit drawings, MCC –Control Room interface & interconnection drawings, power & interlocking philosophy, Building Electrification drawings, Junction box wiring diagrams, system studies (load flow, short circuit, cable study, relay co-ordination and transient analysis study), Generator sizing, UPS & battery Sizing etc. Development of loop wiring diagram / interconnection from field to main equipment/ controller in Control room.
- l. Minimum following fault studies shall be conducted for all facilities to ascertain the values of power and short circuit at switchgear/MCC comes under the subject project.
 - Short circuit Study.
 - Load flow study
 - Relay co-ordination study.
 - Transient analysis study

Note: Load flow and short circuit study of existing main plant only is available (in pdf format) and will be shared with the successful Contractor after award of the contract. Further, please note that aforesaid studies were conducted at earlier stages of the past projects, therefore, as far as reasonable, updated values to be considered and any missing value to be obtain from site by the Contractor at their own. In the absence of non-availability of actual value typical will be considered. No price impact will be consider at later stage.

Aforesaid studies shall be carried out through Licensed Electrical Software i.e. ETAP or equivalent. Also, final report's soft copy / software version shall be also shared with client for their record.

- m. Preparation of specifications and datasheets for all the electrical equipment like Generators, LV Switchgears/ MCC, electric motors, field mounted motor control stations (MCS), UPS system, lighting system, power cables & control cables, cable glands, emergency stop push buttons, cathodic protection system, heat tracing system, earthing system, lightening protection system, distribution boards/ panels etc.
- n. Calculations for cable sizing and preparation of Cable schedule. The cable schedules shall detail all electrical power, control, indication and alarm cables of all voltages. Cable details shall also include individual cable lengths, to and from locations with equipment references, cable types, sizes and number of cores.
- o. Preparation of Layouts including Power & Control Cable layout, Earthing system layout, lighting system layout, lightening protection, Cathodic Protection system layouts, electric heat tracing drawings/ layouts, standard details etc.
- p. Preparation of building electrification drawings for New Buildings. This shall include supply and installation of all electrification material which include but not limited to cables, light fixtures, ceiling fans, exhaust fans, bracket fans, lamps, intercoms, clamps, flexible PVC insulates copper conductor, earth wire, socket outlets, switches, distribution board comprising of incoming/ outgoing MCBs with ELCBs, Split type ACs, etc.
- q. Development of Electrical installation specifications and Electrical Typical installation detail drawings.
- r. Preparation of Layout drawings for electrical switchgear/ MCC room showing equipment locations, cable trenches and cable support details, building services and building penetration requirements.
- s. Preparation of Instrument/ Electrical interface drawings and documents including layout drawings, instrument distribution board schedules and interface termination drawings.
- t. Preparation of list of items of tools required for maintenance and spare part list.
- u. Contractor shall develop equipment arrangement layout plans for MCC/ Switchgear

room. The sizing of equipment, short circuit rating, arrangement layouts and orientations provided with tender shall be considered as a minimum. EPCC may enhance further these requirement in view of detail engineering results without any additional cost and time.

- v. Preparations of electrical hazardous areas classification drawings in line with international codes, standards and regulations. This also includes selection and supply of electrical equipment in line with hazardous area classification.
- w. Design, supply & installation of all power, control, lighting, earthing, interfacing/signaling, lightning cables. This shall include all the supply & installation of material & works required for trenches, trays, conduits, as the case may be.
- x. Cathodic Protection system shall be provided as per scope/criteria defined in Doc# 0258-ELA-6500 Electrical Design Basis, section#4.9 for all new facilities i.e. storage tanks, buried pipes etc.

Further, please note that cathodic protection design engineer for this project nominated by the EPCC Contractor shall be minimum of NACE CP Technologist or / I-corr Certified having at least 10 years' experience. The Design engineer should have experience of design engineering and installation of minimum of 10 tanks and 50km of piping work. Complete design documents, calculation, drawings, and BOQ's shall also be vetted from third party/Vendor (from AVL) at EPCC Contractor's cost.

Contractor will conduct the following Design Calculations to demonstrate the adequacy of the power system design and to establish equipment rating:

- a. Load Flow
- b. RMS symmetrical short circuit fault level calculations
- c. Protection coordination study
- d. Motor Starting Analysis
- e. Cable sizing calculations and drum schedule
- f. Generator sizing calculations
- g. Lighting level calculations
- h. UPS & Battery sizing calculations

The Contractor shall, based on vendors' recommendations, develop a list of two years' operating spares. The Contractor shall seek approval of the electrical inspector as required in the local law/regulations.

The Contractor shall review and approve all vendors' drawings and documents to ensure compliance with specification, and witness testing of equipment in the vendors' works prior to shipment.

The Contractor shall be responsible for Factory Acceptance Test (FAT) / Site Acceptance Test (SAT) for the supplied equipment and material.

The Contractor shall be responsible for the installation and testing of all the electrical items. Complete installation material along with installation shall be included in Contractor's scope

Refer Electrical Design basis Document 0258-ELA-6500 for the design, selection of electrical equipment.

The Contractor will perform pre-commissioning performance testing, operation and commissioning of all electrical equipment and complete start-up of the KPD-TAY Compression project.

Contractor's scope of work described above is meant to highlight general and overall works/scope that may involve/require while executing the subject project. The following subsections provide detail description of work involved in each facility/wellhead. Note that any other associated works required for project completion shall be deemed to be included in the Contractor' scope of work, whether or not mentioned explicitly in the Tender Documents.

Nodal Compression at TAY-03 GGS & Thora Deep -03 GGS

The Electrical works will comprise at TAY-03 GGS & Thora Deep-03 GGS facilities but not be limited to the following: -

– Following studies/calculation shall be conducted:

- ✓ Generator sizing
- ✓ Load flow
- ✓ Short Circuit
- ✓ Voltage Drop
- ✓ Harmonic arc flash

- ✓ Transient stability
 - ✓ Motor starting analysis for considering plant largest motors
 - ✓ Device coordination
 - ✓ Cable sizing & voltage drop calculations and drum schedule
 - ✓ Lighting level calculations
 - ✓ UPS & Battery sizing calculations
 - ✓ Lightning Protection
 - ✓ Grounding/Earthing
-
- The electrical system consists of supply and installation of a Gas engine Driven Power Generation Package capable of catering facility total load and emergency diesel generator catering facility essential loads and provide black start facility. Plant Power Generation shall be based upon one running + one standby Gas Generator Sets + one essential Diesel Generator (400V, 3- Phase, 50Hz.) with synchronization & parallel operation provision, control and protection system & interlocking for overall plant load. The main generating units (Gas Engines) will use respective facility raw gas as a source of fuel supply, composition details of gas are given in respective specifications. Gas generators shall be supplied which shall be suitable for continuous operation on available gas composition. Generating units shall have a fully integrated control system housed within a freestanding panel. Generator control panels shall have the capability of load sharing and synchronization provision. Each generator shall be provided with dedicated control and protection panel.
 - Design, Supply, installation & testing of 400V Switchgear/ Motor Control Centers, Distribution Boards, etc.
 - EPCC Contractor shall develop equipment arrangement layout plans for MCC/ Switchgear room. The sizing of equipment, arrangement layouts along with safety & maintenance allowances and orientations provided with tender shall be considered as a minimum. Final sizing, orientations, arrangements meeting or exceeding mentioned requirement etc. shall be done by the Contractor during detail engineering.
 - Supply, installation and testing of anti-static rubber mat for electrical insulation to be installed in MCC room.
 - Design, Supply, installation & testing of power & control cables. Cabling activity including but limited to installation of cable trays & ladder as required, preparation of cable trenches cable laying, backfilling required for all power and earthing works shall be performed at respective facility.
 - Design, supply and installation of 400V, 50 Hz, double conversion dual redundant on-line UPS and complete with battery systems and distribution board. Each battery bank shall be sized for 60 minutes duty with 100% load. A UPS system shall be utilized for the Instrument Control System & various essential and critical services. UPS system shall be

installed in new Control room. EPCC Contractor shall also be responsible to provide all the interconnecting cables.

- Lighting system shall be designed, supplied and installed including but not limited to supply and installation of lighting distribution board, light fixtures, lighting poles, cables, cable glands, receptacles etc. for complete facility.
- Emergency lighting with battery backup of at-least 30 mints shall be provided at all strategic locations. Nos. of emergency lighting luminaries shall be minimum of 30% of the total number of luminaries.
- Earthing system shall be designed, supplied and installed including but not limited to design, supply and installation of Earthing electrode, earthing plates, cables, cable connectors, etc. for complete facility.
- Design, Supply, installation & testing of Industrial Power Sockets, motor control station etc.
- The Cathodic protection system shall be engineered and designed for the equipment requires corrosion protection within plant facility. Cathodic protection shall be based on impressed current method. The EPCC Contractor shall pre-design survey, investigate, soil testing, design, supply and install Cathodic Protection (CP) for fire & raw water storage tanks, closed drain and oily water network buried pipes etc. Also, CP system shall be provided for new buried flow line of approx.700 meter to tie the Thora Deep-1 at suction pressure of nodal compression (Refer P&ID no. 0258-PB-2108 note#19). Internal cathodic protection system shall also be provided in fire and raw water storage tanks.
- Design, Supply, installation & testing of a comprehensive lightening protection system in accordance with IEC 62305. The lightning protection system shall be provided with separate ground rods, one for each down conductor. The lightning protection shall be provided in Compressors area and MCC room irrespective of study results.
- Permission from electrical Inspector, Explosive Inspector & other local authority approvals if required.
- Design, Supply, installation & testing of complete building electrification material for all the buildings or porta cabins comes in respective facility. Preparation of building electrification drawings for new buildings i.e. MCC Room, Control /CCR room, Generator shed, FC living, security guard room, Pantry/Operator/Employee Room, workshop etc. This shall include but not limited to supply and installation of all electrification material cables, light fixtures, ceiling fans, exhaust fans, bracket fans, lamps, intercoms, clamps, flexible PVC insulation copper conductor, earth wire, socket outlets, switches, distribution board comprising of incoming/outgoing MCBs with ELCBs, split type ACs etc.
- The Contractor shall be responsible to design, supply, install and commission all the air conditioning system for MCC Room, Control / CCR room including battery room, Pantry/Operator/Employee Room and FC living. Air conditioning system shall be installed

and commissioned complete in all respect with all the wiring and accessories as per standards and engineering practice. The contractor shall provide calculations for Air conditioning system for new buildings or porta Cabins.

- An exhaust fan shall be provided in the Battery Room. Exhaust fan motors shall be type of protection Ex d or Ex e, Gas Group IIC, exhausting to the outside the battery room. Also the luminaries and convenience sockets shall be suitable for Zone-I Gas Group IIC. UPS vendor shall provide the detail report illustrating/calculating total amount of hydrogen evolved during normal as well as during abnormal operation & protections given/inherited in UPS to prevent thereof. Sufficient ventilation shall also be provided in order to prevent the hydrogen accumulation in excess of recommended value.
- Dismantling, relocation & installation of existing equipment, if any.
- Electrical equipment i.e. light pole, cable etc. that is/are installed in the area where new mechanical equipment or other to be installed, EPCC Contractor shall be responsible to relocate and reinstate the same equipment as per existing philosophy/purpose.
- The basic designs of the electrical system comprising of preliminary load list, preliminary SLDs, layouts and Equipment / Material specifications are included in the ITB document. The EPCC Contractor shall be solely responsible for the detailed design, sizing of all electrical Equipment and Materials, ensuring proper functional requirements of Equipment and Materials to be supplied under this Contract and the overall electrical system for the KPD-TAY Compression Project. The EPCC Contractor shall provide all vendor documents, drawings along with as listed in the scope of works and other drawings that may be necessary for the Works. These documents and drawings shall be subject to Consultant & OGDCL approval. Approval of the EPCC Contractor's design or drawings shall not relieve the EPCC Contractor of any of his obligations under the Contract.
- Foundations and all civil work for all electrical equipment therein, including the foundations for the lighting pole, LCS stand, Outlet stand, etc.
- Power supply and other interfacing requirements for the telecommunications, instrumentation and control systems, CP system and other systems shall be fully covered in the scope of Electrical Works.
- Inspection and Testing.
- The EPCC Contractor shall be responsible for the start-up and commissioning of all the electrical installations and shall be responsible for the proper functioning of the whole installations during the guarantee period.
- Power supply arrangement for existing equipment i.e. pumps, lighting and building etc. at TAY-03 GGS from new Power Generation and distribution system shall also be included in EPC Contractor scope. This shall include complete supply, install, testing and

commissioning of all electrical material that is required to re-instate the existing facility/system as per existing philosophy.

4.1 Front End Compression for KPD wells at GPP

The Electrical works will comprise at KPD GPP but not be limited to the following: -

- Following studies/calculation shall be conducted:
 - ✓ Load flow
 - ✓ Short Circuit
 - ✓ Voltage Drop
 - ✓ Harmonic arc flash
 - ✓ Transient stability
 - ✓ Motor starting analysis for considering plant largest motors
 - ✓ Device coordination
 - ✓ Cable sizing & voltage drop calculations and drum schedule
 - ✓ Lighting level calculations
 - ✓ UPS & Battery sizing calculations
 - ✓ Lightning Protection
 - ✓ Grounding/Earthing
- There shall be dedicated new Switchgear for this facility divided in two buses (Bus-A and Bus-B) and will be installed in existing MCC-5 (Supervisor Room). Power supply for the new Switchgear (BUS-A) shall be supplied from existing switchgear MCC (103-MCC-05, Bus-A, Panel#1, Space cubical) thru power cables and Power supply for the new switchgear (Bus-B) shall be supplied from existing switchgear mcc (103-MCC-05, Bus-B, Panel#11, Feeder no.61) thru power cables.
- Design, supply and Installation of Low voltage Switchgear and Motor control Center, which shall include the following as minimum;
 - Modification, supply, tie-in, installation of new 4P, 400A, withdrawable MCCB Module, along with metering & protections devices, increasing/addition of bus droppers etc. in existing switchgear MCC (103-MCC-05, Bus-A, Panel#1) as illustrated on to project single drawing and documents.
 - Modification work in the existing switchgear MCC (103-MCC-05, Bus-B, Panel#11, Feeder no.61) as illustrated on to project single drawing and documents.
 - Supply and installation of Low voltage Switchgear and Motor Control Center for FEC Compression facility at KPD GPP.

- EPCC Contractor shall develop equipment arrangement layout plans for MCC/ Switchgear room (supervisor room). The sizing of equipment, arrangement layouts and orientations provided with tender shall be considered as a minimum and proposed final sizing, orientations, arrangements meeting or exceeding mentioned requirement etc. shall be done by the Contractor during detail engineering.
- Design, Supply, installation & testing of power & control cables. Cabling activity including but limited to installation of cable trays & ladder as required, preparation of cable trenches cable laying, backfilling required for all power and earthing works shall be performed at respective facility.
- Design, supply and installation of 400V, 50 Hz, double conversion dual redundant on-line UPS and complete with battery systems and distribution board. Each battery bank shall be sized for 60 minutes duty with 100% load. A UPS system shall be utilized for the Instrument Control System & various essential and critical services. UPS system shall be installed in new Control room. EPCC Contractor shall also be responsible to provide all the interconnecting cables.
- Lighting system shall be designed, supplied and installed including but not limited to supply and installation of lighting distribution board, light fixtures, lighting poles, cables, cable glands, receptacles etc. for complete facility.
- Emergency lighting with battery backup of at-least 30 mins shall be provided at all strategic locations. Emergency lighting luminaries shall be minimum of 30% of the total number of installed luminaries.
- Earthing system shall be designed, supplied and installed including but not limited to design, supply and installation of Earthing electrode, earthing plates, cables, cable connectors, etc. for complete facility.
- Design, Supply, installation & testing of Industrial Power Sockets, motor control station etc.
- The Cathodic protection system shall be engineered and designed for the equipment requires corrosion protection within plant facility. The EPCC Contractor shall pre-design survey, investigate, soil testing, design, supply and install Cathodic Protection (CP) for closed drain and oily water network buried pipes etc.
- Design, Supply, installation & testing of a comprehensive lightening protection system in accordance with IEC 62305. The lightning protection system shall be provided with separate ground rods, one for each down conductor. The lightning protection shall be provided in FEC Compressors area irrespective of study results.
- Permission from electrical Inspector, Explosive Inspector & other local authority approvals if required.

- Design, Supply, installation & testing of complete building electrification material for new Control Room, Battery room & Operator Room building. Preparation of building electrification drawings for new Control Room, Battery room & Operator Room building. This shall include but not limited to supply and installation of all electrification material cables, light fixtures, ceiling fans, exhaust fans, bracket fans, lamps, intercoms, clamps, flexible PVC insulation copper conductor, earth wire, socket outlets, switches, distribution board comprising of incoming/outgoing MCBs with ELCBs, split type ACs etc.
- The Contractor shall be responsible to design, supply, install and commission all the air conditioning system for Control Room, Battery room & Operator Room building and existing MCC-5 (Supervisor room). Air conditioning system shall be installed and commissioned complete in all respect with all the wiring and accessories as per standards and engineering practice. The contractor shall provide calculations for Air conditioning system for new buildings and existing MCC-5 (Supervisor room).
- An exhaust fan shall be provided in the Battery Room. Exhaust fan motors shall be type of protection Ex d or Ex e, Gas Group IIC, exhausting to the outside the battery room. Also the luminaries and convenience sockets, ACs etc. shall be suitable for Zone-I Gas Group IIC. UPS vendor shall provide the detail report illustrating/calculating total amount of hydrogen evolved during normal as well as during abnormal operation & protections given/inherited in UPS to prevent thereof. Sufficient ventilation shall also be provided in order to prevent the hydrogen accumulation in excess of recommended value.
- Dismantling, relocation & installation of existing equipment, if any.
- Electrical equipment i.e. light pole, cable etc. that is/are installed in the area where new mechanical equipment or other to be installed, EPCC Contractor shall be responsible to relocate and reinstate the same equipment as per existing philosophy/purpose.
- The basic designs of the electrical system comprising of preliminary load list, preliminary SLDs, layouts and Equipment / Material specifications are included in the ITB document. The EPCC Contractor shall be solely responsible for the detailed design, sizing of all electrical Equipment and Materials, ensuring proper functional requirements of Equipment and Materials to be supplied under this Contract and the overall electrical system for the KPD-TAY Compression Project. The EPCC Contractor shall provide all vendor documents, drawings along with as listed in the scope of works and other drawings that may be necessary for the Works. These documents and drawings shall be subject to Consultant & OGDCL approval. Approval of the EPCC Contractor's design or drawings shall not relieve the EPCC Contractor of any of his obligations under the Contract.
- Foundations and all civil work for all electrical equipment therein, including the foundations for the lighting pole, LCS stand, Outlet stand, etc.

- Power supply and other interfacing requirements for the telecommunications, instrumentation and control systems, CP system and other systems shall be fully covered in the scope of Electrical Works.
- Inspection and Testing.
- The EPCC Contractor shall be responsible for the start-up and commissioning of all the electrical installations and shall be responsible for the proper functioning of the whole installations during the guarantee period.

4.2 Nodal Compression for TAY at GPP

The Electrical works will comprise at TAY GPP facility but not be limited to the following: -

- Following studies/calculation shall be conducted:
 - ✓ Voltage Drop
 - ✓ Cable sizing calculations and drum schedule
 - ✓ Lighting level calculations
 - ✓ Lightning Protection
 - ✓ Grounding/Earthing
- New pumps comes under this facility / area shall be powered from existing Switchgear/MCC (102-MCC-03) located in main CCR Building. Existing 02 nos. spare modules available in Switchgear/MCC 102-MCC-03 (i.e. Panel-3 (Bus-A) Module/Feeder F-10 (16A Breaker); and Panel-8 (Bus-B) Module/Feeder F-30 (16A Breaker) shall be utilized to supply new LP Condensate Pump Motors. Any modification required in existing starter modules shall be carried-out by the EPC Contractor.
- Instrumentation loads i.e. UCPs, control panel, workstations, printer etc. shall be supplied from existing UPS System Distribution board (DB 102-UPP-022) located in main CCR Building. Existing 05 no. of spare breakers (dual pole) in the UPS DB 102-UPP-022 shall be utilized in this regard. However, during detailed engineering stage, if it is emerged that modification works required in existing Distribution board then EPC Contractor shall be responsible to do the same without any additional cost & time.
- Design, Supply, installation & testing of power & control cables. Cabling activity including but limited to installation of cable trays & ladder as required, preparation of cable trenches cable laying, backfilling required for all power and earthing works shall be performed at respective facility.
- Lighting system shall be designed, supplied and installed including but not limited to supply and installation of lighting distribution board, light fixtures, lighting poles, cables, cable glands, receptacles etc. for this facility.

