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KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru Malaysia	DETAILED DESIGN ENGINEERING AND PROCUREMENT (PROJECT STANDARDS AND SPECIFICATIONS)	

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SCOPE

This Project Standards and Specification which should be regarded as a Recommended Practice, specifies the minimum requirements for handling of a project in the detail design and procurement stages.

However, depending on the nature and extent of the contract between the Company and Contractor, some parts/sections may be added, modified or deleted as required.

The main activities for implementation of the detailed engineering, procurement services and supply of equipment and materials are covered in this Standard Specification.

This Project Standards and Specification does not deal with the construction activities and/or efforts which normally should be made after or in parallel with the engineering phase for completion of the project in the site.

This Standard includes all activities pertaining to the production of drawings, data sheets, specifications, etc., covering all technical aspects of the job, including the execution of the studies, analysis and detailed designs which are necessary to allow the designer to place purchase orders for the supply of equipment and materials, and to award such subcontracts as are planned for fabrication, installation, construction and pre-commissioning of the facilities. Basis of the Works to be executed during the detailed design phase shall be the Basic Engineering Design Packages and Company's Standards / Specifications.

REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

DEFINITIONS AND TERMINOLOGY

Basic Engineering Package - The basic engineering Specifications and preliminary operating and laboratory manuals for the Project

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Completion Certificate - The certificate to be issued by the Engineer stating that part of the permanent works (as defined in the Contract) specified in the Certificate has been completed.

Contractor - The persons, firm, company or consortium whose tender has been accepted by the 'Company' and includes the Contractor's personnel representative, successors and permitted authorized assignees.

Defects - All items which require replacement or repair but could not have been replaced or repaired before Take Over and in no way hinder or affect the requirements for substantial completion.

Dossier - All inspections and test certificates and all other documents that record the 'System' and/or 'Unit' completion status in accordance with terms of 'Contract'. The Dossier will be prepared individually for each 'System' and/or 'Unit'.

Effective Date of the Contract - The date when all the necessary formalities mutually agreed upon including signing of all the Agreement between the 'Company' and the 'Contractor', take place in accordance with the 'Contract'.

Engineer - The Company's authorized representative appointed by the 'Company' from time to time to supervise execution of the 'Project'.

Engineer's Representative - Any authority or person appointed, in writing by the 'Engineer', from time to time, and to whom part or all of the 'Engineer's' authorities and powers are delegated by the 'Engineer'.

Final Acceptance - The certificate to be issued by 'Engineer' stating that all of the 'Contractor's' guarantees under the 'Contract' have been satisfactorily met or discharged subject to 'Contractor's' obligations and after completion of 'Works', tests on completion, taking over, and the remedy of defects period.

Performance Test - The test conducted to demonstrate and ratify performance of Unit or Units meeting all process and utilities guarantees as requested and defined in the Contract.

Permanent Works - All Works which will be incorporated in and form part of the project to be handed over to the "Company" by the 'Contractor'.

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Progress Report - The reports by the 'Contractor' in writing to the 'Company's' authorized Representative specifying the amount of Progress of the Services and Works, respective values and Project area of concerns.

Project - 'Works' to be performed and rendered by the 'Contractor' in accordance with the terms and conditions of the 'Contract' documents.

Provisional Acceptance - 'Operability Test' have been satisfactorily completed with the system operating at capacity as defined in the relevant clauses of the 'Contract', for a continuous period as defined in the 'Contract'. Substantial completion shall be evidenced by issuance of a "Provisional Acceptance Certificate" as per the 'Contract'.

Site - The lands and other places, on, under or through which the works are to be executed or carried out, and any other lands or places provided by the 'Company' for the purposes of the 'Contract' together with such other place as may be specially designated in the 'Contract' as forming part of the site.

Specifications - Drawings, Specifications, data sheets and any other technical documents, whatever they may be, issued with the 'contract' documents including any revisions or additions from time to time to the drawings, specifications, data sheets and any other technical documents.

Sub-Contractor - Any person, firm or company (other than Contractor) to whom any part of the Works has been entrusted by Contractor with the consent in writing of Company, and also the legal representative, successors and permitted authorized assignees of such person, firm or company.

System - A part of each 'Unit' which can be well identified with battery limits in the relevant Unit for systematic turn over of that Unit. e.g., instrument air, cooling water, control room, electrical substation, etc.

Temporary Works - All temporary works of every kind required in or about the execution or remedy of defect of the "Works" but does not include Contractor's equipment.

Tests on Completion - Such tests to be made by the 'Contractor' before the 'Works' are taken over by the 'Company' as are provided for in the 'Contract' and such other tests as may be agreed between the 'Company' and the 'Contractor'.

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Unit or Units - One or all Units and facilities as applicable, to form a complete operable oil or gas refinery, and a petrochemical complex or distribution depot as defined in the Scope of Work of the 'Contract' except those items listed in the Scope of Work as to be designed and constructed by others.

Works - Any and all design and engineering, supply of materials and procurement services, assistance in commissioning and start-up (if required), and remedy of defects and all other services to be rendered by the 'Contractor' in accordance with the 'Contract'.

SYMBOLS AND ABBREVIATIONS

<u>SYMBOL/ABBREVIATION</u>	<u>DESCRIPTION</u>
ACS	Advanced Control System
AFC	Approved For Construction
APC	Advanced Process Control
BFW	Boiler Feed Water
CAD	Computer Aided Design
CIF	Cost, Insurance and Freight
CO	Change Order
COC	Cold Condensate
COR	Change Order Request
CPM	Critical Path Method
DCS	Distributed Control System
DN	Diameter Nominal, in (mm)
DWG	Drawing
ESD	Emergency Shut Down
FOB	Free On Board
HAZOP	Hazard and Operability
HVAC	Heating, Ventilation and Air Conditioning
MESC	Material Equipment Standard Code
MR	Material Requisition
NPSH	Net Positive Suction Head
OSD	Overage, Shortage and Damage
PCO	Preliminary Change Order
PDCS	Power Distribution Control System
PFD	Process Flow Diagram
P&IDs	Piping & Instrumentation Diagrams (P&IDs)
PLC	Programmable Logic Controller
PO	Purchase Order
PM	Project Manager

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PSA	Pressure Swing Adsorption
QA	Quality Assurance
QC	Quality Control
R	Reproducible
SCADA	Supervisory Control And Data Acquisition Systems
SPIR	Spare Parts List and Interchangeability Record
UFD	Utility Flow Diagram

UNITS

This Standard is based on International System of Units (SI) except where otherwise specified.

