

ENGINEERING STANDARD

FOR

DETAILED DESIGN, ENGINEERING

AND

PROCUREMENT

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0. INTRODUCTION

The Standard Practice Manuals titled as "Fundamental Requirements for the Project Design and Engineering" is intended for convenience of use and a pattern of follow-up and also guidance.

These Standard Engineering Practice Manuals also indicate the check points to be considered by the process engineers for assurance of fulfillment of prerequisites at any stage in the implementation of process projects. It should be noted that these Iranian Petroleum Standards (IPS), as a Practice Manual do not profess to cover all stages involved in every project, but they reflect the stages that exist in general in process projects of oil, gas and petrochemical industries of Iran.

These preparation stages describe the following three main phases which can be distinguished in every project & include, but not be limited to:

- Phase I:** Basic Design Stages (containing seven Standards).
- Phase II:** Detailed Design, Engineering and Procurement Stages (containing two Standards).
- Phase III:** Start-up Sequence and General Commissioning Procedures (containing two Standards).

The process engineering standards of this group include the following 11 Standards:

<u>STANDARD CODE</u>	<u>STANDARD TITLE</u>
I: Manuals of Phase I (Numbers 1-7)	
<u>IPS-E-PR-150</u>	"Basic Design Package"
<u>IPS-E-PR-170</u>	"Process Flow Diagram"
<u>IPS-E-PR-190</u>	"Layout and Spacing"
<u>IPS-E-PR-200</u>	"Basic Engineering Design Data"
<u>IPS-E-PR-230</u>	"Piping & Instrumentation Diagrams (P&IDs)"
<u>IPS-E-PR-250</u>	"Performance Guarantee"
<u>IPS-E-PR-308</u>	"Numbering System"
II: Manuals of Phase II (Numbers 8 & 9)	
<u>IPS-E-PR-260</u>	"Detailed Design, Engineering and Procurement"
<u>IPS-E-PR-300</u>	"Plant Technical and Equipment Manuals (Engineering Dossiers)"
III: Manuals of Phase III (Numbers 10 & 11)	
<u>IPS-E-PR-280</u>	"Start-Up Sequence and General Commissioning Procedures"
<u>IPS-E-PR-290</u>	"Plant Operating Manuals"

This Engineering Standard Specification covers:

"DETAILED DESIGN, ENGINEERING AND PROCUREMENT"

1. SCOPE

This Process Engineering Standard 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 Engineering Standard 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.

Note: This is a revised version of the standard specification for detailed design engineering and procurement, which is issued as revision (1). Revision (0) of the said standard specification is withdrawn.

2. 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.

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-GN-100	"Units"
IPS-E-PR-150	"Basic Design Package"
IPS-E-PR-170	"Process Flow Diagram"
IPS-E-PR-230	"Piping & Instrumentation Diagrams (P&IDs)"
IPS-E-PR-290	"Plant Operating Manuals"
IPS-E-PR-300	"Plant Technical and Equipment Manuals (Engineering Dossiers)"

BSI (BRITISH STANDARDS INSTITUTE)

BS EN ISO 9001 2000	"Quality Systems Models for Quality Assurance in Design, Development, Production, Installation and Servicing"
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3. DEFINITIONS AND TERMINOLOGY

Basic Engineering Package

The basic engineering Specifications and preliminary operating and laboratory manuals for the Project as outlined in [IPS-E-PR-150](#) which shall be provided by the basic engineering designer.

Calendar

Project calendar shall preferably be according to Iranian calendar, unless the project requirements call for Gregorian calendar.

Company/Owner/Employer

One of the related affiliated companies of the Ministry of Petroleum of the Islamic Republic of Iran, as National Iranian Oil Company (NIOC), National Iranian Gas Company (NIGC), National Petrochemical Company (NPC) and or their subsidiaries.

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.

Inside Iran

Performance of all obligations covering the part of engineering services, procurement of 'Materials' and equipment, construction management and construction, precommissioning work, commissioning services, assistance in start-up and remedy of defects inside the Islamic Republic of Iran, for the 'Project'.

Outside Iran

Performance of all obligations covering the procurement of 'Materials' and equipment including engineering and other services outside the Islamic Republic of Iran, for the 'Project'.

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'.

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'.

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'.

4. SYMBOLS & 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
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

5. UNITS

This Standard is based on International System of Units (SI) as per [IPS-E-GN-100](#), except where otherwise specified.

6. 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 as defined in [IPS-E-PR-150](#) "Basic Design Package"

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 Iran" portion and the "Inside Iran" 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.
- 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.
- 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, precommissioning, 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 as specified in [IPS-E-GN-100](#).

- 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.

6.1 Project Schedule and Control Services

6.1.1 General

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

6.1.1.1 Establishment of overall communication and coordination procedures with approval of Company.

6.1.1.2 Establishment of overall project execution policies, Project schedules and procedures with approval of Company.

6.1.1.3 Integration of activities to ensure overall uniformity of job philosophy and execution.

6.1.1.4 Being sure that all Work is executed in accordance with the project specifications and within time schedule of the project.

6.1.1.5 Establishment risk management process and mitigation throughout all Project development and implementation phases.

6.1.1.6 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.

6.1.1.7 Submitting original electronic files of all information i.e. progress calculation sheets and reports, in addition to hard copies.

6.1.1.8 Filling the blank information formats sent by Company in respect of planning, scheduling and controlling.

6.1.1.9 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.