- New lighting Distribution board will be energized/ powered from existing Power Distribution board (located in old early facility area). In this regard, additional feeder / breaker as required shall be added in existing Power Distribution board. Complete modification work shall be carried out in a satisfactory manner.
- Emergency lighting with battery backup of at-least 30 mins in this facility area shall be provided. Emergency lighting luminaires shall be minimum of 30% of the total number of luminaires.
- Earthing system shall be designed, supplied and installed including but not limited to design, supply and installation of Earthing electrode, earthing plates, cables, cable connectors, etc. for this facility.
- Design, Supply, installation & testing of Industrial Power Sockets, motor control station etc.
- The Cathodic protection system shall be engineered and designed for the equipment requires corrosion protection within plant facility. The EPCC Contractor shall pre-design survey, investigate, soil testing, design, supply and install Cathodic Protection (CP) for closed drain and oily water network buried pipes etc.
- Design, Supply, installation & testing of a comprehensive lightening protection system in accordance with IEC 62305. The lightning protection system shall be provided with separate ground rods, one for each down conductor. The lightning protection shall be provided in FEC Compressors area irrespective of study results.
- Design, Supply, installation & testing of complete building electrification material for new Operator Room building. Preparation of building electrification drawings for new Operator Room building. This shall include but not limited to supply and installation of all electrification material cables, light fixtures, ceiling fans, exhaust fans, bracket fans, lamps, intercoms, clamps, flexible PVC insulation copper conductor, earth wire, socket outlets, switches, distribution board comprising of incoming/outgoing MCBs with ELCBs, split type ACs etc.
- Operator room shall be supplied from existing CCR building. It is EPCC Contractor's responsibility to arrange spare feeder in existing Switchgear/MCC in consultation with site personals / client during detailed engineering stage. Any modification work or additional components if required shall be provided by the EPCC Contractor at their own. Complete in all respect.
- Permission from electrical Inspector, Explosive Inspector & other local authority approvals if required.
- Dismantling, relocation & installation of existing equipment, if any.

- Electrical equipment i.e. light pole, cable etc. that is/are installed in the area where new mechanical equipment or other to be installed, EPCC Contractor shall be responsible to relocate and reinstate the same equipment as per existing philosophy/purpose.
- The basic designs of the electrical system comprising of preliminary load list, preliminary SLDs, layouts and Equipment / Material specifications are included in the ITB document. The EPCC Contractor shall be solely responsible for the detailed design, sizing of all electrical Equipment and Materials, ensuring proper functional requirements of Equipment and Materials to be supplied under this Contract and the overall electrical system for the KPD-TAY Compression Project. The EPCC Contractor shall provide all vendor documents, drawings along with as listed in the scope of works and other drawings that may be necessary for the Works. These documents and drawings shall be subject to Consultant & OGDCL approval. Approval of the EPCC Contractor's design or drawings shall not relieve the EPCC Contractor of any of his obligations under the Contract.
- Foundations and all civil work for all electrical equipment therein, including the foundations for the lighting pole, LCS stand, Outlet stand, etc.
- Power supply and other interfacing requirements for the telecommunications, instrumentation and control systems, CP system and other systems shall be fully covered in the scope of Electrical Works.
- Inspection and Testing.
- The EPCC Contractor shall be responsible for the start-up and commissioning of all the electrical installations and shall be responsible for the proper functioning of the whole installations during the guarantee period.

5.0 Instrumentation and Control Engineering

- 5.1** The Contractor shall be responsible for the engineering, procurement, supply, storage, installation, testing etc of complete instrumentation and control system of KPD-TAY Compression facilities.
- 5.2** EPCC Contractor shall be responsible for complete design and engineering works including validation of FEED documents, instruments and valves adequacy checks, sizing / selection of instruments, preparation of detail design documents specifications/ datasheets, drawings etc. The EPCC Contractor shall also be responsible to identify the complete requirement in order to ensure the reliable and safe continued operation of the instrumentation and control system for KPD-TAY Compression Facilities. Any work or detail, which is not expressly set forth, but which is necessary to complete the job to the true intent and meaning of this Scope, shall be furnished by EPCC Contractor as though specifically noted herein, without extra charge.
- 5.3** The detailed design shall comply with the requirements set forth in the design codes, recommended practices, safety design codes and other Specification as provided in the Basic Design Package documents and good engineering practices. Due care shall be exercised for the ease of construction and expansion, commissioning and start-up, repair and maintenance, and safety to operate under all conditions. For Instrumentation and controls Works, please refer to FEED Package Volume-IIID.
- 5.4** Preliminary adequacy checks of the Instrument and valves have been carried out and adequacy results are mentioned in the Process Equipment Adequacy Report Document No. 0258-A-1009 attached with the Tender Package; however EPC Contractor shall carry out detail adequacy checks of the same instruments and valves mentioned in the provided adequacy Study Report during detail engineering and if any instrument and valve found inadequate, EPC Contractor shall supply and install new instrument and valve with complete cabling and termination. The EPC Contractor shall share the adequacy results with Consultant & OGDCL for review and approval.
- 5.5** EPCC Contractor shall check and verify the design and data presented to him, clarifying any inconsistencies and obtain any additional information, by Consultant & OGDCL or site

visits that may be required to complete the works. The Contractor shall acquaint himself fully with the existing conditions and limitations at site and all works necessary to complete the project.

- 5.6** EPCC Contractor shall review and approve all vendors' drawings and documents to ensure compliance with specification, and witness testing of equipment in the vendors' works prior to shipment. Final drawings and test reports shall be submitted to Consultant & OGDCL for their record.
- 5.7** EPCC contractor is responsible for Supply and installation of complete Instrumentation and Controls in accordance with but not limited to the basic requirements as mentioned in the project documents including Design Basis, Specification for General Instrumentation, Specification for Instrument Installation, P&IDs and relevant project documents..; however the project Documents/Specifications and Drawings do not relieve the Contractor of any responsibility to provide equipment and services that are suitable for the intended duty.
- 5.8** Complete Package and Off-Package instruments shall be supplied and installed by EPCC Contractor. EPCC Contractor shall consider 2oo2 (2 out of 2) voting system and configuration for all Instruments (transmitters & switches) serving process shutdown in compressor package. Voting logic shall be applied to minimize the occurrence of complete loss of production caused by single instrument (transmitters & switches) fault or spurious trip shutdown. Also Maintenance Override Switch (MOS) bypass system shall also be configured for each of the variables that causes a shutdown sequence to start or for maintenance, calibration, etc. under password protection.
- 5.9** EPCC Contractor is responsible for Supply and installation of fire and gas detectors and devices for complete compression area and within Compressor Package Skids.

Basic engineering for selection of F&G Detector and devices for all facilities has been carried out at FEED stage and Preliminary F&G Detector quantities and locations have been shown in the project respective F&G detector layout drawing, however EPCC contractor shall carry out a detailed F&G mapping study for finalization and revalidation of the F&G detectors quantities, locations, height and coverage for the complete area of all

facilities this will also include the fire and gas detectors study and installation within the Compressor Package Skids which is not shown in F&G detector layout.

- 5.10** Complete monitoring and control of each Compressor Package shall be through dedicated PLC based Unit Control System. The Compressors PLCs shall meet the requirements mentioned in Specification for Package Control System (Document No. 0258-IMA-6004-0) and relevant project documents.
- 5.11** Each Compressor package shall be supplied with control panel mounted touch screen type HMI/MMI for monitoring and controls from field.
- 5.12** New industrial type dedicated Operator and Engineering HMI Workstations shall be supplied, configured and installed in plant existing control room for remote operation, monitoring and control. New One Operator and One Engineering Workstations shall be used as common for individual Compression facility. Refer Tender documents “Control System Architecture Drawings” of all four facilities for further information.
- 5.13** PLC of each Compressor package shall communicate with the Operator and Engineering HMI Workstations in Control room over dual redundant Ethernet/Fiber Optic communication link. Establishment of above mentioned communication link, complete supply and installation of communication equipment and accessories including cables, Switches, Connectors etc shall be in EPCC Contractor scope.
- 5.14** Each Compressor package control panel shall be installed with a Selector Switch with Local & Remote option to either operate compressor from field through Panel mounted HMI or remotely through Operator/Engineering Workstations from Control Room.
- 5.15** Below mentioned signals from/to the Compressor packages PLCs shall be hardwired interfaced with Plant Safety System (new ESD-3 system).
 - DI Signal (Package process Shutdown signal to Central Control System).
 - DI Signal (Package F&G Shutdown signal to Central Control System).
 - DI Signal (Package Status signal to Central Control System).
 - DO Signal (Shutdown Signal from Plant ESD System).

- 5.16** EPCC Contractor shall evaluate the facilities central control systems including DCS and ESD Systems at KPD-TAY GPP and RTU at TAY-3 GGS along with associated workstations HMIs and all communication equipment during pre-bid Site visits and identify all necessary modifications required at facilities end to incorporate new changes after addition of equipment under this project. Complete Hardware and software modification works required in Plant existing Central Systems (DCS, Safety System & RTU) and associated HMIs for new installations under this project shall be included in EPCC Contractor scope. This shall also include supply of any hardware and software for mentioned modification works. This shall also include the configuration of Cause & Effect of each facility into respective Central and Package Control systems. EPCC Contractor will make sure that addition of any hardware & configuration with existing DCS System and ESD System will not affect ongoing Plant operations and serial communication.
- 5.17** DCS-2 System shall be used for interfacing all off-package signals etc. as mentioned in project I/O list Doc # 0258-IMA-6010-1. Complete Hardware and software modification works required in DCS-2 and associated HMIs for new installations under this project shall be included in EPCC Contractor scope. This shall include supply of redundant controllers, I/O modules, redundant power supplies, communication modules, other accessories etc. complete necessary hardware and software modification works in accordance with the existing System architecture and philosophy. However, bidder may evaluate the existing DCS-2 system (ABB PM864) and associated hardware during pre-bid Site visits and identify any necessary modifications required at facilities end to incorporate new changes after addition of equipment under this project.
- 5.18** EPCC contractor is responsible for complete Design, Supply and installation of New PLC based extension panel for existing ESD System as ESD-03 with redundant controller, I/Os modules, redundant power supplies and other accessories similar to existing ESD System complete in all aspects as per the basic requirements mentioned in this document and relevant project documents / drawings. EPCC contractor shall consider minimum of 25% spares to the actual I/O counts and 60% CPU loading before designing new ESD extension system. The existing installed ESD system is of ABB PM865 and therefore same Make/Model and architecture shall be preferred for new extension panel. Existing ESD System Specification document shall be shared with the successful bidder.

- 5.19** EPCC contractor is responsible for dismantling of existing instruments LCV-5103 installed at downstream of existing slug Catcher (SC-5103), BDV-4104 and PDCV-4010 installed at upstream of existing slug Catcher (SC-4101) with complete installation material. Existing cables for LCV-5103 and BDV-4104 shall be re-used if are in healthy conditions; however EPCC Contractor shall also dismantle and rolled back the existing cables of PDCV.
- 5.20** Existing Drain from SLR relocated to new Process drain PIT (T-560) at TAY-3 GGS Nodal Compression facility along with complete instrumentation and valves. Instruments are already configured in Plant existing DCS system, EPCC Contractor scope shall only include the Supply, Laying, Termination and Loop Testing of new Instrument cables from field to Plant existing DCS System/Marshalling cabinets in Control Room with cable glands, shrouds, cable lugs, cable tagging, cable dressing with cable ties at both end of the termination.
- 5.21** All Compressor Package I/Os, instruments, fire and gas instruments/devices shall interface with the respective Compressor packages PLC.
- 5.22** All Off-Package I/Os, instruments, fire and gas (not covering compressors) instruments/devices outside the compressor skids shall interface with the facility Central Control System (DCS-2, ESD-3 or RTU). Refer Tender documents “Control System Architecture Drawings” and I/O List of all four facilities for further information.
- 5.23** New Instrument Air Compressor and Dryer Package shall be supplied and installed by EPCC Contractor. EPCC Contractor scope includes the supply and installation of all instrumentation & controls for Compressor and Dryer Package. Instruments, Valves, control system and Graphical User Interface HMI/MMI shall be same as installed in existing air compressors and air dryer.
- 5.24** Hardwired Start/Stop signals between new Instrument Air Compressor panel and facility central control system (RTU) shall be scope of EPCC contractor accordingly.

- 5.25** Manual Selector and START/STOP switches shall also be provided with new air compressor package to select and START/STOP the compressor as lead or lag manually from the field.
- 5.26** Provision for soft communication for interfacing Instrument Air Compressor package controllers with facility central control system (RTU) shall also be in EPCC Contractor scope.
- 5.27** Supply and installation of Building Addressable Fire Alarm System including Fire Alarm Panel, detectors including smoke detectors (ionization & photoelectric type), Heat detectors, Manual Call Points, Sounder and Beacon along with complete cabling, wiring and installation material shall be in EPCC Contractor Scope. The Addressable Fire Alarm System shall be installed in all new building including at all facilities, this will include Admin building, residential buildings, Control room, battery room MCC etc. This also include the supply and installation of building Addressable fire alarm system at existing MCC-5 (Supervisor room) at KPD-TAY plant GPP. The Addressable Fire Alarm System Manufacturers including Honeywell, Techno-Control, MSA, Det-Tronics, Drager, and Gents shall be preferred.
- 5.28** EPCC Contractor is responsible for Supply, Laying, Termination, Tagging and Loop Testing of all instrument and control Cables (single pair and multi-pair) from Skid/Packages to Skid/field Junction boxes and from Skid/field junction boxes to facilities control rooms till marshalling/control along with cable glands, shrouds, cable lugs, cable tagging, cable dressing with cable ties at both end of the termination. All instrument and controls cables shall be laid in accordance with but not limited to the Project Documents & Drawings.
- 5.29** EPCC Contractor shall be responsible for constructing trenches for cable laying, road crossings etc. and foundations and support where required for instrument, f&g detectors and devices mounting and installations.
- 5.30** Supply and installation of complete installation materials such as impulse tubing, tube-fittings, valves, G.I conduit and supports, cable glands, all type of consumables and

accessories for mounting all instruments (supports, pipe stanchions, brackets, supports, foundations etc) for all instruments installation is in EPCC Contractor scope.

- 5.31** Section 14.6 lists the documentation that will be provided by EPCC Contactor as a minimum.

6.0 Civil and Structural Engineering

- 6.1** The EPCC Contractor shall undertake the complete design of the civil, structural, architectural, external works, underground services and drainage for the Project. The EPCC Contractor shall prepare and submit basic and detailed calculations, specifications, design and construction detailed drawings for foundation of equipment & other items, drainage systems, roads, paving, pipe supports and sleepers, structures & access steel works etc.
- 6.2** The Civil & Structural Design and construction shall include but not limited to the development of Plot Plans, Design of Equipment foundations, Earth works, Boundary wall, Fencing, Security Towers, Offices, Access roads, Paving, Structures, Crossovers, Road crossings, Trenches, Walkways, Stairways, Pipe supports, Pipe sleepers, Pipe racks and Buildings & Sheds (RCC, & Porta Cabin) etc.
- 6.3** All other works, which are necessary to provide safe & efficient design and construction of the Project, tie-in & interfacing works shall also be the responsibility of the EPCC Contractor.
- 6.4** The EPCC Contractor shall undertake the detailed engineering and may be required to provide or develop any data, drawings and specification etc. additional to that provided or referenced in this document.
- 6.5** The EPCC Contractor shall undertake the complete design of the civil, structural, architectural, external works, underground services, building services and drainage, including the process area, offsite and utilities areas, interconnections and for the construction requirements and other areas specified elsewhere in this document.
- 6.6** The EPCC Contractor shall prepare and submit basic and detailed design calculations and construction detailed drawings for foundation of equipment & other items, drainage systems, roads, culverts, paving, buildings, pipe racks & sleepers, tanks, process structures, access steel works, fencing and gates, access gate and boundary wall etc.
- 6.7** The design of drainage, pipe sleepers, Roads and other civil or structural facilities with an interface with existing facilities must be such that interfaces are satisfactory e.g. levels are consistent and specifications are compatible

- 6.8** The EPCC Contractor shall provide full site drainage to cater for firewater, storm and surface water run-off, and equipment and process areas spillages.
- 6.9** The EPCC Contractor shall also undertake additional survey work he considers necessary to verify the soil, survey and other data provided by OGDCL. The additional survey work would include Detail survey and Soil investigations etc, depending upon the requirement of works included in EPCC Contractor's scope. All relevant documents such as levelling & grading plan(s) and foundation design etc. should be developed in accordance with the verified Survey and Soil Investigation Report(s).
- 6.10** The EPCC Contractor should note that certain engineering documents are subject to approval by Consultant & OGDCL and it is the EPCC Contractor's responsibility to obtain such approvals.

7.0 Piping Engineering

- 7.1** Piping should be design in a way that it does not obstruct gangways and leaves enough head room entrance. Aspect of maintenance and shutdown (ATA) major work should also be kept under consideration. If such requirements are not incorporated, the OGDCL/Consultant shall have the right to have such piping modified at Contractor's cost. The cost of such modifications by OGDCL shall be deducted from any Contractor's invoice or any payments due under the CONTRACT during installation and construction.
- 7.2** The Contractor shall be responsible for providing all the Piping engineering design and construction for the compression facilities, including all on-skid and off-skid pipe work. Piping Engineering and Design shall include piping studies, including tie-ins of all skid mounted Unit, tie-ins where required / approved by the OGDCL/Consultant with the existing plant, development of equipment layouts and plot plan, and preparation of specification for all Compression Stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP) and equipment.
- 7.3** The scope shall include calculation of anchor loads for structures and equipment nozzles, performance of stress and other piping calculations, preparation of general arrangements, piping plans, isometrics, pipe crossings, development of line list and support schedule, development of piping tie-in drawings with details.
- 7.4** The Contractor shall design, specify, procure and install insulation, as deemed necessary, for personnel protection thermal insulation and acoustic control, at all required locations.
- 7.5** Complete Piping Flexibility analysis of the hot and cold lines. All line equal to greater than 2" dia. and have temperature equal to or greater than 50 degree Celsius OR temperature less than 0 degree Celsius must be stress analyzed. Detailed calculations must be submitted by the Contractor for OGDCL/Consultant review and approval. Stress analysis must also be performed for dynamic loads of compressor and other rotary equipment where ever required.
- 7.6** All skids piping shall be designed in such a way that it terminated to edge of piping skid with a flanged connection for inter skid or plant piping connections. Connections at boundary limit of the skids must be designed stress free. Similarly all drains and flare

connections must be terminated to respective headers which subsequently provide a common out let from skid.

- 7.7** Contractor shall design piping within the scope of this project as per relevant code and standards as well as incorporating the OGDCL's existing practices.
- 7.8** Contractor shall perform the complete stress analysis of the piping. The stress analysis report along with the native Caesar file shall be submitted to the OGDCL/Consultant for review and approval.
- 7.9** As KPD-TAY Gas Processing Plant (GPP) & Tay-03 GGS is an operational plant, so field joints shall be minimum. Pipe spools shall be pre-fabricated at shop and joined through flanged connection.
- 7.10** Piping Engineering & Design shall include piping studies, development of equipment layouts and plot-plan, and preparation of specifications for all Compression Stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP) and equipment. The EPCC Contractor shall be responsible for the design of firewater network, close drain network and oily drain network of Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP. The EPCC Contractor shall also be responsible for any re-location of and piping (above ground or buried) due to any modification.
- 7.11** EPC Contractor shall design Storm water, sewer water and process drain systems for TAY-03 GGS & Thora Deep-03 GGS Facility and for Compression Stations for TAY & KPD at GPP tie-ins with the existing system shall be in EPC Contractor scope.
- 7.12** UCP of all compressors must be installed on separate foundations adjacent to compressor skids in order to avoid vibration.
- 7.13** A single oily water pit for of Tay-03 GGS Facility (both existing and new compression area) & Thora Deep-03 GGS Facility (new compression area) shall be developed by EPC Contractor along with a pump with associated piping for transfer it to Tank bowser.