DETAILED IMPLEMENTATION PLAN

- The detailed design and engineering and procurement services (hereinafter referred to as Detailed Services) which shall be performed by the 'Contractor' for the realization of the 'Unit' shall be based upon Basic Engineering Design Specifications and shall be done according to the Company's Engineering Standards or Superior (upon approval of the Company on the proposed Superior Engineering Standards). For cases not covered by the Company's Engineering Standards, other Standards upon the Company's approval shall be used.
- In addition to the services stipulated in other parts of the Contract, the following services shall be performed by the Contractor for the Units as defined in the Scope of Work of Contract. The activities specified herein below are minimum requirements and the Contractor should make all his efforts and engineering capabilities to the maximum extent possible in order to complete the "Works".
- The services performed by the Contractor may consist of the "Outside" portion and the "Inside" portion. The limit and extent of the activities in each portion will be clarified in the "Contract" between the Company and the Contractor.
- The main activities of project implementation are covered in the following sections:
 - Project Management.
 - Quality Assurance and Control.

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- Project Controls.
 - Detailed Design and Engineering.
 - Procurement.
- In general Contractor shall provide the following main services as minimum requirement:
- Review project scope and objectives.
 - Provide overall management of the Detailed Services.
 - Perform Detailed Engineering Works.
 - Provide drawings, data sheets, specifications, material requisitions, manuals and other documents as described under project management below for approval and record purposes according to the project schedule to enable the Company to review, check and approve the detailed services and all materials, apparatus and equipment and other goods, including all spare parts required for commissioning and for two years operation and chemical and catalysts for initial loading and for 2 years operation (herein individual or together referred to as 'Materials'), which enter into the realization of the "Unit" with the conditions as defined in the 'Contract'.
 - Review, check and approve any and all Specifications for compliance with the Contract requirements.
 - Review Vendor's drawings and other technical documents of 'Materials' for compliance with purchase order requirements.
 - Ensure that all drawings, data, specifications and other information are specifying applicable codes and standards which will form the basis for purchase order and construction activities.
 - Prepare computerized construction planning schedule, and construction work content, derivation including estimate of manpower required and bills of materials value & progress schedules.
 - Provide supporting procedures and Standard documentation to illustrate day to day running of the Project.
 - Ensure that all detailed and procurement services comply with safety standards.

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- Furnish Company hard copies and electronic files of the Operating and Maintenance Instructions Manuals together with drawings for the Materials in sufficient details to enable the Company to operate and maintain the equipment, and where applicable, dismantle; reassemble and adjust all parts of the equipment.
 - Furnish Company with the revised sheets / drawings of any and all documents and Manuals as may be requested by Company and/or due to changes made by the Contractor.
 - Furnish the Basic Designers and/or Licensors with those portions of Detailed Design which are required to be reviewed and or approved by them, as specified in the relevant Basic Design documents.
 - Furnish Company as-built drawings in hard copies and electronic files not later than 3 months after Completion and in any case before the Provisional Acceptance. However in case any change(s) occur after issuance of the Provisional Acceptance Certificate, the as-built drawings shall be revised accordingly. Contractor shall furnish Company with the said revised as-built drawings in the same number as mentioned above, not later than the date of Final Acceptance Certificate.
 - Provide replies to any questions and queries that may arise from respective authorities, Basic Designers, Licensors and Contractors with respect to the services included in the Contract with prior coordination and finalization with Company.
 - Complete all relevant questionnaires.
 - Provide technical assistance services during construction/ erection, re-commissioning, commissioning and start-up.
 - Supply all services to complete the above.
- The English language shall be used exclusively. All engineering and design data, specifications and drawings including technical information for Materials inclusive of vendor documents and drawings shall be in English with consistent use of SI units of measurements.
 - Any and all review, check, comments and/or approval by Company shall not relieve the Contractor from his responsibilities, obligations and guaranties under the Contract.

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Project Schedule and Control Services

1. General

Contractor is responsible for planning, scheduling, controlling and coordination of the Project including but not limited to the following activities:

- a. Establishment of overall communication and coordination procedures with approval of Company.
- b. Establishment of overall project execution policies, Project schedules and procedures with approval of Company.
- c. Integration of activities to ensure overall uniformity of job philosophy and execution.
- d. Being sure that all Work is executed in accordance with the project specifications and within time schedule of the project.
- e. Establishment risk management process and mitigation throughout all Project development and implementation phases.
- f. Applying computerized system for planning, controlling, scheduling and reporting by using Microsoft Office, Primavera/MSP and other software approved by Company.

In case Contractor uses its in-house software different from the above mentioned software, Contractor shall convert all in-house respective files to the files under the above said and deliver the converted files to Company together with the monthly report.

- g. Submitting original electronic files of all information i.e. progress calculation sheets and reports, in addition to hard copies.
- h. Filling the blank information formats sent by Company in respect of planning, scheduling and controlling.
- i. Documentation of all project phases by using the above said software. It shall be delivered to Company as a package at the end of the Work/Project.

2. Planning

- a. General

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Upon receipt of the Contract a project planning task force shall be established by the Contractor which should include Project Director, Project Manager and the Directorate Coordinators of Planning, Quality Assurance, Engineering, and Procurement in order to:

- Confirm the Master Project Schedule.
- Set-up the Quality Assurance Plan for the Project.
- Identify long-lead equipment, materials and activities.
- Establish fabrication and contracting plans and sequences so that engineering, procurement and all other project activities can be planned accordingly.

b. Work plan

Contractor shall:

- Ratify the basis, on which project activity is to commence,
- Detail project scope and measurable objectives,
- Prepare work plans, schedules, budgets, project procedures and allocate resources.
- Arrange necessary meetings with all parties involved in the Project to ensure that the Project objectives, schedules, priorities and all other criteria required making the Project a success to be defined clearly.

c. Definitive project execution plan

For execution of the work, Contractor shall:

- Set up, and maintain throughout the project, the appropriate communications and transfer of information with the Company.
- Organize and staff the project teams. Place major emphasis on the selection of a balanced team with expert knowledge of the project's requirements.
- Administer the Contract to fulfil its terms and conditions.
- Ensure that the requirements of the Company, governmental regulatory agencies, certifying authorities, insurance underwriters and others are complied with.
- Control the scope, cost, schedule and quality of the project works.

d. Procedures

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Contractor shall prepare, develop and implement complete project control procedures for Planning and Scheduling, including WBS and OBS procedures. WBS procedure including weight factors up to agreed level by Company (approx. 100 activities) shall be detailed. The procedures shall also specify clearly the methods which are used for planning, scheduling, monitoring, controlling and reporting of progress in comply with the plan.

Procedures shall include samples of all standard formats intended to be used by Contractor during execution of the Project. Contractor shall prepare the following procedures as minimum:

- Progress measurement procedure (measuring the physical progress)
- Schedule control procedure
- WBS (Work Break down Structure) procedure including weight factor calculation procedure.
- OBS (Organization Break down Structure) procedure
- Document control procedure
- Requisition control procedure
- Material control procedure
- Cost control procedure
- Reporting procedure (including blank formats)
- Coordination procedure (including primary duties and responsibilities of their staffs vis-à-vis OBS and etc.)
- Schedule revising procedure
- Inventory control procedure
- Value engineering procedure
- Technical Query (TQ) procedure (including blank format)

3. Scheduling

a. General

Contractor shall develop and implement project execution policies, overall plans and schedules for the Work based on project master schedule, milestones and target dates specified in the Contract.

i) Master Schedule

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Means the schedule showing the commencement and completion dates of each major phase of the Work and dates of Milestone events / target dates as agreed between the parties in the Contract.

ii) Initial Schedule

Within one week from the effective date, the Contractor shall issue to Company a schedule in bar-line form covering the initial fourteen weeks or agreed duration of project work. This schedule shall include steps for initial resource mobilisation, Basic and Detail engineering, procurement services, supply of the equipment for preparation of the Overall Project Schedule, and Detailed Schedule. This schedule shall be updated every two weeks until issue of Detailed Schedule.

iii) Overall Project Schedule

Contractor shall issue an overall project schedule for implementation of the Work which shall be agreed upon by the parties in Contract. This schedule shall be detailed up to agreed level of the WBS.

This schedule shall cover Contractor's entire activities in respect of Basic engineering, Detail engineering, procurement activities and estimated manufacturing time. This schedule shall also include all key milestone activities as defined in the Contract. Schedule would form the basis for developing the detailed schedule and shall indicate delivery time for engineering documents (discipline wise), site preparation and other activities.

iv) Detailed Schedule

- Preliminary Detailed Schedule

Contractor shall issue a preliminary detailed schedule using man powers & machines allocation, activity/event oriented network analysis method on time scale, covering all engineering and procurement activities.

- The schedule shall identify probable critical items and shall have all key milestones during implementation of the Work agreed by Parties.

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- Contractor shall issue a graphical "S" curve for the total Project with preliminary detailed schedule. This "S" curve shall not be changed after final detailed schedule approved by Company.

- Final Detailed Schedule

Contractor shall issue a detailed schedule for implementation of the whole Work. This schedule shall cover Contractor's entire activities in respect of basic design, detail engineering activities, manufacturing time, time of delivery of equipment including custom clearance and transportation to the site. Detailed schedule shall cover all key milestones activities including subcontractors' activities and shall also indicate the critical path of the Project.

- The schedule shall be prepared by considering the available resources i.e. manpower, budget during execution of the project.
- Contractor shall submit to Company the Critical Path Method (CPM) network diagram including critical activities.
- Final detailed schedule shall be established according to planning logic & Critical Path.
- Every month, for each activity, the actual monthly progress shall be entered / incorporated in final detailed schedule and update it. Obviously the baseline and S-Curve of schedule shall not be changed.

v) Preliminary construction schedule

Based on project master schedule Contractor shall prepare preliminary construction/erection, pre-commissioning and commissioning schedule which will be developed in next phase by construction Contractor.

4. Monitoring and Controlling

a. General

Project control is that element of a project that keeps it on-track, on-time, and within budget. Project control begins early in the project with planning and ends late in the project. Contractor is responsible by using proven established project control techniques and procedures to monitor and

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control execution of the Work. These techniques and procedures should include cost estimating, cost control and planning and scheduling control, and encompass the engineering, procurement and construction (if required) phases of the project. The principal methods used to plan and control the progress of the job shall include but not be limited to the following activities:

- i) Develop a control system based on project control techniques and procedures.
 - ii) Measure progress performance for cost, time, quality and human resources and compare them to planned progress on a timely immediately.
 - iii) Determine the effects of actual schedule performance on the project schedule and update it.
 - iv) Incorporate project changes into the schedule.
 - v) Control and analyze the project schedule.
 - vi) Recalculate the schedule and allocate the resources.
 - vii) Develop detailed sub-networks where required to meet the objectives shown as critical on the master schedule. These detailed sub-networks should be produced for all activities required controlling the satisfactory progress of the project and should be analyzed by the most appropriate computer systems.
 - viii) Prepare weekly progress reports for the weekly meetings. The reports should show achievements, activities to be achieved during the following week and critical activities. The report should be used as an agenda for the weekly meeting.
 - ix) Issue a monthly progress report which should incorporate progress made by all groups during the period. Particular attention should be paid to any critical activities and problem areas together with recommended action would be included.
- b. Reporting
- i) Contractor shall submit to Company a monthly consolidated report, in an agreed format, prepared as per WBS and schedule control procedures including:
 - Technical review.
 - Key milestone table as plan & actual in agreed format.

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- Goals achieved last month.
 - Next month goals and look-ahead schedule.
 - Progress, actual vs. scheduled with reasons for shortfall and actions to be taken by Contractor to overcome any shortfall or delay at earliest.
 - The reasons of delay if occurred and percentage of each reason for delay.
 - Areas of concern, Contractor shall give reasonable resolutions to overcome any problems raised in the areas of concern.
 - Statement of any reimbursable costs incurred.
 - Document Control Index (DCI) and summary status table of the issued documents.
 - Material Control Index (MCI).
 - Requisition Control Index (RCI) and summary status table of the issued requisitions. MRQs shall be categorized corresponding to the equipment categories as listed in the Contract.
 - Financial status including Change Order, if any.
 - Summary of any Contract changes, pending and agreed issues including cash requirement.
 - Correspondence status table exchanged by Contractor and Company.
- ii) The report shall include Project progress (scheduled and actual) broken down into engineering (up to each document), procurement (up to each equipment and bulk material category).
- iii) Progress shall be measured physically according to "progress measurement procedure" for reporting purpose. Reports shall include curves showing planned and actual progress percentages, together with a statement of work which has not been achieved to schedule and the actions being taken by Contractor to remedy delays.