7.14 PIPELINE ENGINEERING

7.14.1 The Contractor shall provide services including but not limited to Engineering, Procurement, Construction, Pre-commissioning, Commissioning, Testing of flowline of following:

- a. The right of way of Thora Deep-2 Flowline is passing adjacent to the Thora Deep-3 GGS Location, EPC Contractor shall re-route Thora Deep-2 Flowline to the Thora Deep-03 GGS and also the discharge header of Thora Deep-3 GGS will be connected with the existing Thora Deep-2 flowline that is going towards KPD-TAY GPP, Refer P&ID # 0258-PB-2108.
- b. EPC Contractor shall dismantle the 700 meters (approx.) of existing Thora Deep-1 Flowline after Point "A", (marked in As-built Flowline drawing, this flowline is going towards KPD-TAY GPP, tentative distance from Thora Deep-1 wellhead to KPD-TAY GPP=9.68km). Inspection of the existing pipeline shall be performed by EPC Contractor and report shall be submitted to Consultant/OGDCL for review and approval. In case of damage spool, new pipeline shall be supplied by EPC Contractor.

This dismantled pipeline shall be installed (Engineering, Construction, Pre-commissioning, Commissioning, Testing of flowline) on existing ROW of Thora Deep-2 Flowline from Point "A" to Thora Deep-3 GGS (Tentative Distance of flowline from Point "A" to Thora Deep-3 GGS is 700meters).

The tentative length mentioned is just for estimation purpose, however, EPC Contractor shall be responsible to install the flowline of Thora Deep-1 upto Thora Deep-3 GGS.

7.14.2 A 3-Layer Polyethylene (3LPE) corrosion protection coating is proposed for the steel pipeline system. Welding and welding related requirements of the following codes and standards shall be considered part of but subject to the more stringent provision of these specifications:

API 1104 latest edition (Standard for welding pipelines and related facilities).

American National Standard Institute ANSI B31.4 (Latest edition).

ASME Code - Section IX welding / brazing qualification.

- 7.14.3 Prior to starting of production welding, a welding procedure shall be established in accordance with API 1104, Standard for welding of pipelines and related facilities, latest edition, and shall be approved by the COMPANY/COMPANY Representative.
- 7.14.4 Approved pipe welding procedure shall be recorded in detail as outlined in API Standard 1104 and be adhered to during subsequent construction. The Contractor shall obtain a certificate of qualification of welders, from the COMPANY/COMPANY Representative, before any welding is carried out on site
- 7.14.5 All welding electrodes furnished and used by Contractor shall be of an approved type and quality suitable for pipeline welding acceptable to COMPANY/COMPANY Representative. All welding electrodes found to be deteriorated, defective, or otherwise damaged shall be rejected and prohibited from use on the pipeline.

8.0 Fire and Safety Engineering

- 8.1** The EPCC Contractor shall be responsible for the design of all Fire and Safety Systems for New Compression Facilities/Stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP). The Fire and Safety Area shall include involvement in all safety related aspects of the design, including development of the plot plan, control & shutdown philosophy, development of fire & gas detection philosophy, Design of firefighting system, layout and specification of firefighting systems, etc., to ensure that the plant safety systems comply with relevant codes and recommended practices. The facility shall be provided with the following safety facilities:

- Emergency shutdown system
- Fire & gas detection
- Firefighting system.
- Firewater distribution system including, as a minimum, firewater hydrants/Monitors.
- Requirement of oscillating foam monitors at strategic positions or foam pouring system for compressor packages (if necessary).
- Hand held portable firefighting equipment
- Personnel escape routes and warning signs
- Safety showers, douches and eyebaths (if required)

- Safety distances will be established by the EPCC Contractor according to Pakistan Petroleum Act, 1934, NFPA. The EPCC Contractor will also provide the best international guidelines on equipment safety distances for fire and safety.

9.0 Specific Design Requirements

9.1 Design Philosophy

The detailed design shall comply with the requirements set forth in the design codes, recommended practices, safety design codes and other specification as provided in the Basic Engineering Design and good engineering practices. Due care shall be exercised such that the facilities afford ease of construction and expansion, commissioning and start-up, repair and maintenance, and safety to operate under all conditions. Consideration shall be given to the design of facilities in order that no environmental hazards are created to upset the ecology of the surroundings.

It is the OGDCL's intention that as far as possible the plant facilities shall be designed and constructed in skid form, in order to minimize onsite construction. It is the EPCC Contractor's responsibility to ensure that the layout and design within the packages complies with all the requirements of these specifications and documents, and is consistent with good on-shore engineering practice.

9.2 Design Margins & Available Redundancy

In general an overall ten percent (10%) design margin shall be applied to the Compression facilities of KPD-TAY Compression Project. The overall design margin is for the purpose of ensuring that plant will operate steadily at design capacity and still have a small margin for controllability.

Equipment sizing and design will be based on the individual "Worst case" size for each piece of equipment.

9.3 Codes and Regulations

The EPCC Contractor shall perform the design and engineering of the facilities in accordance with sound engineering practices and, as a minimum, with the following:

- Specifications and standards provided within these documents.
- National codes and regulations as listed within these documents.
- Local regulations as applicable.

9.4 Disposal of Flammable Material

The relief and vent philosophy for the GPP is to safely dispose-off all flammable hydrocarbon vapors to continuously ignited flare. In normal operation there should be minimum continuous flaring. Some flaring may be necessary during start-up and shutdown.

9.5 Over Pressure Protection

Equipment shall be protected against over pressure by suitably located relief valves, according to API RP 520 and 521. The EPCC Contractor shall also provide thermal relief of piping as required.

The EPCC Contractor shall endeavor that the relief devices should be located as close as practical to the item being protected. Every effort should be made by the EPCC Contractor to locate the relief devices on the pipe rack above the flare header, so that the tail pipes slope continuously to the header. The EPCC Contractor shall ensure pressure loss in the relief valve inlet piping shall be less than three percent of set pressure.

9.6 Emergency Depressurizing

The depressurizing system shall comprise of solenoid valves on the air lines to blow down valves. The solenoid valves shall be operated by a single, protected, button in the control room to vent the air from the actuators and open the BDV's. The valves shall be sized to depressurize the systems to half design pressure in 15 minutes.

9.7 Valving and Isolation Philosophy

Below is a requirement for valving and isolation philosophy.

a. Emergency Isolation

The purpose of the valves is to be able to stop the flow of flammable material between different parts of the facility in the event of a major leak or fire subject to the final layout.

b. Equipment Isolation for Maintenance and Inspection

Double block valves and positive isolation shall be provided by the EPCC Contractor for equipment that must be isolated and opened relatively frequently while the surrounding process remains on line. This applies to the upstream and downstream of filters.

c. Control and Relief Valve Isolation

All control valves shall be provided by the EPCC Contractor with single block valve isolation at upstream and downstream with bleed valve. Furthermore, bypass of control valves shall be provided with globe valve.

All relief valves shall be provided single block and bleed valves isolation at upstream and only block valve at downstream. Furthermore, bypass of relief valve shall be provided with single block and globe valve.

d. Instrument Isolation

Isolation shall be provided for all instruments.

9.8 Design Units

The following set of units shall be used for the project, and also for all tenders for the work.

- Temperature: ° F
- Pressure: psig
- Weight: lb
- Time: hr.
- Length: ft or inch
- Velocity: ft/sec.
- Energy: Btu
- Work: Btu/hr

- Volume: ft^3
- Vapor Density: lb/ft^3
- Petro Density: API
- Volumetric Gas Flow: MMSCFD
- Duty: Btu/hr.
- Heat Transfer Coefficient: $\text{Btu}/\text{Hr Ft}^2 \text{ } ^\circ\text{F}$
- Thermal Conductivity: $\text{Btu}/\text{Hr Ft } ^\circ\text{F}$
- Viscosity: CP
- Kinematic Viscosity: Centistokes

Standard conditions shall be 60 °F and 14.65 psia.

10.0 **Technical Reviews**

As the work involves integration with the existing plant, it is imperative that the EPCC maintain effective co-ordination with OGDCL/ Consultant's project personnel. All the detailed engineering documents shall be reviewed by OGDCL /Consultant, so that the control concepts and operating philosophy of the new Compression facilities are properly co-ordinate with the existing TAY-03 GGS and GPP units, Offsite and utilities. Besides, standardization of equipment, instruments and materials is also desirable as far as practicable. To achieve these objectives, meetings and reviews shall be required during the project implementation period.

The following meetings are anticipated at various stages of the project.

- a. Upon award of work, a kick-off meeting will be convened at EPCC office in Pakistan for detailed discussions on the design basis, EPCC Contractor design standards and criteria, and control systems of existing plant/facility and other technical matters.
- b. During detailed engineering, a design review meeting to discuss / finalize the design information which would be provided by the EPCC Contractor to OGDCL for the Process, Civil, Structural, piping, electrical, instrumentation and other detailed engineering works for the Project and its tie-in / interconnections with other units as per clause 3.2.2 of ITB.

Besides, the EPCC Contractor's design documentation would also be reviewed / approved.

- c. Project review meetings to identify any areas of concern and to evaluate work progress shall be arranged, as required.

11.0 Procurement Services

11.1 General

The EPCC Contractor shall be responsible for the procurement (supply), expediting, inspection, testing and shipping/transportation of all equipment, skids and materials to complete the facility. Whilst the EPCC Contractor is responsible for equipment and material costs within his fixed price, he will be required to demonstrate that progress on all procurement activities can be assessed and modified as the Project schedule dictates.

EPCC Contractor will source equipment and materials from proven and reputed vendors having track record of providing services for projects related to the oil and gas industry. A list of Approved Vendors is given in Appendix-N. If any deviations are made by the EPCC Contractor from the Approved Vendors list the same will be highlighted in the Bid Proposal giving full justification and shall be subject to OGDCL / Consultant approval. Pakistani manufactured material shall be preferred if complying with project specifications and requirement to promote local industry.

The procurement plan to be submitted as part of the technical bid shall clearly demonstrate EPCC Contractor's capability to procure equipment and material line with project schedule in limited time. The procurement sources shall also be identified.

EPCC Contractor shall cooperate and assist OGDCL / Consultant in checking, marking and maintaining full records of materials.

11.2 Equipment and Materials Supply

It is OGDCL's intention that all equipment shall be purchased as a series of packages in order to minimize on-site construction. The packages will be arranged within steel support structures, skid mounted or freestanding.

All EPCC Contractor's supplied equipment/material shall be 100% traceable and suitably marked for easy identification of manufacturer or supplier, grade, source, size and rating.

11.3 Vendor Co-ordination and Expediting

The EPCC Contractor shall be responsible for all co-ordination within, and expediting of the vendors to ensure that all equipment, packages and materials arrive on site as planned.

11.4 Inspection and Testing

11.4.1 EPCC Contractor shall carry out all inspection including third party inspection from any of the approved Third party inspectors specified in clause 24.2 of Condition of Contract and witness testing for equipment and materials at vendors' works and shall be responsible for ensuring that all items of equipment and materials purchased are supplied strictly in accordance with the specifications as defined in the purchase order and design documents. Such inspection shall in no way relieve EPCC Contractor of his own responsibilities. Such third party inspection agency shall function independently and report to OGDCL.

11.4.2 It is required that OGDCL/Consultant will inspect equipment as per 3.2.2 of ITB.

The inspection and testing work shall include:

- Provision of a team of qualified quality control personnel.
- Checking and inspection of construction materials.
- Ensuring that all inspections and tests are carried out in a satisfactory and orderly manner.
- Ensuring that all testing equipment is setup and calibrated in accordance with requirements.
- Ensuring that any rework is carried out in satisfactory manner.

11.4.3 EPCC Contractor shall prepare a detailed inspection and testing plan, which will be subject to approval by OGDCL. Plan shall include but not limited to:

- An inspection and testing program per specific equipment item, or package.
- Details of certification and documentation requested per equipment item, or package.
- Details of inspection and approval agencies being used.

11.4.4 EPCC Contractor shall employ only qualified inspectors for the inspection. Details of personnel and CVs shall be provided to OGDCL for approval.

11.4.5 Factory Acceptance Test (FAT) shall be conducted at manufacturers work place where testing facility with all necessary infrastructure, latest equipment, spare parts and expert human resources are readily available. FAT aims to verify that the supply conforms to the specifications in the order from the stand point of mechanics, safety devices, and

accessories controls at guaranteed performance parameters, etc. In this respect, shop testing will be required for each compressor package.

- 11.4.6 EPCC Contractor shall submit for OGDCL/Consultant review and approval a complete plan for the factory and site acceptance testing. This plan must be complete and provide sufficient detail to indicate the exact nature of each test, time required, expected results and systematic procedure.
- 11.4.7 Manufacturer shall inform OGDCL/Consultant about the date of test 60 days in advance. No testing shall commence without written approval of OGDCL/Consultant. OGDCL reserves the right to witness any aspects of the assembling process. The Contractor shall submit an inspection and testing procedure of Supplier for review and approval by OGDCL/Consultant prior to shipment.
- 11.4.8 The Contractor shall prepare and issue written reports for review by OGDCL on all interim and final inspection and tests.
- 11.4.9 If equipment has to be modified or adapted in order to pass final inspection and test, the Contractor shall compile a complete dossier containing accurate and detailed records of all design changes, alterations, modification, adaptations and the reasons for them, together with minutes of all relevant meetings and notes of all relevant discussions and shall promptly make such dossier available to OGDCL.
- 11.4.10 The EPCC Contractor shall endorse as correct all fabrication and manufacturing data folders containing, but not limited to equipment test certificates and all other relevant inspection data.
- 11.4.11 The Contractor shall be responsible for sanctioning the release of completed equipment and material for shipment after final inspections have confirmed satisfactory completion. Such a release shall not relieve Contractor of his contractual obligations.
- 11.4.12 The Contractor shall perform the Factory Test as per API-618 “Mechanical Running Test” requirements. The unit including integral auxiliary system packages shall receive a 4-hours mechanical running test before shipment. Further, Auxiliary equipment not integral with the unit such as oil pumps, oil coolers, filters, inter-coolers and after-

coolers shall receive both an operational test and a 4-hours mechanical running test before shipment.

11.4.13 All examination methods shall be as per API 11P 2nd edition, ASME VIII and other applicable codes to the relevant equipment, piping, etc.

11.4.14 Company reserves the right to accept or reject any test and ask for retest at no extra cost, specifying reasons for retest.

11.5 Transportation and Freight Forwarding

The EPCC Contractor shall be responsible for the transportation of all equipment, packages and materials from the source of supply to Port of discharge. EPCC Contractor will be responsible for organizing and coordinating these activities to ensure that all equipment and materials arrive on Port of discharge, intact and on schedule. Such activities will include:

- i. Preparation of packing, marking, shipping and documentation specification.
- ii. Develop optimum plans and procedures for freight forwarding and handling of equipment and materials to ensure that all freight is consigned to arrive at port of discharge on time.
- iii. Make shipping forecasts and advise OGDCL/Consultant of predicted arrivals.
- iv. Prepare, maintain and issue a monthly shipping forecast summary and shipping progress report to OGDCL.
- v. Supply of cranes, trailers and other lifting machinery.
- vi. Inspection / checking of list during unloading at Project Site.
- vii. Proper storage of all transported items at Project Site.

It may be noted that the EPCC Contractor shall be responsible for any delay or damages to equipment packages and material during its installation.

a. Local Material Transportation

EPCC Contractor shall comply with all applicable laws regarding the local transportation of Materials, to include permits, escorts, load limits, signs and diversion construction.

The safe and legal delivery of locally procured Materials shall be a responsibility of EPCC Contractor.

11.6 Equipment and Package Supply

It is OGDCL's intention that all mechanical, electrical, instrumentation and safety equipment will be purchased as a series of packages and installed on prepared foundations, in order to minimize onsite Construction. As far as is feasible, the packages and skids will be fabricated with all equipment, motors, pipe-work and instrumentation pre-installed.

The EPCC Contractor may wish to purchase all equipment and materials for the packages and supply these items free issue to the skid fabricator, or he may place a purchase order on the fabricator, which includes the supply of equipment and materials. In either event, the supply of all equipment / items like Compressors, Engine, Air Coolers / Exchangers, on-skid valve, instruments, panels, etc., shall be from the Approved Vendors lists (refer Appendix-N) and use of different suppliers should be avoided for both ease of maintenance and spares storage. It will be the EPCC Contractor's sole responsibility to ensure that all equipment and materials supplied within the packages conform in all respects with the requirements and specifications in these documents, particularly with regard to operational and maintenance access.

11.7 Bulk Materials

The EPCC Contractor shall be responsible for the provision of all piping, electrical, instrumentation, safety, structural and civil bulk materials and items required to complete the project.

Any mechanical, instrumentation or safety items which need to be shipped loose for installation on site, or any additional items found to be required at site, will be procured by the EPCC Contractor from the Approved Vendors lists (refer Appendix-N) and comply in all respects with the Project Specifications. The local supply from Pakistan shall be done from the provided vendor list (refer Appendix-N).

EPCC Contractor's supplied Bulk Material shall include but shall not be limited to the following activities:

- a. Preparation of procurement document which will include the following:

- Request for quotations (RFQ) containing the detailed Bill of Materials, Specifications, design details, delivery dates, shipping instructions, inspecting, testing requirements, vendor documentation, details draft purchase orders. Separate RFQ shall be developed for each kind of Bulk Materials.
 - Evaluation of Bids
 - Purchase Orders
- b. Inspection and non-conformance report.
 - c. The supply of all Bulk Material for the completion of the Work.
 - d. Review of Material certification and performance of all tests as specified.
 - e. The preparation for shipment, packing and marking.
 - f. The transportation of Bulk Material to Project Site.
 - g. All loading and off-loading operations, handling and movements, protection, storage and maintenance of Bulk Material at the storage area, Work Site fabrication erection or installation area(s), or elsewhere.
 - h. Compliance with Vendors instructions and recommendations, and the applicable provisions of the material procedures.
 - i. The provision of Vendors assistance on Project Site.
 - j. The supply of Vendors Final Documentation.
 - k. Marine Insurance (from Port of loading to Project site) Custom Duties, Custom Clearance and Inland Transportation will be done by OGDCL, however, any demurrages or container detention charges/ penalties imposed by custom authorities due to discrepant or late receipt of Original shipping documents will be recovered from the EPCC Contractor.

- l. Imported equipment and materials supplies under the contract shall be fully insured against loss or damage by the manufacturer/supplier in the country of export. Thereafter marine insurance shall be the responsibility of OGDCL from the port of loading till the port of discharge & up to Project site. However, the manufacturer/supplier shall send declaration of shipment to the insurer and the manufacturer/supplier shall be responsible for the consequences for not making declaration to the insurer in time.
- m. The rectification of any transit damage to the Material or replacement of damaged Material. Compliance with Vendors instruction and recommendations, and the applicable provisions of the Material procedures. Any re-export of the damaged or wrong Material shall be managed by the EPCC Contractor at its own cost.

11.8 Material Certification, Witness Testing and Documentation

Material traceability and equipment conformance certificates will form part of the permanent documentation to be complied and provided by the EPCC Contractor, and will form a specific item on the purchase order for delivery by the Vendor.