Actual physical progress in the field shall be measured based upon physical progress measurement procedure prepared by Contractor and approved by Company. Actual physical progress shall be calculated for each activity from lowest level (job phase) up to highest level of each category of the Work.

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- iv) Procedures to measure the physical progress shall be prepared by Contractor and to be approved by Company. The said procedure shall include the weight of each activity. These weights shall be approved by Company based on the information submitted by Contractor. After approving of weight factor calculation and WBS procedures, Contractor shall make the utmost endeavour to apply any changes in weights of activities, if so requested by Company.
 - v) Monthly consolidated reports shall include any further detailed analysis of any important aspect(s) of the Project as may be requested by Company.
 - vi) Monthly reports shall be issued within maximum five working days of the end of the monthly reporting period (cut-off date as agreed).
 - vii) The sample of progress reports will be reviewed during Kick-off Meeting.
 - viii) Contractor shall send monthly vendors status report to Company as per agreed format.
 - ix) The report shall include Risk Analysis comprising "Risk Events" and "Recommended Response Plan" for each "Risk Event" (if any).
- c. Status Review Meeting
- Periodic project status review meetings shall be held (monthly/biweekly/weekly/Daily or at any time requested by Company) as desired by Company. It may also be necessary to hold review meetings at regular intervals at management levels as deemed necessary by Company. Such meetings shall generally be arranged at the place of activity concerned.
- d. Additional Efforts
- Contractor shall provide additional efforts whenever the CPM diagram indicates a possible delay in the target dates. Such additional efforts may require supplementing of equipment, personnel, work in excess of the normal work per day/week or other resources. All extra costs incurred by Contractor for such additional efforts in order to prevent a happened and/or possible delay in the target dated shall be borne by Contractor.
- e. Risk Analysis and Contingency
- A mathematical model shall be used by estimators, of a project and its various cost components. Each component will be assigned to variable probabilities and these are used to simulate the most probable outcome of

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the project cost. The program analyses the distribution showing the percent estimate costs (or forecast totals) with overrun/ under run probabilities for each component.

f. Access to Documents

Company shall have on line access through an allocated password, to all necessary documents, original electronic files, work centres of non-confidential nature of the Contractor related to this Project necessary for execution of the Work and for assessment of the progress and monitoring.

Company shall have access to the work progress files (original files) whenever he wishes during the course of the project.

Contractor shall establish a database program with suitable & secure software. This program shall have abilities for save, maintain, search & access to all documents of project.

g. Change proposals

Contractor shall provide to the Company a procedure for handling changes in the scope of work. The objective of this procedure shall be to permit the timely evaluation of cost and schedule impacts associated with proposed scope changes prior to their implementation. A brief outline of this procedure is presented in sequential order in Appendix C of this standard.

Quality Assurance and Control

1. General policy

The Contractor shall be responsible for all quality activities associated with the project. These activities shall have two prime objectives summarized as below:

- The establishment of a quality System for their part of the project in compliance with the Contract requirements.
- The verification of compliance (or otherwise) with the Quality System by all personnel assigned to the project.

The main parameters necessary to secure the prime quality objectives of the project by the Contractor shall be as follows:

- To establish Quality Control Organization whose sole duty shall be to insure conformance to the Contract of all contractual activities.

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- To establish a Quality Control System to perform sufficient inspection and tests of all items of work.
- To specify the components of the Quality System by the production of the Project Quality Plan.
- To establish a Schedule of Quality System Audits.
- To make sure that the documentary evidence of the Quality System, (the Quality Program) is established and complete.
- To monitor compliance by project personnel [both Home Office and Construction Site (if required)] with the project Quality System by preparing, conducting and closing out audits of specified activities in accordance with the Audit Schedule.
- To see that project personnel for their part of the project are fully aware of the Quality System and understand all Quality requirements applicable to them.
- To respond the reviews of the Project Quality System by the Contractor's Quality Assurance Department via the Project Directorate.
- To advise the Contractor's Quality Assurance Managers and their respective Task Force Managers of project progress/status by issuance of regular departmental reports.
- To liaise directly with the Construction Site Quality Control Groups (if required by the Company) which will be under the jurisdiction of the Field Engineering Manager(s) and report all pertinent matters regarding Quality to the Construction Manager on a regular basis.
- To liaise with the Company management representatives on Quality related matters on a regular basis.

See Appendix A of this Standard for typical project quality assurance organization/interface.

2. Quality control system

- a. The Quality Control System consists of Quality Controller and Quality Control Engineer as required to meet the specifications and to insure qualified inspection of work.
- b. Quality Control shall perform or coordinate and supervise the performance of all required inspections, testing, and document checking and approval. In addition Quality Control will keep complete, updated records on submittals of documents. As a general procedure, Quality Control shall:

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- Review the Contract requirements.
 - Check to assure that the required submittals have been prepared and approved.
 - Make sure that the required materials and equipment is on the site.
 - Check to assure that the required off-site inspections and tests have been accomplished and approved.
 - Coordinate and arrange for the required on-site inspection and tests (if required by the Contract).
 - Determine that all preliminary work has been completed.
 - Re-check materials and equipment for compliance.
 - Prepare the schedule of inspection.
- c. Quality Control shall continue inspecting the work daily, or as required, to assure continuing compliance with the plans and specifications until the work is completed. Upon completion of an item of work, required operational or performance testing shall be supervised by Quality Control and required certification and/or approval submitted.
- d. When materials being used do not comply with the specifications, or workmanship is not satisfactory, Quality Control shall stop the works immediately and assure the corrective actions.
- e. As soon as a representative segment of an item of work is accomplished, Quality Control shall inspect workmanship, dimensional accuracy, and assure use of approved materials. In addition, Quality Control shall review the testing and inspection operations to insure compliance with the specification.
3. Quality control program
- Quality Control Program shall be prepared by the Contractor and shall be submitted to the Company for review and approval.

Detailed Design and Engineering

1. Work sequence and procedures

The Contractor shall develop project procedures to cover all aspects of the design and procurement phases of the project. These procedures shall be based on the Company's Standard procedures, modified as necessary to suit the project requirements. In case of lack of the Company's Standard

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procedures, Contractor can utilize either his own or other international procedures upon approval of the Company. These procedures should include but not be limited to the following:

- Filing System.
- Document Distribution.
- Standards & Codes (Data Base).
- Engineering Symbols, Scales and Units.
- Numbering Procedures.
- Drafting Procedures.
- Specification for Handling of the Technical Documents.
- Specification Preparation.
- Progress Measurement Procedure for Engineering and Procurement Services.
- Design Interface Control.
- Safety and Operability Review.
- Control of Engineering Budget and Schedule.
- Document Control Center.
- Engineering Document Checks and Reviews.
- Requisitions.
- Testing and inspection.
- Quality assurance plan.

2. Work Methods

The Contractor shall:

- Monitor the progress in all areas against the Project schedule to detect early deviations to schedule and to arrange for corrective action, e.g. additional staff, computing facilities or other measures. A biweekly progress meeting may be held to outline the progress achieved, problems encountered, and solutions intended.
- Monitor, identify and resolve any non conformity with the Contract requirements and potential problems.

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- Be responsible for any and all specifications prepared by vendors/subcontractors. In this connection the Contractor shall review and check and approve the said Specifications compliance with the Contract requirements.

Be responsible for the quality and completeness of Work and shall review and sign all drawings, data sheets, Specifications and acquisitions.

- Establish format of all data sheet forms.
- Confirm that works are all in accordance with Contract requirements and design guides, and shall act to identify and resolve problems. The Contractor shall also monitor any possible trends involving design changes and shall alert the Company of these potential changes.

3. Process, utilities and safety engineering

a. Process and utilities engineering

Based upon the Basic Design Process P & IDs, Contractor shall develop and prepare detail design P & IDs to be approving for design and then follow through to approve for construction incorporating vendors' information.

The P&IDs shall show the interfaces with other drawings included but not limited to those supplied parts by vendor.

In case any P&ID prepared by vendors, the said P&IDs should comply with the above mentioned requirements.

The Contractor shall perform the following main activities as minimum requirement relevant to Process, and Utilities:

- Develop complete (inclusive auxiliary system) P&IDs for each Unit to be approved for design based upon the Basic Engineering P&IDs and then follow through and complete the said P&IDs to be approved for construction incorporating vendors information.
- Develop definitive Plant General Plot Plan considering plant safety aspects, operability and maintenance.
- Develop definitive detailed plot plan drawings for the Units taking into account safety, easy operation and maintenance of individual equipment and accessories and parts included in the plant.
- Complete where necessary as a basis for detailed design and issue process data sheets.

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- Develop process engineering specifications and drawings for each individual equipment.
- Review and develop basic requirements for plant drainage and disposal systems.
- Provide equipment list/index and schedule for all equipment including driver where applicable.
- Prepare utility data including-effluent data and utility balances diagrams.
- Develop safety data related to P&ID and review process design safety and conduct P&I Diagrams safety review.
- Review equipment arrangement drawings.
- Prepare and develop procedures for preservation of equipment during short/long time of non operation.
- Review flares and relieving philosophy (in conjunction with different emergency cases) and finalize size of the flares headers and approve flares load data.

- Check and verify all tower capabilities in design, normal and turn down throughputs based on the tower load calculations performed by the tray or packing supplier.
- Prepare line schedules for all piping, including line numbers, unit number, fluid symbol, origin and termination, size, material specification, operating and design conditions field test pressure, insulation type and thickness, special requirements (e.g., stress relieving) and tracing design conditions.
- Prepare piping lists for hydraulic review of piping engineering.
- Prepare hazardous area drawings.
- Prepare piping classification data.
- Develop instrument control system and develop safety safeguarding system basic requirements.
- Complete utility summary tables. The summaries shall be provided all required utilities such as but not limited to for the following utilities:
 - Electrical Load.

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- Steam (All types).
 - Condensate (All types).
 - Boiler Feed Water (BFW).
 - Cooling Water (all types), Demineralized Water, Fire Water, Desalinated Water, Plant Water and Potable Water.
 - Instrument and Plant Air.
 - Nitrogen.
 - Fuels (Gas and Oil).
- Prepare Utility Distribution P&I Diagrams for each Unit showing distribution of the all utility services as mentioned above. All headers, branches to the users and all miscellaneous items such as utility stations, safety showers and eye washes and etc. with full details shall also be shown.
 - Provide system hydraulic design calculations. Contractor shall perform a complete hydraulic design at rated (design) capacity and at the defined turndowns (i.e., Lower Operating Levels) for each part of the Units within the Units Battery Limits. Hydraulic Design shall be based on the procedure established by the Contractor and approved by the Company and shall include, but not be limited to the following:
 - Calculation of line sizes.
 - Control valve process design specifications (e.g., differential pressure across the control valve, etc.).
 - Pump suction and discharge pressure and NPSH.
 - Equipment elevations.
 - Compressor inlet/discharge pressure.
 - Equipment and piping design pressures.
 - Liquid flows in towers and vessels to ensure satisfactory hydraulic flows.
 - Relief systems including relief valve specifications.
 - Equipment to be purchased, to ensure that such equipment will perform satisfactorily within the system for which it is specified.

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- Prepare for the Company's review, the pressure profiles for all systems comprising the Unit based on the hydraulic design calculations.
 - Develop emergency shutdown philosophy and review P&I Diagrams for Advanced Process Optimization start-up, shut-down and emergency operations of each Unit and catalyst regeneration (where applicable) to ensure that all necessary processing, utility, and blow down piping and facilities are included for safe operation.
 - Review alternative operations of the Units when associated Units may be shutdown to ensure continuous operation of each Unit.
 - Prepare each Unit battery limit conditions (operating and design) for any and all lines inclusive of operating and design flow rates, temperature, pressure and destination/sources.
 - Complete process information on all equipment data sheets including instruments, vessels, heat exchangers, heaters, electrical motors, fans and blowers and all other miscellaneous equipment.
 - Define the philosophy and the functionality for Advanced Process Control system for fired heaters and multi products column.
 - Develop process duty specifications for the packaged units.
 - Prepare catalyst and chemicals summary.
 - Prepare effluent summary for each UNIT separately.
 - Prepare chemical hazard report.
 - Prepare start-up, shut down, catalyst regeneration (if applicable) and normal operation procedures.
 - Prepare normal and emergency shutdown procedures.
 - Supply of all other services required to do process and utilities works.
 - Supply all other services as may be required to complete the above.
- b. Safety engineering
- i) General
- Contractor shall:
- Make sure that applicable safety and loss prevention codes as well as the Company's special requirements as expressed in the Safety Rules as mentioned in the Contract are applied in a systematic and

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effective manner by safety audits during the engineering design phase.