The EPCC Contractor supplied Equipment and Bulk Material to be approved by the Third Party Inspector shall include but shall not be limited to the following provisions:

- a. EPCC Contractor shall provide in its Purchase Orders for all inspection and certification requirements.
- b. EPCC Contractor shall submit in a timely manner to the OGDCL / Consultant all applicable Vendors documentation for Approval.
- c. It is understood that inspection by the Third party Inspectors and OGDCL / Consultant shall not release EPCC Contractor from performing its inspection and quality control programs and it shall not release the EPCC Contractor of his obligation of supplying the Equipment and Materials in accordance with the requirement of applicable Project Specification and codes.
- d. EPCC Contractor shall incorporate all inspection certificates and/or compliance certificates in Vendors Final Documentation.
- e. Witness Shop inspections and performance testing would be required for all major items of equipment and machinery. Typically, these include:
 - Pressure tests of air coolers
 - Reciprocating Compressors

- Vessels
- Any new equipment proposed by EPCC Contractor.

The schedule of these visits is to be developed by EPCC Contractor.

11.9 Commissioning (including Performance Test, Reliability Guarantee Test) and Operating/Maintenance Spares

The EPCC Contractor shall be responsible for the provision for one (1) year as compulsory of all the required commissioning spares, lube oils, greases, consumables including startup and operation during Performance Test and Reliable Guarantee Test. as recommended by Vendors. This will form a specific item on the EPCC Contractor's purchase order.

EPCC Contractor shall also submit the price list of two (02) years OEM recommended operating/maintenance spares (optional) on OEM letter head along with the bid.

12.0 Construction, Erection and Facility Hookup

12.1 General

EPCC Contractor shall carry out construction, fabrication, erection and hookups / tie-ins to existing Plant/facility installations necessary for expansion of Plant/facility. EPCC Contractor's responsibilities will include but not limited to the following;

- a. Site preparation and civil works as per drawings & specifications.
- b. Provision of project management, progress control of the Work, and reporting to OGDCL / Consultant as required in the Contract.
- c. Preparation and submission of all engineering, drawings and quality control documentation for review or Approval necessary to satisfy OGDCL / Consultant. Typically these should include but not limited to the following;

- Execution Plan
- Design Calculations
- Site Coordination Procedure
- Hydrotesting & Water Disposal Procedures
- Material Control Procedures
- MTO's verification for bulk materials
- Tagging and marking procedures
- Storage procedures
- Transportation Procedures
- Refurbishment procedures
- Construction Procedures
- Dimensional Control Procedures
- Construction Safety Procedures
- Document Control Procedures
- Quality assurance/quality control plans and procedures/QA/QC Formats
- Welding procedures complete with all necessary supporting documentation
- Welder qualification Records
- NDT Reports
- Lifting procedures for lifts over 30 ton or abnormal size and any other lifting operation designated by OGDCL / Consultant within the existing plant area.

All of the above shall be submitted to OGDCL / Consultant for approval prior to commencement of the Work.

- d. Performance of Work in a workmanlike and professional manner, utilizing sound construction design and fabrication principles and procedures.

- e. EPCC Contractor shall be fully liable for the adequacy, stability and safety of all operations and methods of construction, and for the correctness of the position, levels, dimensions and alignment of all parts of the equipment on site.
- f. Performance of Work continuously and diligently and in accordance with Work Time Schedule.
- g. Compliance with all local regulations including safety and environment regulations and obtaining all permits required for the execution of the Work and bears all the relevant expenses in this regard.
- h. Allowing access to OGDCL / Consultant Personnel at EPCC Contractor's work place and Site to enable them to witness and check the quality of Work, and to survey EPCC Contractor's quality control activities, inspections and / or tests.
- i. Provision of all fills, for cleaning and first filling (such as oil, greases, etc). EPCC Contractor should submit required fills quantity at least three (3) months prior to commissioning.
- j. Providing qualified manpower that shall include design engineers, vendor representatives, technical experts, and construction and engineering personnel at Site during Commissioning and Start-up.
- k. Obtaining and maintaining all permits, authorizations and licenses as may be required to be obtained in the name of EPCC Contractor for the performance of the Contract at its own cost.
- l. Providing of all Final Documentations (soft & hard copies)
- m. Providing of material reconciliation documentation.
- n. Clearing Site of scrap, wreckage, debris and other items not forming part of the Facility.
- o. Achieving product specifications and production targets set by OGDCL.
- p. Maintaining EPCC Contractor tools, tackles, etc in first class working order through Provisional Acceptance.
- q. Notwithstanding the omission thereof from the above list of any duty that would be necessary for or incidental to, the performance of Work, EPCC Contractor shall duly perform any such duty.

12.2 Contractor Furnished Site Facilities

12.2.1 The EPCC Contractor shall be responsible for the supply, installation, hookup and maintenance of all facilities and services required to enable him to carry out the work.

12.2.2 These shall include but not limited to office accommodation, messing facilities, workshops, warehouses, prefabrication sheds, power, water, sewage disposal, communications (telephone/telex/Email), etc.

12.2.3 The Contractor shall also be responsible for installation or erection of any temporary facilities required to assist the work including weather protection, lighting, scaffolding, etc., and removes these on completion of the work.

a. Temporary Camp

The EPCC Contractor shall establish a temporary camp as per clause 11.11 of Condition of Contract for storage of its own use equipment & material, work area and staff residence. Any such establishment shall be self-sufficient in all respects, including supply of all utilities.

b. Temporary Site Facilities

The EPCC Contractor shall establish a fenced and guarded ware-house/store as per clause 11.11 of Condition of Contract for secured storage of material and equipment procured for the project.

The EPCC Contractor shall provide, erect, construct, furnish, equip, clean, maintain, heat, light and subsequently remove all first aid facilities and workshops, etc, necessary for the completion of the Work and the site and layout of which shall be to the general approval of OGDCL.

Before providing any of the above the EPCC Contractor shall submit detailed proposals for the approval of OGDCL. The workshops shall be constructed of fire retardant materials and located in accordance with the recommendations of the fire prevention officer.

It is the EPCC Contractor's responsibility to provide firefighting equipment. Ownership of temporary buildings and any furniture and equipment provided as aforesaid shall refer to the EPCC Contractor.

The offices shall be lockable and furnished with new or reconditioned furniture and be level ground finished with gravel concrete or paving slabs. Suitable paths shall be ensured by the EPCC Contractor.

c. Material Storage and Control

The EPCC Contractor shall be responsible for receiving, storing, protecting and issuing all materials and consumables as required for fabrication and installation for the KPD-TAY Compression Project. The EPCC Contractor will develop material control procedures to ensure that the materials are correctly stored and used in the appropriate service and can be readily identified at all times. These procedures will be subject to agreement with OGDCL.

Loading, hauling and unloading shall be performed in such a manner as to prevent damage and if materials sustain damage, EPCC Contractor shall be responsible for all repair and/or replacement costs.

The EPCC Contractor is to ensure that all equipment is properly stored and protected from weather and damage. Whenever possible, unloading of major equipment items shall be scheduled to permit the equipment to be placed directly on foundations.

d. Testing Facilities

The EPCC Contractor shall be responsible for providing adequate Testing Facilities to enable him to complete the work, including radiography and other NDT methods and instrument calibration and testing.

12.2.4 Contractor Furnished Facility and Materials

The EPCC Contractor shall be responsible for the provision and maintenance of Compression Stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP) consumables and materials. This will include all construction and tools necessary to install and test the work and all consumables such as welding electrodes, etc. It shall also include any transportation requirements the EPCC Contractor's workforce may have, and the provision of all spreader bars, slings, etc.

12.3 Onsite Organization

12.3.1 Construction Supervision

The EPCC Contractor shall provide an onsite supervision team to ensure that the work is carried out and tested in accordance with the drawings, specifications and agreed procedures. EPCC Contractor shall provide a designated site manager who shall be responsible for the day-to-day running of the site and liaison with OGDCL representative(s) on all scheduling, control, inspection and testing approvals, etc. his supervisory team will be responsible for the progress and quality of the work carried out by the individual disciplines and will include:

- a. Implementation of agreed construction procedures.
- b. Maintenance of construction and testing documentation.
- c. Supervision of workforce including any trade and/or qualification tests and maintenance of the records of such tests.
- d. Ensuring that all works are constructed in accordance with approved drawings and specifications including the checking of “As-built” drawings.
- e. Upon completion of hookup/commissioning tie-ins, and performance test run, EPCC Contractor shall update original documents to “As-built” status and submit to OGDCL.
- f. EPCC Contractor shall submit one (1) print of all “As-built” documentation to OGDCL representative(s) for approval.
- g. Review, approval and implementation of any design modifications.
- h. Reporting and participation in progress meetings.

12.3.2 Field Engineering and Procurement Services

In addition to the provision of construction management services, the EPCC Contractor will be responsible for the provision of any on-site engineering, procurement or other field services, which may be required as a result of design changes, additional work.

12.3.3 Inspection and Testing

The EPCC Contractor shall undertake all inspection and testing of the work carried out in the field in accordance with specifications and procedures.

The inspection and testing work shall include:

- i. Provision of a team of qualified quality control personnel.
- ii. Checking and inspection of construction materials.
- iii. Ensuring that all inspections and tests are carried out in a satisfactory and orderly manner.
- iv. Ensuring that all testing equipment is setup and calibrated in accordance with requirements.
- v. Ensuring that any rework is carried out in satisfactory manner.

The EPCC Contractor's procedures will ensure that all phases of the work are satisfactorily inspected and tested, and that appropriate signatures are obtained on the relevant documentation.

All inspection and testing work by the EPCC Contractor will be subject to witnessing and approval by OGDCL/Consultant and all planned inspections and tests must be carried out at times acceptable to OGDCL/Consultant. Adequate prior notice of inspection and tests must be given to OGDCL/Consultant to allow its representatives to attend.

12.3.4 Documents For Fabrication and Installation

EPCC Contractor shall submit to the OGDCL / Consultant for approval detailed procedures for the fabrication/ installation works. The procedure shall be developed for all disciplines (Civil, Mechanical, Electrical, Instrumentation and Control System, etc.). Fabrication and installation documents shall be transmitted to OGDCL / Consultant for review and approval.

12.3.5 Procedures For Material Control, Fabrication, Transportation and Installation

It shall include but shall not be limited to the preparation and issue of detailed procedures including drawings, calculation notes, list of Equipment, list of personnel, planning, back-up procedure if necessary for:

- a) Inspection
- b) Shipping and forwarding

- c) Surveys
- d) Material control, storage, handling
- e) Assembly of main structural works
- f) Lifting
- g) Welding procedures specifications and qualifications, including repair
- h) Welders qualifications and welding personnel list (updated as necessary)
- i) NDT controls
- j) NDT operators qualification
- k) Welding programme
- l) Sand blasting and painting
- m) Safety on Worksite
- n) Site preparation
- o) Installation

12.3.6 **Shop And Construction Drawings**

Shop drawings shall include but shall not be limited to the preparation and issue of shop drawings for the prefabrication, fabrication, and erection works, such as

- a) Cut-off drawings
- b) Weld locations plan
- c) NDT controls location plan
- d) Fabrication isometrics for piping. Spooling drawings.
- e) Detailed design and fabrication drawings for steel storage tanks and `Package Units.
- f) Structural Details Drawings
- g) System Schematic Drawings
- h) Detailed Equipment Foundation Drawings
- i) Detailed drawings for Buildings (Control Room & Generator Building Room)
- j) Equipment layout drawings.
- k) Cable layout and trenching details.

- l) Anyother shop/ fabrication/ construction drawing which may be required for the Works

EPCC Contractor shall provide all vendor drawings, sketches, informaiton and data for the detailed design.

12.3.7 **Material Reconciliation**

- On completion of all works at Site the EPCC Contractor shall prepare a material reconciliation report in accordance with the requirement of the OGDCL / Consultant. The reconciliation report shall give an account of all Equipments and Materials purchased, consumed, wastage and surplus/ scrap.
- The surplus, scrap and packing material shall be the property of the OGDCL and it shall be handed over to the OGDCL at designated place(s) with proper documentation.

12.3.8 **Contractor Provided Documents**

EPCC Contractor shall produce all other documents, procedures required to execute the Works. Typically these should include but not be limited to the following:

- As-built mark-ups of specified drawings
- Completed inspection and test sheets as required by the EPCC Contractor's Quality Plan, including records for material traceability and welder identification.
- Completed inspection and test sheets as required by the EPCC Contractor's Quality Plan.
- Upon completion of the Work, EPCC Contractor shall produce a mechanical completion dossier (five copies) complete with all as built drawings, documents, and all electrical and instrument inspection documentation, Vendor information/manuals.

12.3.9 **As-Built Records**

EPCC Contractor shall maintain a continuous up to date record of the as-built condition throughout the construction, installation and pre-commissioning. This record shall be in the form of marked-up drawings and documents, duly signed by EPCC Contractor.

These records are to be made available to OGDCL / Consultant on demand. Full and final five (05) sets (hard copies) of this documentation along with the softcopies are to be provided to OGDCL / Consultant within four (04) weeks of the completion of the Work.

The requirements of each aspect of the Work are given in the relevant OGDCL / Consultant Specifications.

12.3.10 **Completion of Final Punch Lists**

Prior to provisional acceptance of the facilities, the EPCC Contractor shall be required to complete any outstanding work. This shall be achieved by the generation of mutually agreed punch lists of a point where the project is substantially complete.

12.3.11 **Miscellaneous**

- The EPCC Contractor shall provide a completely “fitted out” facilities, including all painting, insulation, installation of firefighting equipment, installation of general equipment signs and installing safety signs and equipment.
- All facilities within EPCC Contractor’s Scope of Work, including structural aspects, piping, equipment, instrumentation and electrical, shall have all protective coatings applied and paintwork touched-up, as required.
- The EPCC Contractor shall be responsible for collecting and disposal of all refuse from the Work Site at regular intervals and after job completion.
- The EPCC Contractor shall be responsible for removing all excess materials from the site at the completion of the Work.
- The EPCC Contractor shall make good all damage to equipment, structures, finishes, etc., caused during the performance of the Work.
- The EPCC Contractor shall reinstate any areas disturbed during the Work including any temporary access ways, roads, etc.
- Painting of well site surface facilities and spur lines according to international standards.

12.3.12 **Civil and Structural Works**

The EPCC Contractor shall undertake the design and construction of all civil and structural works for all the components/ facilities of the KPD Compression Project, namely;

- Thora Deep – 3 GGS
- Tay – 03 GGS
- KPD at GPP
- Tay at GPP

EPCC Contractor’s responsibilities include furnishing all material, form work, plant, labor, equipment & appliances etc, associated with the design and construction of Project’s civil works, which will include, but, not limited to earth works, boundary wall, fencing, access

gates, security towers/ office, buildings & sheds (RCC & porta cabin), foundations for equipment and other items, Pipe rack & Sleepers, Drainage, Roads, culverts, & Paving, Steel Structure and Access ways etc.

In addition, the EPCC Contractor shall also be responsible for the design and construction of civil works required for the tie-ins of process / utility lines and cables etc.

All construction activities shall be carried out as per the applicable international Codes & Standards and as per the requirement of safety manual.

The EPCC Contractor shall undertake the detailed survey to establish the reference benchmark, requirement of cut & fill for finished ground levels, finished levels of roads, drains and other areas to ensure soundness of design and construction works of the project. The EPCC Contractor shall ensure that FGL's of KPD Compression Project shall be compatible with the FGL(s) of existing plant(s).

The EPCC Contractor is required to undertake inspection and appropriate tests applicable to the particular work activities e.g. cement, aggregate, excavation and compaction, reinforcement, formwork, foundation and other R.C.C. works concrete cube etc, and is to submit the results of such inspections and tests for review and acceptance by OGDCL.

The EPCC Contractor shall be responsible for the dismantling / removal of certain items as shown on respective Plot Plans and also for cleaning, levelling and site preparation etc. of all the components / facilities of the KPD Compression Project.

The civil works for the KPD Compression Project shall be carried out in the vicinity, or within existing Plants, therefore, during the design and construction phase, the EPCC Contractor shall ensure the safety and operation of existing plants and allied facilities.

The EPCC Contractor shall be responsible to undertake all precautionary measures to ensure safety and operation of existing facilities, protection of all underground and exposed utility lines and cables etc. whether shown on plans or encountered during the construction activities.

During the construction phase, the EPCC Contractor shall be responsible for the clearance of area. The clearance of area shall be monitored in such a manner that all undesired/surplus material shall be disposed off within two (02) days of completion of individual item/activity and within ten days of completion of construction phase. The undesired material shall be disposed to a lead as directed by OGDCL / Consultant.

The Scope of civil & structural work for KPD Compression Project shall include but not limited to the design, supply and construction of the following:

12.3.12.1 Survey

The EPCC Contractor shall undertake the detailed survey of the project sites to verify the dimensions and coordinates provided on Plot Plans and other documents of OGDCL.

12.3.12.2 Setting Out

The EPCC Contractor shall set out the works to correct lines, levels, and coordinates with respect to a Bench Mark (to be established by the EPCC Contractor). In order to establish the Bench Mark the EPCC Contractor shall take into account the reference datum indicated by OGDCL and the levels and coordinates of existing facilities to be interfaced or any other area as deemed necessary for the purpose.

The EPCC Contractor shall have unshared responsibility for correct setting out of work. If any error in this respect shall appear during design or construction phase, the EPCC Contractor shall rectify the same at no extra charge to OGDCL.

12.3.12.3 Earthworks & Dewatering

The EPCC Contractor shall carryout all earthworks necessary for the completion of the work, which shall include but not limited to the following:

a. Clearing, Grading & Leveling

The EPCC Contractor shall undertake the clearing, grading and leveling of the Project areas in accordance with the guidelines provided on the respective Plot Plans.

The EPCC Contractor shall develop site preparation & grading plan in accordance with above referred drawings, topographic survey and the site observations by the EPCC Contractor.

The work for grading and leveling shall be carried out in accordance with the Project Specifications. The EPCC Contractor shall undertake any cut or fill of the area,

removal of trees, vegetation and disposal of undesired material at a designated place approved by the OGDCL / Consultant.

b. Excavation

Excavation shall include the removal of earth, rocks, gravel, shale, and any other material encountered in securing the proper sub grades or proper elevation to receive foundations etc. The minimum requirements for excavation shall include but not limited to followings:

- i. The sub-grade level obtained from excavation shall be compacted to achieve 95% max. dry density at optimum moisture content.
- ii. For deep excavation methods shall be adopted for upholding the sides of excavation to prevent caving-in.
- iii. All surplus excavated material not used in backfilling or leveling and grading work shall be disposed off to designated place(s) approved by OGDCL / Consultant.

c. Dewatering

Dewatering shall be carried out to achieve the designed excavation levels and to keep the excavated areas free from standing water. The disposal of water shall be made in accordance with the local laws and approval of OGDCL / Consultant.

d. Earth Filling

The Finished Ground Level (FGL) of the Project areas may require to be raised. The areas required to be raised (through earth filling) shall be finalized in accordance with the topographic survey, approved Plot Plans and approval of grading & leveling plan by OGDCL / Consultant.

The earth filling shall be carried out (by EPCC Contractor) in accordance with Specification for Earth works. The EPCC Contractor may propose to use surplus excavated material for earth filling, provided that, the referred material meets the requirements of specification. In case, the surplus excavated material failed to meet the requirements of specifications, the EPCC Contractor shall be responsible for the supply of material through an outside source as approved by OGDCL / Consultant.

The slopes (if required) of earth filled area should be designed in accordance with the type of material used for earth filling and shall be protected against erosion by providing concrete slab and or stone pitching etc.

In addition, EPCC Contractor shall also be required to undertake earth filling, within the plinth area of buildings / rooms and / or any other depressions as may be observed from topographic survey drawings and / or Detail Survey.

12.3.12.4 **Equipment Foundation**

The EPCC Contractor shall be responsible for the design and construction of foundations for all the equipment as mentioned in the equipment list or may be required in the final design phase.

The design and construction of equipment foundations shall be carried out in strict accordance with relevant codes, standards, project specifications and manufacturer / vendor recommendations.

12.3.12.5 **Foundation for Pipe Racks / Sleepers and Supports:**

The foundations for pipe racks, sleepers and pipe supports shall be designed and constructed as per requirement of approved piping layouts.