- Provide necessary documentation to support safety case and certification submissions as required by the applicable legislation.
- Prepare and/or complete the overall safety philosophy and based on the this philosophy, the Contractor shall prepare separate detailed safety documents for each section of the Project.

The said documents among other necessary information and Specifications shall includes hazards and loss prevention data including plant layouts and arrangements, hazard sources and evaluation, area classifications, detection and alarm systems for specific events e.g., fire, gas release, shutdown, ESD (Emergency Shut Down) systems, toxic gas release, fire protection systems both active and passive, fire fighting equipments, means of escape, life saving appliances, drainage systems, ventilation, communication systems, navigational aids, regulations for effluent discharge, emergency power supply, sick bay and first aid requirements.

- Foresee the following main sequences of safety and Loss prevention work:
 - Preparation of logic diagram, Cause and Effect Charts; preparation of safety documentation.
 - Preparation of layouts of fire and gas detection systems as well as fixed fire fighting equipment; collection of up-to-date vendor information; preparation of inquiry packages for loss prevention systems; review and approval of Vendor drawings and documentation.
 - Provide all other services as may be required to complete the above.

ii) HAZOP Study

In support of safety and safe operation obligations, full HAZOP studies which allow a systematic approach to identifying hazards and potential operating problems, is required to be conducted at the detail engineering design early stage.

HAZOP will be undertaken at the start of detail design and another following the approved for construction issue of engineering

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documents. Actions arising from HAZOP studies shall be recorded and implemented in accordance with HAZOP procedure.

Contractor shall prepare HAZOP study procedure for Company's review and approval.

Contractor shall be responsible for organizing the HAZOP and following up all actions outstanding as well as provision of any and all facilities for the Works, to insure that all the process, utility, offsite, miscellaneous and other units and equipments to be operated and maintained safely without endangering personnel and equipment at all time.

iii) HAZOP Outputs

The information provided by Contractor shall include but not limited to:

- Hazard identification report: Defining objectives, methods and scope of hazards and operability.
- Hazard Assessment: The hazard identification studies shall identify areas for hazard assessment and appropriate actions for elimination of the hazard.

The following major hazards are to be considered as minimum requirements:

- Fire,
 - Explosions,
 - Hazardous substances release and their environmental impact,
 - Events causing escalation of incident, including process emergency systems,
 - Power supply failure,
 - Human error,
 - Others, specific to a Unit or equipment.
- Supply all other services required to do HAZOP study and review.

4. Civil and structure engineering

Contractor shall:

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- Review the Site survey provided by the Company and perform Site survey if additional data is required as per Contract requirements. In case, no Site survey data is provided by Company, Contractor is responsible to perform Site survey to complete required data for implementation of the Project.
- Prepare site preparation information including drawings and data which are necessary for construction activities.
- Establish engineering and construction specific job specifications.
- Establish specific job requirement for civil work including structure and fire-proofing.
- Design and prepare detailed drawings for all foundations, elevated concrete, floors, roads, sewer system, basins, sumps, cable trenches, underground piping, etc., including arrangement and detailing of reinforcing and piling (if required), complete with relevant specifications and re-bar bending schedule for equipment foundations.
- Design and Prepare general arrangement drawings, specific details and design computations for all reinforced concrete piperacks, steel structures such as equipment structures and platforms, steel building, etc in sufficient detail.
- Develop and design special equipment, which may be necessary for handling of Materials.
- Design and Prepare general arrangement plans, elevations and specific details for concrete structures including concrete buildings.
- Perform checks for equipment and structural drawings, which are bolted to foundations.
- Prepare key plan showing location and orientation of the Units, buildings, shelters, structures and etc.
- Design and Prepare arrangement of reinforcing for concrete structures and the necessary details.
- Prepare foundation location plan.
- Design special pipe supports and assist in preparation of pipe support drawings.
- Coordinate foundation and structural steel drawings.
- Prepare bills of material.
- Prepare drawings for ladder and platform of vessels.

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- Prepare drawings covering specific details for fire-proofing.
 - Provide fire alarm and fire fighting systems for buildings.
 - Provide loading diagram and calculations results for structure.
 - Provide loading diagram and calculations results for foundations.
 - Design and prepare detail drawings for industrial buildings as per project requirements.
 - Coordinate with job Site.
 - Incorporate vendor information on drawings.
 - Review, comment and approve vendor documents.
 - Design buildings and all aspects of the building including:
 - Architectural layouts,
 - HVAC,
 - Building services,
 - Structural engineering.
 - Design and prepare drawings and specific details for boundary and fencing, retaining walls, lift stations, evaporation ponds, etc.
 - Carry out surveying, engineering and design of temporary access roads, diversion channel (if required) and other facilities to the plant, required for Materials handling as well as construction activities.
 - Design and prepare detail drawings for area paving, sumps and drainage drawing complete with bills of material and specifications with due consideration to Contract requirements.
 - Prepare any other drawing and detailed specification as required.
 - All civil & structure drawings should be Approved for Construction (AFC).
 - Supply all other services required to do civil and structure works.
 - Supply all other services as may be required to complete the above.
5. Vessels, towers, reactors and storage tanks
- Contractor shall:
- Establish specific job specifications for towers, pressure vessels and storage tanks.