The design of above foundations shall be in strict accordance with relevant codes, standards and project specifications

12.3.12.6 **Grouting**

The EPCC Contractor shall be responsible for undertaking the Grouting at the underside of Base Plates of Equipment, Pipe Racks and Supports for equipment etc. The Grouting shall also be required for the pockets in foundations for fixing Anchor Bolts. Generally the type of Grouting Material to be used is Non-Shrinkable Cementitious Grout and Non-Shrinkable Epoxy Grouts.

For the Grouting of Equipment, the recommendations of Vendor, for the type and thickness of Grout shall be strictly followed.

12.3.12.7 **Roads, Concrete Paving and Gravel Paving**

- **Roads**

The EPCC Contractor shall be responsible for the dismantling and restoration / reinstatement of the existing road(s) for the road crossing / culverts for piping, cables and storm water drain etc.

OGDCL's standard drawings and specification shall be followed for the restoration / reinstatement of roads.

- **Concrete Paving**

The EPCC Contractor shall be responsible for the design and construction of RCC/ PCC pavements, as per approval of OGDCL. Concrete Paving shall be required around equipment, pumps and for providing access to certain areas of the Project.

The EPCC Contractor shall provide concrete paving of suitable thickness at hard standing areas for maintenance crane. The EPCC Contractor shall assess the tonnage of crane and obtain OGDCL's approval prior to initiating the detail design of pavement.

The Concrete Paving for equipment area shall be slopped towards catch basins and hubs to ensure proper drainage, whereas other paved areas and access ways shall also be slopped to avoid standing water on surface of the paved areas

- **Gravel Paving**

The EPCC Contractor shall provide 75 mm thick Gravel Paving at areas where concrete paving is not required or as may be decided by OGDCL. As a guideline, the EPCC Contractor shall be required to provide Gravel Paving at space in between Road and paved areas.

12.3.12.8 **Drainage**

The scope of work for the design and construction of drainage system shall include:

- Oily water drainage
- Storm water drainage
- Sanitary sewer system

The oily water drain system shall be designed / constructed with underground piping network, Catch Basins, Manholes, cleanouts and treatment & tie-in with existing network. The manholes and Catch Basins shall be of R.C.C and seal type.

The storm water drains shall be R.C.C. and shall be designed/ sized as per catchments area. The design of storm water drains shall also include tie-in of the storm water to existing network.

The sanitary sewer system shall be required for the drainage & discharge of sanitary water from the buildings. The sanitary sewer system shall generally comprise of sanitary sewer manhole, septic tank & soak pit.

The plant drainage system shall be designed and constructed in accordance with relevant codes, standards and project specifications.

12.3.12.9 **Culverts**

The EPCC Contractor shall be required to design and construct the Culverts for the road crossing of storm water drains, piping and cables etc. The EPCC Contractor may also be required to dismantle the existing Storm Water Drain(s) and roads for construction of culvert(s). The design & construction of Culverts for the Project should be compatible with the Culverts of existing facility or as approved by OGDCL/ Consultant.

12.3.12.10 **Fencing & Fence Gates**

The EPCC Contractor's scope for the design and construction of chain link fencing and fence gates shall include but not limited to the following:

- a. Temporary fencing around EPCC Contractor's lay down and fabrication shop areas.
- b. Fabrication & installation of Chain Link Fence & Fence Gate as shown on Plot Plans.

The fencing & gates shall be designed and constructed in accordance with Project's Specification applicable codes and standards. As a guideline, layout of fencing is shown on the Plot Plans. However, the design, fabrication and installation of fencing and gates shall be carried out in accordance with the layout(s) approved by OGDCL, during the detail engineering phase.

12.3.12.11 **Boundary Wall & Steel Gates**

The design and construction of boundary wall and steel gates shall be included in EPCC Contractor's scope. The initial layout of boundary wall & gates is shown on Plot Plans which may be referred for the development of boundary wall & gates layout.

The EPCC Contractor shall be required to develop boundary wall layout in accordance with the referred layout & site condition and submit for OGDCL's approval. The design & construction of boundary wall shall be in accordance with the specifications and also the local / international codes & standards.

The construction works for the boundary wall shall be carried out in close coordination with OGDCL's relevant department(s) and the EPCC Contractor shall be required to adhere to the OGDCL's regulations with respect to safety and security etc. and also to conditions / requirements imposed (if any) by local authorities.

12.3.12.12 **Building and Sheds**

The requirement of building(s) sheds for each facility should be referred from the respective Plot Plan(s).

The EPCC Contractor shall provide roads / access to all the Buildings & Sheds and provide paved areas round the building to a minimum width of one (01) meter from the external face of the walls.

The design and construction of all Buildings & Sheds shall be carried out in accordance with the OGDCL's Specifications & Standard Drawings and international / local codes and standards.

Prior to the detail design of Buildings & Sheds the EPCC Contractor shall develop the general arrangement drawings with reference to the above mentioned OGDCL's drawings, vendor data and project's requirement of clear / working space etc. The EPCC Contractor shall also develop the internal layout and finishes of all buildings & sheds for obtaining OGDCL's comments / approval. The detail design of the buildings shall be undertaken by the EPCC Contractor in accordance with OGDCL's approved general arrangement drawing, finishing schedule and elevation etc.

The sizes of rooms & toilets as shown on the OGDCL's drawings represents the minimum requirement. The EPCC Contractor shall be required to refer these drawings for the development of layout / plan of the buildings in accordance with project requirement and obtain OGDCL's approval.

All the buildings shall be provided with air conditioning, electrification, telephone, LAN, fire alarm, plumbing & drainage network with fittings and fixtures of OGDCL's approved grade and quality.

The EPCC Contractor shall undertake the design and fabrication / construction of following type of Buildings & Sheds.

- a. RCC Buildings
- b. Porta Cabin Buildings
- c. Steel Structure Sheds

The Buildings & Sheds required at each facility may be referred from respective Plot Plan(s) whereas, minimum size and other requirements may be referred from General Arrangement Drawings (RCC Type) and mentioned below (Porta Cabin Type).

a. **RCC Building**

The RCC building shall include following

- i. Watch Towers
- ii. Prayer Hall & Ablution
- iii. Guards Room
- iv. Work Shop
- v. Switch Gear & MCC Room
- vi. F.C Living Facility
- vii. Office Building
- viii. CCR/UPS & Battery Room
- ix. CCR/UPS, Operator & Battery Room
- x. Operator Room

b. **Porta Cabin Buildings**

- | | | |
|-------|---|-----------------------------|
| i. | Office Incharge Room with attached bath | (Minimum Size 10ft x 20 ft) |
| ii. | Employees Sitting Room | (Minimum Size 20ft x 20 ft) |
| iii. | Employees Toilet Block | (Minimum Size 10ft x 20 ft) |
| iv. | Employees Pantry Room | (Minimum Size 10ft x 20 ft) |
| v. | FC Living Room | (Minimum Size 10ft x 40 ft) |
| vi. | FC Toilet Block | (Minimum Size 10ft x 20 ft) |
| vii. | FC Kitchen | (Minimum Size 10ft x 20 ft) |
| viii. | Control Room / Operator Room | (Minimum Size 10ft x 20 ft) |
| ix. | UPS Room | (Minimum Size 10ft x 20 ft) |

c. **Steel Structure Shed**

- i. Generator Sheds

12.3.12.13 **Tank Foundations**

The EPCC Contractor shall design and construct foundations for Fire / Raw water steel storage tanks. The Tank foundation shall be designed and constructed in accordance with API 650 and OGDCL's specifications and drawings

12.3.12.14 **Miscellaneous Works**

The EPCC Contractor shall perform detail design and construction of miscellaneous works such as drain pits, foundation of E&I items and any other work which is required as per the detail design and /or as advised by OGDCL / Consultant.

12.3.12.15 **Survey and Soil Reports**

The below listed Survey / Soil Investigation Drawings / Report are provided as 'Civil Documents for EPCC Scope of Work' with this document.

1. **KPD at GPP**
 - a. **Soil Investigation Report**
 - i. Kunnar LPG Plant & Oil Field, KPD Tay Site, Tando Jam, Sindh
 - b. **Survey Drawings**
 - i. Survey for Kunnar Plant China Camp Dwg. No. 0704423-PS-02 (R0)
 - ii. Contour Layout for Kunnar Plant China Camp Dwg. No. 0704423-CL-02 (R0)
2. **THORA DEEP – 3 GGS**
 - a. **Soil Investigation Report**
 - i. GGS Thora Deep – 3 Moolan, Hyderabad, Sindh
 - b. **Survey Drawings**
 - i. Pipe Line Survey for Thora Deep – 3 Dwg. No. 0704423-PS-04 (R2)
 - ii. Contour Layout for Thora Deep- 3 Dwg. No. 0704423-CL-04 (R0)
3. **TAY 3 GGS**
 - a. **Soil Investigation Report**
 - i. GGS Tay-3 Tando Allahyar, Sindh
 - b. **Survey Drawings**
 - i. Pipe Line Survey for Tay- 03 Dwg. No. 0704423-PS-03 (R2)
 - ii. Contour Layout for Tay- 03 Dwg. No. 0704423-CL-03 (R0)
4. **TAY at GPP**
 - a. **Soil Investigation Report**
 - i. Geotechnical Investigation Report for Gas Processing Plant
Doc. No. 165-4-GTR-004(R0)
 - b. **Survey Drawings**
 - i. Gas Processing Plant Topographical Survey Dwg. No. 165-4-SUR-001(R-F0)

ii. Gas Processing Plant Topographical Survey Dwg. No. 165-4-SUR-002(R-F0)

iii. Gas Processing Plant Topographical Survey Dwg. No. 165-4-SUR-003
(R-F0)

12.3.12.16 **Protection of Environment**

The EPCC Contractor shall be responsible for the protection of environment during the construction activities and shall follow the data / guidelines provided by the local environmental agencies. The EPCC Contractor shall also be responsible for obtaining environmental data from concerned departments.

12.3.13 **Mechanical Construction and Hookup**

12.3.13.1 **General**

The EPCC Contractor shall be responsible for the all mechanical site fabrication, construction and hookup of all mechanical and piping facilities at all Compression Facilities/ Stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP) . This shall include, but not be limited to:

- a. Installation of all packages and equipment as described elsewhere.
- b. Prefabrication of all interconnecting pipe work & installation on pipe racks.
- c. Installation and weld out of closing spool pieces.
- d. Interconnection of all ancillary services such as flare, blow-down drains etc.
- e. Tie-ins (every Tie-in should be flanged with double block and bleed arrangement).
- f. Complete inspection and testing of all mechanical and piping systems.
- g. Installation of pipe supports, supporting structures, etc.
- h. Preparation and completion of all painting, coating and insulation.
- i. Access & stair structures etc.

12.3.13.2 **Mechanical Testing of Packaged Units**

The packaged Compressor units shall be tested in the Vendor's works prior to shipment. Such tests may include hydro-testing of on-skid pipe work. Under such circumstances, it may not be necessary to retest such systems on site provided that the EPCC Contractor can provide all documentary evidence that the required tests have been carried out at vendor's workplace and witnessed by the EPCC Contractor's & OGDCL/Consultant. Where the documentation is incomplete, or there is evidence of damage in transit, OGDCL may, at its discretion, request that a retest be carried out without any extra cost.

12.3.14 Electrical Installation, Hookup and Testing

12.3.14.1 General

The EPCC Contractor shall be responsible for all the installation, construction, hookup and testing of the electrical work at the all Compression Stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP).

The work performed will include but not be limited to:

- Installation, connection and testing of all Gas and Diesel generators, Switchgear/MCC, UPS System.
- Installation, connection and testing of all electrical equipment, lighting distribution boards, junction boxes.
- Glanding, termination connection, dressing, fixing and identification of all above & below ground cables.
- Megger and Continuity testing of all cables after installation & subsequent sealing in an approved manner.
- Cutting, fabrication, forming and installation of electrical cable tray (ladder type).
- Installation and painting/galvanizing of all cable support and fittings.
- Installation of cable identification makers.
- Installation of cable transits, accessories and protective ducts/sleeves.

- All work associated with building penetrations (if required) for the installation of cables including making good after installation.
- Installation and testing of the earthing system & lightning protection system.
- Installation and testing of all lighting system components, including those fixed to equipment packages.
- Installation and testing of Cathodic Protection system including of TR.
- Installation and testing of Heat Tracing System.
- Approval of Electrical inspector for all electrical equipment installations.

All of the above work shall be carried out by the EPCC Contractor in accordance with the requirements and specifications within these documents.

A Cathodic protection system shall be supplied and installed by EPCC Contractor for corrosion protection against underground pipes i.e. Oily Water Sewerage pipeline and Closed drain Network lines at new front compressors area as per piping layout (to be developed by EPCC Contractor).

Every metallic structure/ skid, motors shall be earthed from two different ends.

All metal Work used to enclose or contain current carrying conductors or components including the metal sheathing and armoring of cables shall be mechanically and electrically bonded together to form an efficient and effective earth return path for the maximum prospective earth fault current that may occur.

Apparatus shall be connected to the earth system via cable armor, in addition to other means of earthing, except in the case of single core armored cable.

Where package distribution boards, motor starter panels, motors, lighting distribution boards, cable trays (ladder type), piping, steel work, junction boxes, socket outlets, lighting fixtures, as well as frames, supports, pedestals, etc., are connected to the earth system or bonded together by means of earth conductors, the conductors shall be fitted with robust compression lugs and the Equipment shall be provided with earth terminals, lugs or bosses made of flat bar.

Moreover, please refer Electrical Installation Workmanship Document for further details.

12.3.14.2 **Testing of Electric Motors**

During the construction, pre-commissioning, commissioning, startup, Performance test and RGT phases of the work, the EPCC Contractor shall undertake all routine maintenance and checks of the electric motors including rotating check etc, as recommended by the motor Vendors.

12.3.15 **Instrument Installation, Hookup, Calibration and Testing**

12.3.15.1 The Contractor shall be responsible for the installation, hookup, calibration and testing of all instrumentation and Controls work at all Compression Stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP). The work performed shall include but not be limited by:

- a. Calibration, testing and re-installation of all instruments and valves supplied on the packages, irrespective of such work being carried out in the Vendor's works.
- b. Continuity testing and checking of all cables with associated instruments I/Os, irrespective of such work being carried out in the Vendor's works.
- c. Calibration testing and installation of all loose instruments and valves not pre-installed on packages.
- d. Installation and testing of all pneumatic, electrical and hydraulic connections.
- e. Installation of all instrument air supply lines and signals transmission tubing including the installation and coating of any supports and ducting.
- f. Relocation of existing instruments and valves.
- g. Installation of control panels supplied on the packages, irrespective of such work being carried out in the Vendor's works. After installation of Packages Control Panels, "Cold Testing" with documented evidence to be provided by EPCC before power up.

- h. Provision of all cables, tags and identifiers.

12.3.16 Security, Safety and Work Requirements

Security, Safety Policy & procedures, protection of environment etc. shall be as per clause 11.0 of Condition of Contract.

12.3.16.1 Security and Access

The EPCC Contractor shall be responsible for establishing the facility boundaries and security fencing. The EPCC Contractor shall also be responsible for the security of all facility, equipment and materials until the handover of the facility.

12.3.16.2 Safety Policy and Procedures

Prior to commencement of construction, the EPCC Contractor shall produce a written safety policy and procedure for OGDCL approval, which EPCC Contractor shall enforce during all construction and commissioning activities.

The procedure shall include as a minimum contingency plans for a plant emergency, fire precautions, accident procedure, safety training, levels of authority and responsibilities, etc. The EPCC Contractor shall designate a plant safety officer who shall be responsible for the day-to-day coordination with OGDCL representatives on all safety aspects of the work.

12.3.17 Vendor's Representatives

The EPCC Contractor shall be responsible for all costs associated with the provision of any on-site services, including the attendance of Vendor's representatives during the fabrication, construction, testing, commissioning and Performance Test Run phases of the Project.

12.3.18 Sub-Contracting

The EPCC Contractor may sub-contract any component of the Works. However, the Sub-contractor to be employed shall be approved by the OGDCL. The EPCC Contractor shall at all times be fully accountable and responsible for the sub-contracted work as if no such sub-contracting has been made. No act or omission of Sub-contractors and/or their employees shall in any way relieve the EPCC Contractor of its obligations covenants, warranties and guarantees given in the Contract. The EPCC Contractor shall in no way sub-contract the whole Works.

12.4 Mechanical Testing, Pre-commissioning, Commissioning, Facility Startup Performance Test, Reliability Guarantee Test & Handover

EPCC Contractor to submit a complete program for the erection & commissioning and testing & training of the compression facility for OGDCL's review and approval at least 4 weeks before the scheduled activity. Training shall be arranged before commissioning of the facilities.

EPCC Contractor shall provide all test equipment & communication radios required for construction, pre-commissioning, start-up, commissioning, and performance testing etc. Contractor shall use separate frequency band for its communication and shall arrange VHF license from the concerned authorities accordingly.

12.4.1 Contractors Organization

It is OGDCL's intention that all Compression Stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP) shall be tested, pre-commissioned and commissioned in discrete packages and systems, and the each phase of the work is carried out in an orderly and properly documented fashion. The EPCC Contractor shall be responsible for all these activities and his onsite organization should therefore reflect the importance of these activities and ensure that these can be carried out in a satisfactory manner to OGDCL's approval. OGDCL staff may be involved to assist in all phases of commissioning and plant startup.

12.4.2 Mechanical Testing and Mechanical Completion

12.4.2.1 "Mechanical Testing" shall mean the carrying out of such hydraulic, pneumatic, electrical and other field tests as are specified and are required to demonstrate that the various sections and components of the Works have been constructed in accordance with the Contract.

Mechanical testing would typically include:

- Hydrostatic, pneumatic or other NDT testing of all pressure containing parts of the system.
- Testing of all electrical system components including switchgear and motor starters, motors, etc.
- Calibration and testing of all instruments including those installed on packages or skids.
- Testing of power and instrument cables.
- Testing of Package PLCs.
- Testing of Communication cables.
- Completion of appropriate test sheets and documentation.

All such testing of system components by the EPCC Contractor shall be subjected to witnessing by OGDCL/Consultant.

Mechanical completion of the package by the EPCC Contractor shall be signified after all such tests have been completed and documented and after the following has been carried out:

- Cleaning, flushing, draining, blowing out and drying out of vessels and piping systems and the installation, removal of temporary blinds used for isolation and testing of joints, as necessary.

- Replacing control valves, relief valves and orifice plates as removed for above.
- Replacement of gaskets and tightening of flanges, etc.

When these activities have been carried out by the EPCC Contractor to the satisfaction of OGDCL, the equipment and/or system shall be ready for pre-commissioning.

The EPCC Contractor shall notify OGDCL in writing at least two (2) weeks in advance of his intent to pre-commission the equipment and facilities.

12.4.2.2 Mechanical Completion Certificate

The Mechanical Completion date is considered as the date of the last pre-commissioning satisfactory test and issuance of the Mechanical Completion Certificate by ENAR/OGDCL (upon the request of EPCC Contractor) for the last portion or system of the Works.

Following steps shall be followed for the issuance of mechanical completion certificates for each individual system / equipment;

- a. EPCC Contractor shall conduct an in-house inspection of the relevant system and generate a Punch-List.
- b. Once the contractor's punch-list items are closed and pre-commissioning requirements/tests related to each individual system (portion of the Works) are completed, Contractor shall invite/request for OGDCL's inspection and provide Contractor's closed punch-list, test results, and Mechanical Completion checklist for OGDCL's review and information.
- c. Consultant/OGDCL shall carryout inspection of the system/equipment and issues a punch list to Contractor within 7 days of Contractor's request to OGDCL for inspection. The punch lists will be of two types:
 - **Category-A:** Critical (items in the opinion of the ENAR/OGDCL, without which safe and intended operation of the facility cannot be ensured);
 - **Category-B:** Non-Critical (items in the opinion of the ENAR/OGDCL, without which safe and intended operation of the facility is not compromised in any manner and that the same could be carried out without Plant/facility shut-down);

- d. EPCC Contractor shall carry out all the necessary activities to clear out the punch list items. The procedure mentioned above shall be repeated until all OGDCL's punch-list items are closed and signed off by ENAR/OGDCL representatives;
- e. EPCC Contractor shall apply for the mechanical completion certificate of the individual system/equipment when all the critical punch-list items have been closed out and signed off by Consultant/OGDCL representatives.