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- Design each vessel (reactors, towers, storage tanks and etc.) and prepare detail drawings showing wall thickness, heads, shells, nozzles, supports, internals including number and locations of caps/valves, risers, baffles, weir supports, downflow section, platforms clips, insulation clips and angles, etc. in sufficient details to permit vendors to prepare shop details.
 - Check vendor's drawings for conformance with Specifications.
 - Compile vendor information on the drawings, data sheets and specifications.
 - Finalize vessel drawings with orientation and lugs.
 - Check all drawings including vendor's drawings to be virtually complete and issue for Approved for Construction (AFC).
-
- Perform checks for:
 - Vessel foundation drawings.
 - Drawings for steel work and platform supporting vessels.
 - Nozzle sizes and location / orientation.
 - Supply all other services required for vessel, tower, reactor and storage tank works.
 - Supply all other services as may be required to complete the above.
6. Heat transfer equipment (including heaters, heat exchangers, water and air coolers, condensers, reboilers, coils, etc)
- Contractor shall:
- Establish specific job specifications for heat transfer equipments.
 - Prepare and complete data sheets.
 - Perform thermal and mechanical optimization.
 - Supply thermal and mechanical design.
 - Supply bills of materials.
 - Supply setting plans.
 - Prepare detailed drawings to enable vendors to prepare shop detail drawings.

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- Review vendors' drawings, data sheet and setting plants for conformance with Specifications, orientation of nozzles and location of supports.
- Compile vendor information on the drawings, Specifications, data sheets and other Project documents.
- Assist in preparation of plant technical and Equipment manuals.
- Supply all other services required to do heat transfer equipment works.
- Supply all other services as may be required to complete the above.

7. Machineries (pumps, compressors, blowers, etc & their drivers)

The Contractor shall:

- Establish specific job specifications for machineries.
- Provide and complete data sheets and make NPSH and machinery discharge systems hydraulic calculations.
- Review vendors' data sheets and drawings for conformance with Specifications and Project requirements.
- Compile vendor information on the drawings, Specifications and other Project documents.
- Perform checks for:
 - Machinery foundation drawings.
 - Nozzle sizes and location / orientation.
- Supply all other services required to do machinery works
- Supply all other services as may be required to complete the above.

8. Piping

Contractor shall:

- Establish specific job specifications for piping.
- Prepare general and unit plot plans.
- Prepare piping layout and general arrangement drawings.
- Establish mechanical and material specification for each section of piping, including specifications and data sheets for expansion joints, spring support, shock arrestors and other special items.
- Prepare line numbering schedule.
- Prepare and complete line list.

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- Review and check technically all packaged units' inquiries and purchase order requisitions where piping is to be furnished by a vendor as part of the packaged unit with conformity with contract requirements.
- Check vendor drawings and specifications for piping and piping components for compliance with Contract requirements.
- Design all piping system including special piping items (steam jacketing included) and prepare all necessary arrangement and detail drawings including tie-in points.
- Where steam tracing is required, design the steam tracing system and provide details and specifications of steam tracing and traps materials and details plus isometric drawing.
- Design underground piping systems and prepare all necessary arrangement and detail drawings.
- Design utility piping and prepare drawings showing arrangement of utilities distribution system.
- Prepare isometric drawings and spool drawings inclusive of complete bill of materials suitable for fabrication of small and large bore piping, except for underground pressurized lines of below 2" and for skids to the extent they are shop assembled.
- Prepare P&ID for pressure testing giving required information for testing.
- Prepare bill of material sheets for each isometric in the same drawing.
- Prepare stress analysis calculations and pipe support details.
- Finalize layout arrangement drawings.
- Check and coordinate equipment nozzle orientation.
- Prepare plant three dimensional computer models for the new Units. For the Units which are duplicated one computer model may be prepared and in this case the interconnecting piping between the identical units shall also be shown.
- Perform checks for:
 - Drawings of equipment and terminal point of package units to which piping is connected.
 - Layout drawings of foundations.
 - Layout and elevations on structural steel drawing.

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- Assist in preparation of plant technical and Equipment manuals.
- Supply all other services required to do piping works
- Supply all other services as may be required to complete the above.

9. Instrumentation and control system

Contractor shall:

- Establish specific job specifications for field instruments and analytical instruments.
- Prepare detail specifications for Process Control System (PCS), Emergency Shut-down Systems (ESD), Safe Guarding System (SGS) and Fire and Gas (F&G) Detection systems.
- Prepare detail specification for advanced process control system.
- Prepare detail specifications for Maintenance Management system.
- Prepare detail specification for Management Information System.
- Prepare detail specifications for Asset Management system.
- Provide detail specification for tank gauging system.
- Provide computer system and application software for the above mentioned systems.
- Develop process P & ID's and utility distribution diagrams including instruments numbering symbols and identification.
- Provide computerized data base inclusive of data and information for any and all equipment and other items to be utilized for the said application software.
- Minimum two dedicated consoles shall be provided for start up and shutdown in main control system. Allocation of the various Units to each console shall be proposed by Contractor and approved by Company.
- Prepare instrument lists, comprising all loop components, instrument tag numbers and relevant drawing cross-references.
- Prepare data sheets for all instrumentation components.
- Size control valves
- Size safety and relief valves
- Size orifice plates and other flow elements.
- Size UPS, battery and chargers.

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- Size PD meters, turbine meters and meter provers.
- Prepare cable schedule
- Prepare layouts for instrument panels, etc
- Review and check technically all packaged units' inquiries and purchase order requisitions where instrumentation is to be furnished by a vendor as part of the packaged unit with conformity with Contract requirement.
- Prepare drawings showing location of instruments, cable route and utilities distribution systems.
- Layout and develop electrical systems, for instrumentation.
- Check instrumentation vendor prints / drawings and Specifications for compliance with Contract requirement.
- Perform checks on vessel drawings for instrumentation.
- Prepare panel layout drawings to scale with overall dimensions and show the locations of instruments, push buttons, lights, annunciators, alarms, etc.
- Prepare instrument location drawings, using piping drawings as background.
- Prepare logic diagrams for interlock and alarm systems.
- Prepare logic diagrams for sequence and program control.
- Prepare cause & effect tables showing all causes with their consequences.
- Establish SIL (Safety Integrity Level) requirements.
- Prepare SIL assessment report.
- Prepare all other data sheets drawings and diagrams required for installation maintenance and operation of instrument and control items.
- Prepare instrument cable/tubing schedules.
- Prepare junction box locations.
- Prepare instrument hook-up drawings with bill of material.
- Prepare instrument transmission loop details.
- Prepare bulk items specifications.
- Prepare all analyzer specifications.