The duration in which EPCC Contractor shall complete the punch list items of the works shall be agreed by (ENAR/OGDCL & EPCC Contractor) both parties;

The Mechanical Completion Certificate forms, system by system basis, shall be prepared during the procedure set-up stage. Forms shall be prepared by Contractor and submitted to OGDCL at least eight (8) weeks before the first pre-commissioning test.

12.4.2.3 Mechanical Completion Check Lists

Detailed Mechanical Completion Check lists (System-wise) will be prepared during detailed engineering phase, as a part of pre-commissioning manual which shall be submitted for ENAR approval at least eight (8) weeks in advance before the start of any pre-commissioning activities (OGDCL shall endorse all of the Consultant's approved check lists). These check lists shall be prepared based on API 700 guidelines for Mechanical Completion and shall cover, as a minimum, the following sections:

- i. Vendor's assistance;
- ii. Permits;
- iii. Vendor's / special instructions;
- iv. Lubricants and consumable supplies
- v. Packing and seals;
- vi. Removal of temporary supports, bracings, weather protection etc.;
- vii. Tie-ins at units limits;
- viii. Leak and pressure test;
- ix. Inspection;
- x. Pressure/vacuum safety relief devices;

- xi. Flushing and cleaning;
- xii. Temporary screens, strainers and blinds;
- xiii. Purging;
- xiv. Housekeeping;
- xv. Maintenance, spare parts and special tools;
- xvi. Noise Survey;
- xvii. Specific procedures/checks/tests for electrical, instrumentation, piping, static equipment, rotary equipment and safety systems.

EPCC Contractor shall ensure that all conformity checks, as defined above, shall be carried out in accordance with the Mechanical Completion checklists.

EPCC Contractor shall ensure that the Mechanical Completion checklists shall define the scope of Works which must be systematically performed, individually, on each type of equipment and system. The checklist shall also be used as a log to record the checks made.

EPCC Contractor shall ensure that a Pre-commissioning test sheet be completed for each test performed. All other pre-commissioning activities such as process piping / piping flushing and cleaning, shall be supported by respective documents.

12.4.2.4 Operations and Maintenance Manuals

Operations and Maintenance Manuals shall be provided by the EPCC Contractor to Consultant/OGDCL, at the time of issuance of purchase order prior to mechanical completion of the Facility. They shall include Instruction Manuals that are complete and specific, and whose contents conform to the index. Documents shall be used which are specific to the work, including literature of the suppliers or manufacturers that would be useful to the OGDCL in the care, operation and maintenance of the equipment. Nomenclature used to reference each item shall be consistent throughout the manuals.

Information furnished shall be complete for equipment and systems furnished by the EPCC Contractor and its suppliers. Material that does not contribute to the understanding of the design, care, operation and maintenance of the equipment shall be excluded from the Instruction Manuals where practical. If it is necessary to use existing material containing extraneous items, the item referred to shall be clearly and plainly marked, the irrelevant data

shall be deleted in an orderly and systematic manner and the date of publication shall be clearly shown.

The Instruction Manual shall be organized as follows:

Section I: Operation shall include the following:

- i. General description of equipment, including overall design, specific and special features of design and descriptive drawings.
- ii. Performance specifications for equipment stating the basis for calculations and allowable variations.
- iii. Information to allow the OGDCL to update existing or create new OGDCL system design descriptions, which shall include but not be limited to detailed operating instructions for start-up, shut-down, normal operation and emergency shut-down as further detailed below.
- iv. Starting instructions complete, detailed and specific for equipment furnished, noting the step-by-step procedure to be followed. Precautions and critical points to be observed shall be noted and emphasized as required. These instructions shall be divided into Initial Starting, Normal Starting and Starting after extended shutdown.
- v. Operating instructions complete, detailed and specific for equipment furnished. It shall include precautions and critical points to be observed, including suggested form to be used in taking periodic readings to maintain an operations record. There shall be a tabulation of possible operating difficulties with the probable cause listed and remedial action to be taken.
- vi. Shutdown instructions complete, detailed and specific for equipment furnished, noting the step-by-step procedure to be followed for shutting down the equipment. Precautions and critical points to be observed shall be divided into “Normal Shutdown” and “Emergency Shutdown.”
- vii. Design data for equipment and systems specifying horsepower, kilowatts, voltage, amperage, pressure, temperature, revolutions per minute, flow, etc.
- viii. Characteristic curves for equipment where called for in the Technical Section(s) of the equipment specifications or when normally furnished for the particular equipment, such as fuel consumption, head, capacity, horsepower, efficiency, etc.
- ix. Operator alarm responses for enunciator alarms.
- x. Piping and instrument diagrams which provide proper valve alignment for equipment for normal operation.

- xi. Composite drawings or color reproductions of computer CRT graphic displays showing type of control board or computer-accessed and displayed operating stations for valves and major equipment.
- xii. Normal process operating ranges and set points for all facilities equipment.

Section II: Maintenance shall include the following:

- i. Disassembling instructions complete, detailed and specific for assemblies of equipment furnished, noting the step-by-step procedure to be followed. Unusual care and precautions to be taken shall be noted and emphasized. Reassembly instruction shall also be included.
- ii. Maintenance instructions complete, detailed and specific for equipment furnished normal preventive maintenance instructions and lubrication information, including periodic inspection, testing and maintenance requirements in accordance with applicable codes and manufacturers' instructions. Schedule covering tests and inspections to be performed after various periods of operation and overtime shall be included. A summary description and identification of special tools required and/or furnished for maintenance shall also be included.
- iii. Settings, clearance and adjustment data tabulated for equipment, covering instrument settings for operation, alarm and shutdown and operating clearances and adjustments required for proper operation. Also, a tabulation of recommended and actual operating conditions, such as temperature, pressure, flow, etc., for equipment and systems. The actual shall be entered after installation or field test. Included also shall be calibration procedures and instrument data sheets.
- iv. Test reports, mill test certificates and material specifications where the requirement for these items has been specified in the Technical Section(s).
- v. Parts Catalogue/manual for spare parts identification/estimation.
- vi. OEM recommended spares parts showing frequency of change or minimum/maximum levels.

12.4.3 Pre-Commissioning

- 12.4.3.1 The EPCC Contractor shall be responsible for pre-commissioning, which is defined as the systematic check of equipment and systems, on completion of fabrication installation and testing i.e. after signature of the mechanical completion certificate, in order to verify that:

- All installation work, including testing, is complete.

- The equipment and systems are fit and safe to be put into operation with the intended service fluids, power sources, etc.
- 12.4.3.2 The EPCC Contractor shall furnish and install all fuels, lubricants, preservatives and any other consumables necessary for operation of the entire facility.
- 12.4.3.3 The EPCC Contractor shall be responsible for preparing and submitting for approval to Consultant/OGDCL, his proposed procedures, acceptance forms and sequences for the pre-commissioning of each section of the work. This shall include, but not be limited to the following:

a. Mechanical

- Running in all drives and compressors and their drives.
- Cleaning screens and filters, replacing and adjusting packing and seals.
- For piping system, installation and removal of temporary blinds as required, circulation and pre-commissioning of systems including service and potable water, effluent and drainage, fire protection, instrument and plant air, relief and blow-down and interconnecting lines.
- For engine driven equipment, the setting of governors, the alignment of coupling, cleaning and removal of temporary screens.
- Vibration checks, alignment checks in accordance with the manufacturer's requirements and subject to OGDCL's approval.
- All running tests to ensure that the sections and components of the Works are ready for operation and safe commissioning.
- Any other checks and running tests required by the Vendor.

b. Electrical

EPCC Contractor shall perform complete Testing, Pre-commissioning and commissioning of all electrical items for new nodal / front end compressors & allied utilities and shall carry out the following activities at site(s) as a minimum:

– Testing

EPCC Contractor shall carry out all inspection and witness testing for equipment at vendors' works and shall be responsible for ensuring that all items supplied are strictly in accordance with the specifications mentioned in relevant design documents for all electrical equipment and accordingly submit inspection reports.

For testing, documentation, spare list, refer the relevant equipment specification. Few are listed below for major Electrical equipment;

- 0258-ELA-6502 (for motors)
- 0258-ELA-6507 (for Gas generators)
- 0258-ELA-6508 (for Diesel generator)

Similarly, Approved Field Testing Inspection and Pre-commissioning & Commissioning, refer Doc. # 0258-ELA-6511 (Electrical Installation Workmanship), and henceforth for all electrical equipment.

The EPCC Contractor shall be responsible for the factory and field tests of electrical equipment of the project. As a minimum, factory acceptance tests shall be required for Gas & Diesel Generators, Switchgear/MCC, Power & Control Cables. Field acceptance testing shall be completed in accordance with international standards and procedures. During testing, it will be the responsibility of the EPCC Contractor to correct the malfunctions and problems detected in the electrical equipment/system, documentation of results, witnessing and to manage of a master copy of all documents, which will later be used to make the documentation "As Built".

The EPCC Contractor shall prepare and issue written reports for review by Consultant & OGDCL on all interim and final inspection and tests. The EPCC Contractor shall keep records of all the tests carried out and provide a copy to Consultant & OGDCL.

– Pre-Commissioning

The EPCC Contractor will perform pre-commissioning of the Compression facilities. In this regard a complete plan shall be provided for electrical system.

The EPCC Contractor shall perform pre-commissioning and shall be responsible for preparing and submitting for approval to Consultant & OGDCL his proposed procedures, acceptance forms and sequences for the pre-commissioning of each section of the work. This shall include, but not be limited to the following:

- Function testing and operation of equipment in compliance with Vendor requirements and in accordance with the applicable design codes.
- Check of power & control cables i.e. continuity check, megger check, and other international standard checks, required to demonstrate completeness of scope of work.

c. Instrumentation

- i. Function testing and operation of control loops.
- ii. Set points and action of alarm and shutdown devices.
- iii. Stroking of control and shutdown valves.
- iv. Continuity testing and checking of all cables and instruments & I/Os.

12.4.3.4 Pre-commissioning of the Package and Off-Package instrumentation shall be carried out by the Contractor systematically, starting with individual instruments and controllers through system instrumentation to a final demonstration of the individual Compressor safety shutdown to overall facility safety shutdown system. All pre-commissioning activities shall be subject to witnessing by Consultant and OGDCL, and the Contractor shall prepare and submit written reports on all pre-commissioning work carried out together with completed acceptance forms.

12.4.3.5 Receipt of such completed documentation (check lists, acceptance forms, etc duly witnessed and signed by Consultant and OGDCL's representative) is necessary to enable OGDCL to issue a "Mechanical Completion Certificate", which is required before plant pre-commissioning/preliminary testing and commissioning may commence.

12.4.3.6 The facilities shall only be accepted by Consultant/OGDCL as mechanically complete and ready to commission after receiving Mech Completion Certificate and physical inspection of the installation has been carried out to verify that all piping, electrical and instrument systems, etc. are installed in accordance with final construction drawings. Such inspection shall also consider:

- i. The pressure test has been successfully completed.
- ii. Electrical and instrumentation loop checks have been executed.
- iii. Control valves, motors, engine drivers, etc., are functional.
- iv. All other checks (functional and otherwise) have been executed in accordance with the Contract.
- v. Operating areas are clear of debris and construction equipment.
- vi. Mechanical completion dossiers are completed along with all inspection and test records, materials test certificates etc.

The EPCC Contractor shall prepare and submit the detailed program and procedures for approval to Consultant/OGDCL for pre-commissioning of facility so that final document will be available at site at least six (6) weeks prior to commencement of pre-commissioning.

12.4.4 Commissioning and Performance Testing

12.4.4.1 Commissioning

- a. After all pre-commissioning work has been satisfactorily carried out, the Compression facility shall be commissioned with the introduction of hydrocarbons.
- b. The EPCC Contractor shall be fully responsible for all commissioning activities and operation until steady state operating conditions (within seven days from commissioning) are achieved and the Compression Facility is meeting flow and pressure specifications. At a mutually agreed time, the EPCC Contractor shall

carry out the Performance Test run. Upon satisfactory completion, the facility shall be handed over to OGDCL.

- a. EPCC Contractor is required to prepare a schedule of Level-4 (min) in Primavera or MS Project, which summarizes their interpretation and understanding of the completion of contract activities from construction through to final acceptance at the start of project the schedule will be base lined and shall be used as reference to measure the project progress.
- b. Final versions of application programs, Configuration files and complete backup of Project software.
- c. The EPCC Contractor shall prepare a detailed program and procedure for approval by Consultant/OGDCL for commissioning and testing the process plant so that a final document will be available at Site at least Two Months before commencement of pre-commissioning. Immediately after the Compression Facility has been commissioned, guarantee tests shall be carried out as follows;

12.4.4.2 Performance Test

- a. The purpose of this Test shall be to demonstrate that the compression facilities meets the performance requirements laid-down in the Technical Specifications and respective data sheets.
- b. Performance test shall be carried out by the EPCC CONTRACTOR on peak ambient conditions in order to evaluate the compressor package performance, flow rate, inlet / outlet pressures of the packages.

However, if the Performance Test is performed in peak summer conditions by the EPCC Contractor then OGDCL shall perform performance test in peak winter season. Any abnormality observed or faults identified during the test perform by the OGDCL, this will be communicated to the EPCC Contactor to rectify the same at its own cost during defect liability period.

Similarly, if the Performance Test is performed in peak winter conditions by the EPCC Contractor then OGDCL shall perform performance test in peak summer season. Any abnormality observed or faults identified during the test perform by the OGDCL this will be communicated to the EPCC Contactor to rectify the same at its own cost during defect liability period.

- c. During the PERFORMANCE TEST, the measurements of flow rates (gas and liquid), inlet / outlet pressures, temperatures etc. shall be taken at hourly intervals.
- d. The Compression packages shall be operated for seventy two hours (72) continuous running Performance Test under peak load and turndown rates. The procedure for these Tests and methodology for performance evaluation shall be agreed between the EPCC Contractor and Consultant/OGDCL during the design phase. It shall be designed to demonstrate satisfactory operation of the entire Compression Package performance.
- e. Particular attention shall be paid by the EPCC Contractor to such things as the level of vibration of all rotary/reciprocating units and other critical operating parameters and gas & liquid stream vessels. Any component malfunction and has an effect on satisfactory plant operation during these Tests, the particular Test being carried out shall be considered void and shall be re-conducted after remedial action has been completed to OGDCL's/Consultant's satisfaction.
- f. Following completion of the Test to OGDCL's/Consultant's satisfaction it is required that the operation of the Compression Package and all equipment forming part thereof shall be demonstrated to be in accordance with the Technical Specification. For this purpose the following Tests shall be carried out separately by the EPCC Contractor to the satisfaction of OGDCL/Consultant in order to fulfill the requirements of the Performance Guarantee Test. The procedure for the Tests shall be agreed between the EPCC Contractor and OGDCL/Consultant during the design phase:
 - i. Each Compressor shall be operated for a continuous period of not less than seventy two (72) hours in the fully automatic mode.
 - ii. A complete emergency shutdown of each compressor shall be initiated. This shall demonstrate the safe and satisfactory shutdown of all operating equipment and the safe isolating and flaring of the Compressors.
 - iii. If the PERFORMANCE TEST is interrupted for reasons attributable to the EPCC CONTRACTOR, then EPCC CONTRACTOR shall promptly reengineer and/or carry out such modifications as are required to rectify the causes of the interruption. OGDCL/Consultant will thereafter give notice in writing to the EPCC CONTRACTOR specifying the date on which PERFORMANCE TEST may be recommenced. Additional cost, if any, resulting from such interruption shall be to the EPCC CONTRACTOR'S account.
 - iv. If the WORKS or any part thereof fail to pass the MECHANICAL TEST or if the Process Guarantees specified (in the specifications and data sheet) are not met for

reasons attributable to the EPCC CONTRACTOR; Tests of the WORKS or the said portion shall be repeated within a reasonable time upon the same terms and conditions save that all reasonable expenses which the OGDCL/Consultant may have to incur by the repetition of the Tests shall be deducted from the CONTRACT PRICE

- v. A demonstration that Compressor Package cold and hot start under both summer and winter ambient condition and meets all technical specifications and requirements, particularly equipment which are affected by ambient conditions such as liquid production rate, temperature, Compression system performance, etc.
- vi. The acceptability of noise levels (85 db @ 1 meter) shall be demonstrated by taking sound pressure level reading during operation of the Compression Facility. Those readings shall be by means of a precision grade sound level meter to BS-4197. Corrections, as agreed between the EPCC Contractor and OGDCL/Consultant during the design phase, shall be applied to the reading in order to forecast the figures that will apply in the future when the Facility is operating under full power and load. Acceptable final sound pressure levels shall be in accordance with the relevant codes and standards.
- vii. The satisfactory operation of the automatic fire and gas detection system shall be demonstrated. This Test shall be detailed during the Project design phase.
- viii. The EPCC Contractor shall ensure through the Purchase Order that the performance of each cooler, heat exchanger, radiator and compressors shall be demonstrated to OGDCL's/Consultant's satisfaction by a further test to be conducted during the summer at a time when the ambient temperature is close to the design maximum temperature. The exact procedure for this test shall be agreed between OGDCL/Consultant and the EPCC Contractor during the design phase.
- ix. On completion of the Performance Test, to the satisfaction of OGDCL/Consultant a Provisional Acceptance Certificate signifying that the Compression Facility meets the performance requirements of the Technical Specification shall be issued to the EPCC Contractor by OGDCL/Consultant and signed by the representatives of both OGDCL/Consultant and the EPCC Contractor.

12.4.4.3 Reliability Guarantee Test (RGT)

The continuing availability of all Compression Stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP) to deliver required gas/ liquid flow rates and pressures up to and including the design maximum day flow at the contractual delivery pressure and temperature shall be demonstrated by means of a Reliability Guarantee

Test. This Test shall start on completion of the Performance Guarantee Test to the satisfaction of OGDCL/Consultant and shall continue for a minimum of 30 days.

The EPCC Contractor shall ensure that all defects arising during the Reliability Guarantee Test are properly and expeditiously rectified with no cost to the OGDCL. The EPCC Contractor shall also be responsible for the provision of all spares, consumables, lubricants, etc required for Compression Facility operations and maintenance with no cost to the OGDCL upto the complete RGT.

Completion of the Reliability Guarantee Test shall occur after Compression Facility has completed a continuous period of 30 days with a maximum of four (04) shutdowns of major components of Compression Facility lasting not more than twelve hours (12). EPCC Contractor will require to repeat the RGT for a period of thirty (30) days if four (04) such shutdowns occur during the RGT period.

Further to above condition, EPCC Contractor shall also perform RGT for a particular compressor package for which shutdown is continued more than seventy two (72) hours due to unavailability of spare parts or any other malfunctioning during RGT period, for a thirty (30) days' time. In this case, the relevant payment milestone of RGT will be proportionate linearly as per the compression packages completed the RGT.

Should the completion of the Test be delayed or prevented by an occurrence of force Majeure or by direction of OGDCL then the Test shall be recommenced on cessation of the Force Majeure occurrence or at OGDCL direction from the point at which the Test has been delayed or prevented.

The EPCC Contractor shall be responsible for directing, training and assisting OGDCL's personnel in correct operation and advising and assisting in the correct maintenance of Compression Facility during the whole period of the Reliability Guarantee Test.

If as a result of a deficiency or error in the services provided by the EPCC Contractor, the Suppliers of equipment or Sub-contractors, the Reliability Guarantee Test has not been completed within a period of 30 days from its commencement then the test shall be re-conducted for which the EPCC Contractor shall be responsible for the continued attendance of its personnel at no cost to OGDCL for completion of the test.

EPCC Contractor shall have sole responsibility to carry all necessary work/ upgrade if required to comply/ satisfy RGT requirements.

12.4.4.4 **Performance Guarantee**

During the Performance Test and RGT, the reading of following major parameters (but not limited to) shall be taken at hourly and four hourly intervals respectively including the performance requirements laid-down in the Technical Specifications and respective data sheets:

1. Gas Flow rates.
2. Inlet and outlet Pressures and temperatures.
3. Fuel gas Consumption etc.

12.4.4.5 **Training**

EPCC Contractor is required to provide training to all operation and maintenance staff, and therefore appropriate technical personal shall be included as part of his team during the pre-commissioning & commissioning, start up, Performance Test and RGT phases of the project. While the EPCC Contractor shall remain responsible for all Compression Stations (Thora-deep-03 GGS, Tay-03 GGS, TAY at GPP and KPD at GPP) until handover, he shall be required to provide such assistance as is necessary during this familiarization phase.

In the pre-commissioning and commissioning phases of the plant, the EPCC Contractor shall provide informal training for OGDCL personnel from time to time. During this time, the OGDCL personnel shall be coordinated by EPCC Contractor's Commissioning Engineer.

The EPCC Contractor shall prepare a training program for the purpose of training OGDCL personnel in the operation and maintenance of Compression Facility. The EPCC Contractor shall obtain the relevant information relating to training from its Suppliers.

Specialized training of OGDCL personnel in the operation and maintenance of the Compression Facility shall be conducted at site by the EPCC Contractor's site supervisors during the erection of Compression Facility.

Final training of OGDCL personnel in the operation and maintenance of the Compression Facility shall be conducted at site by the EPCC Contractor's site personnel during commissioning of the Compression Facility and for a period thereafter to be agreed when all aspects of the Compression Facility operation will be demonstrated. However the EPCC Contractor shall be required to provide operational management assistance and training services not less than 6 weeks after the facility is handed over to OGDCL.

13.0 **Health, Safety & Environment**

OGDCL HSE Policy (<https://www.ogdcl.com/hse-policy-statement>) and Integrated HSE System Manual (<https://www.ogdcl.com/hse-management-system>) and HSE Pledge Handbook(https://www.ogdcl.com/sites/default/files/OGDCL_Contractors_HSE_Pledge_Handbook_Final%2884%20pages%29%20Dec%202021.pdf) shall be followed by all Contractors and sub-contractors.

EPCC Contractor will conform to the OGDCL HSE Policy and principles during the execution of the project. All facilities provided for OGDCL personnel during the execution of the Work will conform to the OGDCL HSE Policy and principles. The Compression Facility will be designed, constructed and commissioned so that during operation it conforms to the OGDCL's HSE Policy and Principles.

The EPCC Contractor shall take all precautions to maintain health & safety of its personnel deputed at site and avoids any adverse effects on the environment of the area. Any incident/accident shall be recorded and brought to the knowledge of OGDCL / Consultant.

The EPCC Contractor will immediately take safety and mitigation measures to minimize the effect of the incident.

Prior to commencement of construction, the EPCC Contractor shall produce a written HSE policy and procedures for OGDCL / Consultant's approval. The policy and procedures Contractor shall enforce during all construction and commissioning activities shall be in lined with OGDCL HSE policies.

As a minimum contingency plan for a plant emergency, fire precautions, accident procedure, safety training, lines of authority and responsibilities, etc. shall be required. The EPCC Contractor shall designate a Construction HSE Officer (who will head a team of watchmen) who shall be responsible for the day-to-day coordination with OGDCL / Consultant on all health safety and environmental aspects of the work.

a) **Work Permits**

During construction, pre-commissioning, testing and startup a permit to work system shall be required. Details of the system shall be by agreement with OGDCL, but shall involve a formal permit by a nominated OGDCL representative to carry out a specific

item(s) of work and a statement of conditions under which the work must be carried out. No Work shall be allowed without proper authorization from Plant's Safety Personnel and OGDCL/Consultant may stop the work if proper safety precautions/procedures are not being followed by EPCC Contractor personnel.

b) Protective Personal Equipment

The EPCC Contractor shall, at his own expense, supply his personnel and Sub-Contractor's personnel, required in connection with the safe performance of the Work, with adequate protective personal clothing and other protective equipment which shall be maintained in good condition or replaced, and shall be worn on all relevant occasions as indicated by notices, instructions and good practice.

c) Security

The EPCC Contractor shall be solely responsible for the safety and security of the Site in its possession until its takeover by OGDCL. The EPCC Contractor shall make appropriate security arrangements and shall strictly comply with security requirements and instruction of OGDCL site security incharge and shall be as per clause 11.11 of Condition of Contract.

d) Housekeeping

The EPCC Contractor shall be responsible for ensuring that the site is kept clean and tidy all times even during execution and installation activities and that all scrap materials and tools are removed from the job site on completion of the Work.

e) Medical Welfare

EPCC Contractor shall be responsible for the medical welfare of his own and Sub-Contractors' employees, servants or agents and shall take care of periodical medical examinations, arrangements for medical attendance, treatment or hospitalization if and when necessary and shall arrange suitable insurance coverage for such contingencies. In cases of emergency, OGDCL may make or provide for, the necessary emergency arrangements, the costs of which shall be reimbursed to OGDCL by EPCC Contractor.

f) Safety Equipment

EPCC Contractor shall at his own expense provide adequate first aid equipment, fire extinguishers and other safety equipment of an approved type, as may be specified (or expected in accordance with good working practice) and shall maintain this in a professional manner as directed by OGDCL / Consultant or the legal and industry standards.

In addition, EPCC Contractor shall keep up-to-date inspection calibration records of all said equipment. Free access by all persons on site to all fire extinguishing and safety equipment must be maintained at all times. Contractor shall ensure his personnel to conduct the necessary safety drills and make familiar with the existing plant.

13.1 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

EPCC Contractor will conform to the recommendations of Environment Impact Assessment (already performed by OGDCL for complete KPD-TAY GPP and TAY-03 GGS through its pre-qualified third party) during the execution of the Work. The Compression facilities for KPD-TAY Compression Project will be designed, constructed and commissioned so that during operation it conforms to all requirements of the EIA.

13.2 COMMUNITY RELATIONS AND CODE OF BEHAVIOR

EPCC Contractor will at all times behave towards the community in the area of the Site in accordance with the Community Relations and Code of Behavior.

14.0 Deliverables

General

The EPCC Contractor shall supply all documentation/deliverables in English language and shall be in accordance with applicable codes and standards in staging for review and finalization by Engineering Consultant/OGDCL. All additional documentation required by the Specifications shall also be provided by the EPCC Contractor.

The EPCC Contractor shall produce the following information, as a minimum during the course of the Contract. The below list does not relieve EPCC Contractor from its responsibility to produce all documentation & test certificates as mentioned in each items/equipment's respective specification / datasheets.

The EPCC Contractor shall produce but not limited to the following:

14.1 General Facility Information

- Scope of Work
- Project Schedule
- Design and Construction Procedures

14.2 Process Design

- Basis of Design
- Philosophies
- Description of Facilities/Special Features
- Interconnection with all Process Unit
- Facility Utilities
- Control of Facility /Operating Variables/ Facility Surging/ Facility Turndown
- P&IDs/ PFDs / UFDs / Utility Balances, Material Selection, datasheets.

- Detailed Equipment Listing (including design conditions, size/weight information, etc.)
- Dynamic simulation study for Nodal Compression facilities.

14.3 Facility Layout

- Philosophy
- Separation Requirements
- Updated Plot Plan
- Area Classification Drawings
- Site Drainage Plan of the facility

14.4 Safety

- Philosophy
- Cause and Effect Diagrams
- Fire and Gas Detection/Site Zoning
- Fire & Gas Mapping study Report
- SIL Study Report
- Overpressure Protection
- Facility Blow-down
- Fire Fighting Systems
- Safety Facilities/Drainage Systems
- Vent/Flare Heat Radiation and Dispersion Considerations as well as Liquid Dropout Potential
- HAZOP Study

- HAZID Study

14.5 Mechanical/Piping

- Plot Plan
- Key Plan
- Piping Layout
- Isometrics
- Mechanical and stress analysis specifications
- Stress Analysis Report
- Compressor Packages Vendor Drawings of all Equipment
- Underground Piping Layout
- Fire Water Layout
- Storage Tank Calculations and Fabrication drawing
- Pressure Vessel & Heat Exchanger Calculations and fabrication drawing
- Vent Stack GA Drawing
- Pulsation study Reports-

14.6 Instrument and Control

The below list does not relieve EPCC Contractor from its responsibility to produce all documentation & test certificates as mentioned in Instrument equipment's respective Datasheets.

- Control & Shutdown Philosophy

- Detail Specifications & Data Sheets of all items (instruments, control, cabling, bulk material etc).
- Detail Specifications for Instrument & Controls installations.
- Compressor Control System Architecture Drawings
- Reference documents, codes and standards
- Quality Plan
- Operator Interface Proposals including Screen Animation principles and color standards, display sketches, alarm philosophy
- Soft & hard copies of system software configuration
- Soft copy of program for developing graphic screen displays & CPU programming
- I/O Loading schedules
- Control Panels dimensioned layout drawings
- System hardware configuration
- Description of all implemented computational algorithms
- Power consumption detail.
- Component list along with make model and OEM detail
- Heat Dissipation detail
- System BOM with complete Vendor detail,
- Power supply details including distribution line diagrams
- Instrument List for Packages as well as Off-Package Instruments.
- I/O List for Package PLCs.

- I/O List for existing DCS, ESD and RTUs.
- Communication Block Diagram.
- Equipment Interconnection schemes for interfacing compressor PLCs with complete package instrumentation & with facilities central control systems.
- Equipment Interconnection schemes for interfacing compressor PLCs with Operator and Engineering Workstations and with Laptop.
- F&G Mapping Study report.
- SIL study report,
- Availability and reliability calculations
- Cause & Effects
- Logic Diagrams
- Loop Drawings
- Manufacturer/Vendor's Panel Drawings and Component list
- Hook-Ups/Installation Drawings
- Typical Engineering Drawings
- Technical Data Sheets of components used
- Instrument & JB Location Layout
- Fiber Optic Cable Layout
- Instrument Cable Layout
- Fire & Gas detectors layout
- Buildings Fire Alarm Layout.

- Cable Schedules
- Wiring, termination and interfacing details drawings
- Inspection and certification
- Inspection & Testing documents including continuity testing and checking.
- Vendor Certifications to be used in mentioned Hazardous area installation.
- Commissioning Manual
- Calibration Certificates
- SIL certificates
- ATEX Certificates
- Quality Plan
- M.T.O.
- BOM (Supply & Installation)
- Engineering/Operator Username & Password lists of all Control Systems & Work Stations
- Licensed communication software and calibration files of ESM of all Engines.
- Single/ one line diagrams
- Installation, Operation and Maintenance Manuals;
- Pre-commissioning & commissioning manuals.
- Loop/ IO wiring diagrams (from field to marshalling / controllers);
- HMI Snapshots.
- Installation drawings.

- Control Panel General Arrangement Drawing.
- Panel Internal Wiring Drawings.
- Tagging details.
- I/O Schedules details
- Logic Diagrams as per standard format
- Final versions of application programs, Configuration files and complete backup of Project software.

14.7 Electrical

- Electrical equipment specifications
- Electrical equipment data sheets
- Electrical load list
- Single line diagrams
- Hazardous area classification drawings
- Power and Control cable layout drawings
- Earthing layout drawings
- Lighting layout drawings
- Lightning protection drawings
- Distribution board drawings
- Cable schedules
- Material take-off list
- Detail installation drawings

- Supplier drawings and test certificates
- Hazardous Area Equipment certificates provided by international authorities
- Reference documents, codes and standards
- Cathodic protection drawings
- Electrical heat tracing drawings
- Quality Plan
- System Architecture Layout.
- Cable sizing calculations.
- Final Electrical Load List with equipment and system level segregation.
- Power Distribution Drawings;
- Termination Drawings;
- Testing and inspection procedures/details;
- Electrical equipment and cable layout drawings

14.8 Structural

- Philosophy
- Equipment Access
- Calculations
- Steel structure Specifications
- Pipe Support Drawings
- Structural Analysis Report (along with staad file) of all steel structure including pipe Supports, Compressor, Generator & pumps Sheds, Pipe Rack & Vent Stack etc.

- Steel Structure Drawing of Pipe Rack, Platform & Sheds etc.
- Detailed calculations to verify suitability of support structure to withstand wind velocity

14.9 Surface Treatment

- Painting

14.10 Calculations

- Process
- Mechanical
- Piping (including stress)
- Safety
- Instrumentation
- Electrical
- Civil
- Structural
- Others as required

14.11 Data Sheets

- Process
- Mechanical
- Instrumentation
- Electrical
- Others as required.

14.12 Equipment Specifications/Requisitions

- Mechanical
- Instrumentation
- Electrical
- Unpriced Purchase Orders for all equipment
- Others as required

14.13 Start-up and Operating Procedures (To be included as part of Project Data Book)

The Start-Up and Operating Procedures shall include, but not be limited to, the following generalized information headings:

Introduction

- Processing Scheme Description
- Process Units/Facility.

14.14 Basis of Design

- Capacity/Feed and Product Specifications, etc.

14.15 Description of Compression Facilities/Special Features

- Listing of Major Equipment/Design Conditions, etc.

14.16 Control of Plant

- Description/Philosophy
- Operating Variables/Facility Surging/Facility Turndown
- Fire/Gas and Smoke Detection System
- Emergency Shutdown and Blowdown Systems

14.17 Plant Start-up

- Pre-Start Preparations/Checks
- Start-up Procedures ('Black Start' Conditions)
- Start-up Procedures ('Live Plant' Conditions)

14.18 Deliverables Requirements

Contractor shall provide OGDCL with:

- One (1) reproducible (full size) of drawings in A2, A1, A0 format
- Two (2) prints (full size) of drawings and documents in A4 and A3 format

Only key drawings and documents shall be submitted for review. EPCC Contractor shall provide OGDCL/Consultant with list of key documents including drawings, specifications and calculations for review prior to commencement of work.

Documents for review shall be sent to Consultant and OGDCL head office or documents required by OGDCL will also be submitted.

14.19 Approved for Construction Documents

Contractor shall provide OGDCL/Consultant with:

- Two (2) reproducible (full size) of drawings in A1, A0 format
- Four (4) prints (full size) of drawings and documents in A4 and A3 format

- Four (4) prints A3 size reductions of drawings in A2, A1 or A0 original format
- Delivery of 'Approved for Construction' documents shall be provided to OGDCL site and head office.

14.20 Final and As-built Documentation

Within Two (2) months of completion of construction (i.e. mechanical completion) Contractor shall submit to OGDCL a Project Data Book.

Information to be included in the Project Data Book shall consist of, but not be limited to the following:

- Description of the Project
- Lists of drawings, specifications, calculations, purchase orders, manuals, etc.
- Design Reports
- Basis of Designs
- Calculations
- Specifications
- Data Sheets
- Certification & Traceability Records
- Testing & Pre-commissioning Procedures and Records
- Commissioning Procedures and Records
- Start-up and Operation Procedures and Manual.
- Operation and Maintenance Manuals (Vendors) including parts catalogue.
- Drawings (both EPCC Contractor and Vendor)

Revisions of the above documentation for inclusion in the Data Books shall be the latest including 'As built' where applicable.

Four (4) copies of the Project Data Book shall be presented to OGDCL in the following format:

- A4 size (except for drawings)
- Bound in hard plastic cover volumes
- Each volume shall be marked with title and Company logo and name (both A4 and A3 format)

- Each volume to be indexed
- Drawings to be reduced to A3 size and bound in A3 hard plastic cover volumes
- One (1) copy to be marked 'Original', three (3) other copies to be numbered and marked accordingly

EPCC Contractor shall submit proposed Project Data Book index to OGDCL for review prior to commencement of work.

OGDCL may request specific volumes or sections of the Data Book to be submitted prior to completion date e.g. Purchase Orders, Start-Up Procedures.

14.21 Other Documentation

14.21.1 Progress Reports

Weekly and 'Draft' Monthly Progress Reports shall be in A4 format, stapled only along with soft copies.

'Final' version of monthly progress reports provided by the Contract shall be in A4 format, card covered, with window for title and either comb or thermal bound according to number of pages in the report.

A soft copy of the report shall also be submitted.

14.21.2 Operation & Maintenance Manuals (Including Parts Catalogue)

The Operation and Maintenance manuals shall be provided by the EPCC Contractor at the time of issuance of purchase order prior to mechanical completion of the Facility. EPCC Contractor shall also submit the training manuals.

14.21.3 As-Built Drawings

As well as drawings presented in A3 format in the Project Data Book EPCC Contractor shall provide Company with one (1) full size reproducible, together with one (1) full size print of all A1 and A0 drawings raised to the as built status. EPCC Contractor shall nominate drawings to be 'As Built' and submit to OGDCL for review. Soft copies of the As-built drawings shall be submitted in format and software as specified by the Company.

15.0 **Specifications**

15.1 **Process**

0258-A-1007	Design Basis
0258-A-1010	Hydraulic Study Report
0258-A-1009	Process Equipment Adequacy Report
0258-A-1008	Operation, Control and ESD philosophy
0258-LS-1000	Line List
0258-LS-1001	Tie-In List
0258-B-1500	PFD for Nodal Compressors
0258-B-1501	PFD for Tay, Kay & Thora Slug Catchers
0258-B-1502	PFDs for KPD & Separation Equipment
0258-B-1503	Heat & Material Balance
0250-DS-1701	Data Sheet For K and T Trim Coolers
0258-DS-1000	Data Sheet of Nodal Compressor at Thora Deep-3 GGS
0258-DS-1001	Data Sheet of Nodal Compressor at TAY-3 GGS
0258-DS-1002	Data Sheet of Nodal Compressor at TAY GPP
0258-DS-1003	Data Sheet of K-FEC at GPP
0258-DS-1005	Data Sheet of New LP Condensate Pumps P-4601AB
0258-DS-1006	Data Sheet of New LP K-Finger Slug catcher (SC-4601))
0258-DS-1007	Data Sheet of New Thora Deep HP Slugcatcher (V-5801)
0258-DS-1008	Data Sheet of TAY-3 GGS Vent K.O Drum (V-5601)
0258-DS-1009	Data Sheet of Thora GGS Vent K.O Drum (V-5802)
0258-DS-1010	Data Sheet of TAY-3 GGS Vent Stack (X-5601)
0258-DS-1011	Data Sheet of Thora GGS Vent Stack (X-5801)
0258-DS-1012	Data sheet of TAY-3 GGS Process Drain Pit PUMP (P-5601)
0258-DS-1013	Data sheet of TAY-3 GGS Process Drain Pit PUMP ((P-5801)
0258-DS-1050	Data Sheet of Raw water Bore Pump (TAY-3 GGS)
0258-DS-1051	Data Sheet of Bore Water Filters (TAY-3 GGS)
0258-DS-1052	Data Sheet of Raw water Tank (TAY-3 GGS)

0258-DS-1053	Data Sheet of Raw Water Supply Pump (TAY-3 GGS)
0258-DS-1054	Data Sheet of Raw water Bore Pump (THORA- 3 GGS)
0258-DS-1055	Data Sheet of Bore Water Filters (TAY-3 GGS)
0258-DS-1056	Data Sheet of Raw water Tank (THORA-3 GGS)
0258-DS-1057	Data Sheet of Raw Water Supply Pump Supply (THORA- 3 GGS)
0258-DS-1058	Data Sheet of Fire Water Tank (TAY-3 GGS)
0258-DS-1059	Data Sheet of Fire Water Pump Diesel Engine (TAY-3 GGS)
0258-DS-1060	Data Sheet of Fire Water Pump Motor Engine (TAY-3 GGS)
0258-DS-1061	Data Sheet of Fire Water Pumps Jockey Pumps (TAY-3 GGS)
0258-DS-1062	Data Sheet of Hydrant (TAY-3 GGS)
0258-DS-1063	Data Sheet of Monitor (TAY-3 GGS)
0258-DS-1064	Data Sheet of Hose Cabinet (TAY-3 GGS)
0258-DS-1065	Data Sheet of Fire Water Miscellaneous (TAY-3 GGS)
0258-DS-1066	Data Sheet of Water Spray Nozzle (TAY-3 GGS)
0258-DS-1067	Data Sheet of Instrument Air System (TAY-3 GGS)
0258-DS-1068	Data Sheet of Instrument Air System (THORA-3 GGS)
0258-DS-1069	Data Sheet of Fire Water Miscellaneous (THORA-3 GGS)
0258-DS-1070	Data Sheet of Hydrant (PLANT GGP)
0258-DS-1071	Data Sheet of Monitor (PLANT GGP)
0258-DS-1072	Data Sheet of Hose Cabinet (PLANT GGP)
0258-DS-1073	Data Sheet of Fire Water Miscellaneous (PLANT GGP)
0258-DS-1074	Data Sheet of Water Spray Nozzle (PLANT GGP)
14-0258-CE-1000	Cause & Effect for Thora Deep-3 GGS
14-0258-CE-1001	Cause & Effect for TAY at GPP
165-4-C&E-001	Cause & Effect for KPD at GPP
165-4-C&E-003	Cause & Effect for TAY-3 GGS