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- Prepare detail test procedures for PCS/SGS/F&G systems.
- Prepare detail test procedure of the interlocks and sequential Loops.
- Prepare basic logic scheme and function description for start-up, shutdown, emergency shutdown procedure, anti-surge control and etc.
- Prepare comprehensive drawings and Specifications index sorted by document number as well as document title.
- Prepare list of all set point values for alarm and shutdown system.
- Prepare full instrument instruction manuals including operation, installation, calibration, trouble-shooting and maintenance.
- Prepare instrument inspection report.
- Prepare instrument summaries for checking, cross-checking and reference.
- Provide comprehensive calculation sheets and selection philosophy, bounded separately for each category of control valves, flow elements, safety valves, pressure control valves, PD meters, turbine meters, UPS and batteries & charges including method of calculations.
- Prepare Schematic wiring diagram of alarms and inter-locks showing functional sequence of start and stop buttons, relays, alarms, solenoid and shutdown switches.
- Prepare initial and final material Take-off for all instruments and instrument material.
- Supply all other services required to do instrument and control system works.
- Supply all other services as may be required to complete the above.

10. Electrical

Contractor shall:

- Establish specific job specifications for all electrical system (inclusive of electrical tracing system and cathodic protection system).
- Prepare single line diagrams for the whole electrical generation and distribution systems, and also for each area substations.
- Design electrical distribution system.
- Design electrical tracing where required.

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- Prepare lighting systems and prepare drawing showing arrangement of lighting panels, lighting requirement at grade, on platforms and structures and electrical trays with specific details as required.
- Prepare data sheets for electrical equipment (including motors).
- Prepare layout drawings of power cables and specific requirements for switchgear and motor control center.
- Prepare grounding drawings and details.
- Layout and prepare electrical power supply systems for instrumentation.
- Prepare area classification drawings.
- Perform checks for underground drawings of piping and civil where underground electrical cables are to be laid.
- Prepare electrical load list including motors and other consumers.
- Prepare relay setting schedule.
- Prepare electrical system design report including voltage profile, re-acceleration, and fault studies.
- Prepare electrical system study and short circuit calculations.
- Prepare electrical cable schedules and routing.
- Prepare schematic wiring diagrams for all circuit breakers and electrical items having internal wiring or relays.
- Prepare layout of switch rooms showing the location of major equipment, battery charger room and classification of hazardous locations.
- Prepare list of all starters and switchgears with capacity requirements and specifications for each.
- Prepare all earthing, control station and other miscellaneous fixing and mounting details.
- Prepare material Take-off for all electrical material.
- Prepare power control house building (substation) layout.
- Prepare substation and switchgear drawings.
- Prepare system shutdown connection diagrams.
- Prepare electrical instrument drawings.
- Prepare electrical heat tracing drawings.

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- Prepare cathodic protection system with detailed specifications and drawings.
- Supply load flow calculations in start-up and steady state operation of the electrical system.
- Design emergency supply including uninterrupted power supply system.
- Prepare initial and final material take-off for all electrical equipment, accessories and materials.
- Prepare material requisitions for all electrical accessories, equipment and materials including heat tracing material, if any.
- Prepare block diagrams, connection diagrams, design philosophy and instruction manuals for interlocking systems, alarm system and other complicated power and control systems.
- Prepare physical location of electrical equipment and wiring installed and installation details.
- Prepare physical location of grounding electrodes, equipment to be grounded and wiring layouts as well as their installation details.
- Prepare engineering, manufacturing, inspection requirements, construction/erection, precommissioning and commissioning specifications and procedures for all electrical components, equipment, accessories and materials.
- Prepare cable cutting schedule.
- Prepare cable orientation on trays and /or trenches
- Prepare cable room tray orientation.
- Prepare PDCS system installation.
- Prepare PDCS I/O list (including serial links).
- Prepare logic sequence diagram for PDCS system.
- Prepare PDCS software details.
- Prepare operation and maintenance manual for PDCS completed with illustrated spare list.
- Check vendor's drawings and data for conformance with Contract requirements.
- Supply all other services to do the electrical works.
- Supply all other services as may be required to complete the above.

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11. Telecommunication

Contractor shall:

- Establish specific job specifications for the telecommunication systems.
- Prepare detailed drawings and specifications for the telecommunication systems.
- Perform checks for underground drawings of piping and civil where underground telecommunication cables are to be laid.
- Check vendor's drawings and data for conformance with Contract requirement.
- Supply all other services required to do telecommunication works.
- Supply all other services as may be required to complete the above.

12. Miscellaneous and/or special equipment

Contractor shall:

- Establish specific job specifications for miscellaneous and/or special equipment.
- Prepare detailed specifications, data sheets, duty specifications (where applicable) for each item.
- Review vendor's drawings and technical documents for conformance with Contract requirements.
- Supply all other services to do miscellaneous/special equipment.
- Supply all other services as may be required to complete the above.

13. Insulation and painting

Contractor shall:

Establish specific job specifications for all insulation and painting items.

Prepare insulation schedules for equipment and piping showing operating temperature, insulation, service, type and thickness of insulation and reference to the applicable specifications.

- Prepare painting schedule and paint/painting application specifications
- Prepare insulation and painting bill of material.

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- Prepare methods and procedures of surface preparation in detail.
- Prepare methods and procedures of painting of equipment and material in the manufacturer workshop and at Site in detail.
- Supply all other services required to do insulation and painting works.
- Supply all other services as may be required to complete the above.

14. Fireproofing

Contractor shall:

- Prepare fireproofing specifications for steel structure and vessel skirt or supports.
- Establish specific job specifications for fireproofing.
- Prepare drawings covering specific details for fireproofing.
- Prepare fireproofing material specification and bill of quantities.
- Supply all other services required to do fire proofing work.
- Supply all other services as may be required to complete the above.

15. Fire fighting system

Contractor shall:

- Establish specific job specifications for fire fighting system.
- Prepare detail specification, data sheet and detail drawings for fire fighting system.
- Perform checks for underground drawings of piping and civil where underground fire fighting system is to be laid.
- Check vendor's drawings and data for conformance with Specifications.
- Prepare overall design basis and specification of fixed fire and gas systems and fire fighting equipments.
- Supply all other services required to do fire fighting system works.
- Supply all other services as may be required to complete the above.