15.2 Mechanical

165-4-SPM-055	Specification for Skid Mounted Equipment Packages)
0258-VA-3002	Specification for Unfired Pressure Vessel
165-4-SPM-058	General Specification for Painting
165-4-SPC-018	Specification for Steel Structure
165-4-SPM-046	Piping Material Specification
0258-GS-9253	Specification for Stress Analysis
165-4-SPM-041	Specification for gaskets
165-4-SPM-044	Specification for Stud Bolts and Nuts
165-4-SPM-035	Specification for Carbon and Stainless Steel Pipes
165-4-SPM-036	Specification for Carbon and Stainless Steel Fittings
165-4-SPM-040	Specification for Steel Flanges
0250-S-0450	Specification for Atmospheric Storage Tank
0250-MA-3500	Specification for Centrifugal Pump
165-4-SPM-054	Specification for Insulation
165-4-SPM-031	Specification for Export Packing & Crating
164-4-SPM-061	Specification for Polyethylene Tape Wrap Coating
0258-PU-8602	Specification for Reciprocating Compressor
0258-PU-8603	Specification for Rotary Compressor
0258-EA-5503	Specification for Shell and Tube Heat Exchanger
0250-PA-2001	Specification for Hydrotesting
165-3-SPM-069	Specification for Fire Truck
0258-GS-9520	Specification for 3D Model Review Procedure
0258-PA-2003	Specification for Fabrication & Installation of Piping

15.3 Instrumentation

0258-IMA-6000	Specification for General Instrumentation
0258-IMA-6001	Specification for Package Instrumentation
0258-IMA-6002	Specification for Instrument Installation Works
0258-IMA-6003	Specification for Instrument Cable
0258-IMA-6004	Specification for Package Control System
0258-IMA-6005	Instrument Basis of Design
0258-IMA-6010	Instrument List (Plant)
0258-IMA-6011	Instrument List (Tay-03)
0258-IMA-6012	Instrument List (Thora Deep-03)

0258-IMA-6020 to 0258-IMA-6025	Datasheets for Fire & Gas Detectors
0258-IMA-6026 to 0258-IMA-6028	Datasheets for Instrument Cable, Gland & Junction Box
0258-IMA-6030 to 0258-IMA-6047	Instrument Datasheets - Plant
0258-IMA-6130 to 0258-IMA-6140	Instrument Datasheets - Tay-03
0258-IMA-6230 to 0258-IMA-6248	Instrument Datasheets - Thora Deep-03
0258-IMD-6201	F&G Location Layout - Thora Deep-03
0258-IMD-6202	Instrument Cable Routing Layout - Thora Deep-03
0258-IMD-6203	F&G Location Layout - Tay-03
0258-IMD-6204	Instrument Cable Routing Layout - Tay-03
165-4-ICL-2501	Instrument Cable - Tay-03 (Existing)
165-4-IFL-002	F&G Detection Zone and Placement Layout (Existing)
165-4-ILL-005	CCR Building Equipment and Placement Layout (Existing)
0258-IMD-6205	New CCR & Battery Room Layout - Plant
0258-IMD-6206	Instrument Cable Routing Layout - New KPD Comp. Area
0258-IMB-6100 to 0258-IMB-6117	Typical Instrument Hook-up Drawings
0258-IMB-6300 to 0258-IMB-6305	Typical Installation Drawings for F&G Detectors
0258-IMB-6306 to	Typical Installation Drawings for Junction Box

0258-IMB-6308	
0258-IMB-6309	Control System Architecture Diagram - Tay-03
0258-IMB-6310 (05 Sheets)	Typical JB Termination Drawings
0258-IMB-6311 (04 Sheets)	Typical Instrument Loop Drawings
0258-IMB-6312	Control System Architecture Diagram - Thora Deep-03
0258-IMB-6313	Control System Architecture Diagram - KPD Compression
0258-IMB-6314	Control System Architecture Diagram - TAY Compression

15.4 Electrical

0258-ELA-6500	Electrical Basis of Design
0258-ELA-6501	Electrical Load List (KPD & TAY @ GPP)
0258-ELA-6512	Electrical Load List (THORA DEEP-03 GGS)
0258-ELA-6513	Electrical Load List (TAY-03 GGS)
165-4-SPE-005	Specification for LV Switchgear / MCC
0258-ELA-6502	Specification for LV A.C Induction Motor
0258-ELA-6503	Specification for LV Power & Control Cable
0258-ELA-6504	Specification for Earthing & Lightning Protection System
0258-ELA-6505	Specification for Lighting Material
0258-ELA-6506	Specification for Uninterruptible Power Supply (UPS) System
0258-ELA-6507	Specification for Gas Engine Driven Generator
0258-ELA-6508	Specification for Diesel Engine Driven Generator
0258-ELA-6509	Specification for Building Electrification works
0258-ELA-6510	Data Sheet for LV Induction Motor
0258-ELA-6511	Specification for Electrical Installation Workmanship

15.5 Civil

0258-CA-7001	Specification for Earth Work and Excavation/ Dewatering
0258-CA-7002	Specification for Plain and Reinforced Concrete Works
0258-CA-7003	Specification for Plumbing Works
0258-CA-7004	Specification for Brick Masonry
0258-CA-7005	Specification for Cement Plaster

0258-CA-7006	Specification for Floor and Wall Finishes
0258-CA-7007	Specification for Carpentry & Joinery and Steel / Aluminum Doors, Windows & Ventilator
0258-CA-7008	Specification for Ironmongery
0258-CA-7009	Specification for Roofing
0258-CA-7010	Specification for Painting
0258-CA-7011	Specification for Stone Soling
0258-CA-7012	Specification for Termite Control
0258-CA-7013	Specification for Glazing
0258-CA-7014	Specification for Roads & Pavements & Gravel Filling
0258-CA-7015	Specification for Drainage
0258-CA-7016	Specification for Grouting
0248-CA-7017	Specification for Fencing
0248-CA-7018	Specification for Tank Foundation

Above listed Specifications are provided in Appendix -II of Volume-IIE of this document.

16.0 **Drawings**

16.1 **Piping & Instrument Diagrams (Process)**

165-4-PID-001 (Sheet 1 of 2)	P&ID For Legends and Symbols
165-4-PID-001 (Sheet 2 of 2)	P&ID For Legends and Symbols
165-4-PID-026 (Sheet 3 of 3)	P&ID For Gathering System at Tay-3 GGS
165-4-PID-032- (Sheet 1 of 3)	P&ID For T Manifold at GPP
165-4-PID-032 (Sheet 2 of 3)	P&ID For K Manifold at GPP
165-4-PID-032 (Sheet 3 of 3)	P&ID For K Manifold at GPP
165-4-PID-034 Sh. 1 of 2	P&ID for T-Slug Catcher
165-4-PID-034 (Sh. 2 of 2)	P&ID For K-Slug Catcher
165-4-PID-035 Sheet 3 of 3	P&ID For Gas, Oil, Water Gathering System
0250-PB-2101 Sheet 1 of 2	P&ID For KPD & TAY Feed Gas Cooler
0250-PB-2101 Sheet 2 of 2	P&ID For Cooling Water Supply and Return Header
0258-PB-2100	P&ID For Nodal Compression Package TAY-3 GGS
0258-PB-2101 (Sheet 1 of 3)	P&ID For Nodal Compression Package (Typical P&IDs)
0258-PB-2101 (Sheet 2 of 3)	P&ID For Nodal Compression Package (Typical P&IDs)
0258-PB-2101 (Sheet 3 of 3)	P&ID For Nodal Compression Package (Typical P&IDs)
0258-PB-2102	P&ID For Nodal Compression Package TAY GPP
0258-PB-2103	P&ID For LP Header
0258-PB-2104	P&ID For New LP K-Slug Catcher
0258-PB-2105	P&ID For Front End Compressors at KPD GPP
0258-PB-2106 Sheet 1 of 2	Typical P&ID For Front End Compressors
0258-PB-2106 Sheet 2 of 2	Typical P&ID For Front End Compressors
0258-PB-2107	P&ID For New Condensate & Produced Water Header at GPP
0258-PB-2108	P&ID For Thora-3 GGS Nodal Compressor
0258-PB-2109	P&ID For Thora-3 GGS HP Slug Catcher
0258-PB-2110	P&ID For Raw Water System For Tay-3 GGS Nodal Facility
0258-PB-2111 Sheet 2 of 2	Plot Plan for Fire Water Ring System TAY-3 GGS
0258-PB-2111 Sheet 1 of 2	P&ID For Fire Water For Tay-3 GGS Nodal Facility

0258-PB-2112	P&ID For Instrument Air System For Tay-3 GGs Nodal Facility
0258-PB-2113	P&ID For Raw Water System For Thora-3 GGs Nodal
0258-PB-2114	P&ID For Instrument Air System For Thora-3 GGs Nodal
0258-PB-2115	P&ID For FEC KPD Compressors Fire Water Ring at GPP
F80-01-PRO-DWG-02-02	P&ID For Fuel Gas System
F82-01-PRO-DWG-01-01	P&ID For Flare Unit
F83-01-WTS-DWG-02	P&ID For Closed Drain System
F85-01-PRO-DWG-01	P&ID For Nitrogen Unit
F86-01-PRO-DWG-01-02	P&ID For Instrument & Utility Air System
F86-01-PRO-DWG-01-03	P&ID For Instrument & Utility Air System)
F87-01-WTS-DWG-02-02	P&ID For Potable & Utility Water Distribution
F98-01-WTS-DWG-02-02	(P&ID For Cooling Water System
STI-1391-102	P&ID For Gas Oil Separators V-5201
STI-1391-103	P&ID For Gas Oil Separators V-4201
165-4-GPP-007	General Plot Plan for Fire Water Network

16.2 Mechanical Drawings

165-4-GPP-001-R	Plot Plan (KPD TAY GPP)
0258-PC-2201	Plot Plan (THORA DEEP GGS)
0258-PC-2205	Plot Plan (TAY-03 GGS)
0258-PC-2207	Part Plan (KPD Compressor China Camp Area)
165-4-MPL-10005-R	Piping Layout
165-4-MPL-10006-R	Piping Layout
165-4-MPL-10007-R	Piping Layout
165-4-MPL-10010-R	Piping Layout
165-4-MPL-10011-R	Piping Layout
165-4-MPL-10012-R	Piping Layout
165-4-MPL-10013-R	Piping Layout
165-4-MPL-10015-R	Piping Layout
165-4-MPL-10016-R	Piping Layout
165-4-MPL-10017-R	Piping Layout
165-4-MPL-10018-R	Piping Layout
0258-PD-2301	Piping Layout
0258-PD-2302	Piping Layout
0258-PD-2303	Piping Layout
0258-PD-2304	Piping Layout

0258-PD-2305	Piping Layout
0258-PD-2308	Piping Layout
0258-PD-2311	Piping Layout
0258-PD-2312	Piping Layout
0258-PD-2313	Piping Layout
0258-PD-2314	Piping Layout
0258-PD-2315	Piping Layout
0258-PD-2316	Piping Layout
0258-PD-2325	Piping Layout
0258-PD-2326	Piping Layout
0258-PD-2327	Piping Layout
0258-PD-2331	Piping Layout
0258-PD-2332	Piping Layout
F99-04-PIP-DWG-02-001	Pipe Layout For Main Pipe Rack
F99-04-PIP-DWG-02-002	Pipe Layout For Main Pipe Rack
F99-04-PIP-DWG-02-004	Pipe Layout For Main Pipe Rack
F99-04-PIP-DWG-02-039	Pipe Layout For Main Pipe Rack
F99-04-PIP-DWG-02-040	Pipe Layout For Main Pipe Rack
F99-04-PIP-DWG-02-041	Pipe Layout For Main Pipe Rack
F99-04-PIP-DWG-02-042	Pipe Layout For Main Pipe Rack
F99-04-PIP-DWG-02-043	Pipe Layout For Main Pipe Rack
F99-04-PIP-DWG-02-044	Pipe Layout For Main Pipe Rack
F99-04-PIP-DWG-02-045	Pipe Layout For Main Pipe Rack
F99-04-PIP-DWG-02-046	Pipe Layout For Main Pipe Rack

16.3 Civil Drawings

KPD & TAY at GPP

0258-CD-7101	Standard Drawing Culvert for Piping
0258-CD-7102	General Arrangement CCR/UPS, Operator & Battery Room
0258-CD-7103	General Arrangement Operator Room

EXISTING DRAWINGS

165-4-C-062	Gas Processing Plant Grading Plan.
165-4-C-064 (Sheet 1 of 2)	Road Layout Plan
165-4-C-065	Typ. Cross Sections of Roads
165-4-C-070 (Sheet 1 of 3)	Storm Water Drain Layout Plan

165-4-C-070 (Sheet 2 of 3)	Storm Water Drain Schedule
165-4-CSTD-001	Standard Drawing of Legend and Abbreviation
165-4-CSTD-002	Standard Drawing for General Notes For Civil Works And Bar Arrangement
165-4-CSTD-003	Standard Drawing for General Notes For Civil Works And Bar Arrangement
165-4-CSTD-004	Standard Drawing for R.C.C. Works
165-4-CSTD-005	Standard Drawing for Chemical Coating
165-4-CSTD-006	Standard Drawing for Pedestal Anchor Bolts
165-4-CSTD-007	Standard Drawing for Pedestal Anchor Bolts
165-4-CSTD-008	Standard Drawing for Anchor Bolts For Equipment
165-4-CSTD-009	Standard Drawing for Doors & Glazing Detail
165-4-CSTD-010	Standard Drawing for Windows/Ventilator Glazing Detail
165-4-CSTD-011	Standard Drawing for Watch Tower
165-4-CSTD-013	Standard Drawing of Typical Road Cross Section
165-4-CSTD-015	Standard Drawing of Paving Detail
165-4-CSTD-033	Standard Drawing For Tank Foundation (R.C.C Ring Wall)
165-4-CSTD-027	Standard Drawing for Storm Water
165-4-SSTD-028	Standard Drawing of Typical Gate And Fence
165-4-SSTD-029	Standard Drawing of Typical Gate And Fence
165-4-PB-011	Sanitary Sewer Detail
165-4-PB-012	Soak Pit & Septic Tank Details

THORA DEEP 3 GGS

0258-CD-7201	General Arrangement Generator Shed
0258-CD-7202	General Arrangement Prayer Hall & Ablution
0258-CD-7203	General Arrangement Guard Room
0258-CD-7204	General Arrangement Work Shop
0258-CD-7205	General Arrangement Watch Tower
0258-CD-7206	General Arrangement Switch Gear & MCC Room
0258-CD-7207	Standard Drawing Pavement
0258-CD-7208	Standard Drawing Storm Water Drainage
0258-CD-7209	Standard Drawing Sanitary Drainage
0258-CD-7210 Sh. 1 of 2)	Standard Drawing Fencing & Fence Gate

0258-CD-7210 Sh. 2 of 2)	Standard Drawing Fencing & Fence Gate
0258-CD-7211	Standard Drawing Raw Water Tank
0258-CD-7212	Standard Drawing Oily Water Manhole
0258-CD-7313	Standard Drawing Catch Basin

TAY 03 GGS

0258-CD-7301	General Arrangement Generator Shed
0258-CD-7302	Standard Drawing Boundary wall
0258-CD-7303	Standard Drawing Steel Gate
0258-CD-7304	Standard Drawing Road
0258-CD-7305	Standard Drawing Pavement
0258-CD-7306	General Arrangement Work Shop
0258-CD-7307	(Deleted)
0258-CD-7308	General Arrangement F.C Living Facility
0258-CD-7309	General Arrangement Guard Room
0258-CD-7310	General Arrangement Watch Tower
0258-CD-7311	General Arrangement Office Building
0258-CD-7312	General Arrangement Switchgear / MCC Room
0258-CD-7313	Standard Drawing Storm Water Drain
0258-CD-7314	Standard Drawing Sanitary Drain
0258-CD-7315	Standard Drawing Raw Water Tank
0258-CD-7316	Standard Drawing Fire Water Tank
0258-CD-7317	Standard Drawing Oily Water Manhole
0258-CD-7318	Standard Drawing Catch Basin
0258-CD-7319	General Arrangement CCR /UPS & Battery Room

Above listed Drawings are provided in Volume-IIIE of this document.

16.4 Electrical Drawings**THORA DEEP-03 @ GGS**

0258-ELB-6600	Single Line diagram
0258-ELB-6601	UPS DB Single Line Diagram
0258-ELD-6700	Power Cable Route Layout
0258-ELD-6701	Hazardous Area Classification Layout
0258-ELD-6702	Switchgear/MCC Equipment Room Layout

TAY-03 @ GGS

0258-ELB-6602	Single Line diagram
0258-ELB-6603	UPS DB Single Line Diagram
0258-ELD-6703	Power Cable Route Layout
0258-ELD-6704	Hazardous Area Classification Layout
0258-ELD-6705	Switchgear/MCC Equipment Room Layout

KPD & TAY @ GPP

0258-ELB-6604	Single Line diagram
0258-ELB-6605	UPS DB Single Line Diagram
165-4-ELL-009	Power Cable Route Layout- KPD-GPP
0258-ELD-6706	Power Cable Route Layout- KPD-GPP (FEC Area)
165-4-ELL-031	Hazardous Area Classification Layout KPD-GPP
0258-ELD-6707	Hazardous Area Classification Layout KPD-GPP (FEC Area)
165-4-ELL-018	Equipment Layout for MCC Building
165-4-ELL-015	Equipment Layout of Electrical Room in CCR Building (Existing)
(3)G76003-A6585-5112-D	Single Line Diagram - 102-MCC-03
0258-ELF-6801	Typical Installation Detail Drawings

THORA DEEP-03 @ GGS

0258-ELB-6600	Single Line diagram
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0258-ELB-6601	UPS DB Single Line Diagram
0258-ELD-6700	Power Cable Route Layout
0258-ELD-6701	Hazardous Area Classification Layout
0258-ELD-6702	Switchgear/MCC Equipment Room Layout

TAY-03 @ GGS

0258-ELB-6602	Single Line diagram
0258-ELB-6603	UPS DB Single Line Diagram
0258-ELD-6703	Power Cable Route Layout
0258-ELD-6704	Hazardous Area Classification Layout
0258-ELD-6705	Switchgear/MCC Equipment Room Layout

KPD & TAY @ GPP

0258-ELB-6604	Single Line diagram
0258-ELB-6605	UPS DB Single Line Diagram
165-4-ELL-009	Power Cable Route Layout- KPD- GPP
0258-ELD-6706	Power Cable Route Layout- KPD- GPP (FEC Area)
165-4-ELL-031	Hazardous Area Classification Layout KPD-GPP
0258-ELD-6707	Hazardous Area Classification Layout KPD-GPP (FEC Area)
165-4-ELL-018	Equipment Layout for MCC Building
165-4-ELL-015	Equipment Layout of Electrical Room in CCR Building (Existing)

G76003-A6585-5112-D

Single Line Diagram - 102-MCC-03

0258-ELF-6801

Typical Installation Detail Drawings