6.1.2 Planning

6.1.2.1 General

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.

6.1.2.2 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.

6.1.2.3 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.

6.1.2.4 Procedures

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)

6.1.3 Scheduling

6.1.3.1 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.

a) Master Schedule

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.

b) 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.

c) 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.

d) 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.
- 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.

e) 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.

6.1.4 Monitoring and Controlling

6.1.4.1 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 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:

6.1.4.1.1 Develop a control system based on project control techniques and procedures.

6.1.4.1.2 Measure progress performance for cost, time, quality and human resources and compare them to planned progress on a timely immediately.

6.1.4.1.3 Determine the effects of actual schedule performance on the project schedule and update it.

6.1.4.1.4 Incorporate project changes into the schedule.

6.1.4.1.5 Control and analyze the project schedule.

6.1.4.1.6 Recalculate the schedule and allocate the resources.

6.1.4.1.7 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.

6.1.4.1.8 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.

6.1.4.1.9 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.

6.1.4.2 Reporting

6.1.4.2.1 Contractor shall submit to Company a monthly consolidated report, in an agreed format, prepared as per WBS and schedule control procedures including:

- a. Technical review.
- b. Key milestone table as plan & actual in agreed format.
- c. Goals achieved last month.
- d. Next month goals and look-ahead schedule.
- e. Progress, actual vs. scheduled with reasons for shortfall and actions to be taken by Contractor to overcome any shortfall or delay at earliest.
- f. The reasons of delay if occurred and percentage of each reason for delay.
- g. Areas of concern, Contractor shall give reasonable resolutions to overcome any problems raised in the areas of concern.
- h. Statement of any reimbursable costs incurred.
- i. Document Control Index (DCI) and summary status table of the issued documents.
- j. Material Control Index (MCI).
- k. 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.
- l. Financial status including Change Order, if any.
- m. Summary of any Contract changes, pending and agreed issues including cash requirement.
- n. Correspondence status table exchanged by Contractor and Company.

Note: Contractor shall update DCI, MCI and RCI monthly and attach to monthly progress report in hardcopy & electronic files.

6.1.4.2.2 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).

6.1.4.2.3 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.

6.1.4.2.4 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.

6.1.4.2.5 Monthly consolidated reports shall include any further detailed analysis of any important aspect(s) of the Project as may be requested by Company.

6.1.4.2.6 Monthly reports shall be issued within maximum five working days of the end of the monthly reporting period (cut-off date as agreed).

6.1.4.2.7 The sample of progress reports will be reviewed during Kick-off Meeting.

6.1.4.2.8 Contractor shall send monthly vendors status report to Company as per agreed format.

6.1.4.2.9 The report shall include Risk Analysis comprising "Risk Events" and "Recommended Response Plan" for each "Risk Event" (if any).

6.1.4.3 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.

6.1.4.4 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.

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

6.1.4.6 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.

6.1.4.7 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.

6.2 Quality Assurance and Control

6.2.1 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.
- 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.

6.2.2 Quality control system

6.2.2.1 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.

6.2.2.2 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:

- a) Review the Contract requirements.
- b) Check to assure that the required submittals have been prepared and approved.
- c) Make sure that the required materials and equipment is on the site.
- d) Check to assure that the required off-site inspections and tests have been accomplished and approved.
- e) Coordinate and arrange for the required on-site inspection and tests (if required by the Contract).
- f) Determine that all preliminary work has been completed.
- g) Re-check materials and equipment for compliance.
- h) Prepare the schedule of inspection.

6.2.2.3 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.

6.2.2.4 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.

6.2.2.5 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.

6.2.3 Quality control program

Quality Control Program shall be prepared by the Contractor and shall be submitted to the Company for review and approval.

6.3 Detailed Design and Engineering

6.3.1 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 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.

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- 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.

6.3.2 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.
- 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.

6.3.3 Process, utilities and safety engineering

6.3.3.1 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. These P&IDs shall be prepared in accordance with the requirements as outlined in [IPS-E-PR-230](#).

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.
- 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 as per requirements outlined in [IPS-E-PR-150](#).
- 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.
 - 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).

Note: Above summaries shall be provided for each Unit as well as the whole plant and shall include all operating modes (as applicable) and for summer and winter cases.

- 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.
- 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.

6.3.3.2 Safety engineering

6.3.3.2.1 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 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:

- a) Preparation of logic diagram, Cause and Effect Charts; preparation of safety documentation.
- b) 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.
- c) Provide all other services as may be required to complete the above.

6.3.3.2.2 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 documents. Actions arising from HAZOP studies shall be recorded and implemented in according 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 .

6.3.3.2.3 HAZOP Outputs

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

- a. Hazard identification report: Defining objectives, methods and scope of hazards and operability.
- b. 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.
- b. Supply all other services required to do HAZOP study and review.

6.3.4 Civil and structure engineering

Contractor shall:

- 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.
- 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.

6.3.5 Vessels, towers, reactors and storage tanks

Contractor shall:

- Establish specific job specifications for towers, pressure vessels and storage tanks.
- 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.

6.3.6 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.
- 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.

6.3.7 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.

6.3.8 Piping

Contractor shall:

- Establish specific job specifications for piping.

Note: Stress relief and branch reinforcement requirements shall be included in piping specifications.

- 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.
- 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.
- 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.

6.3.9 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.
- 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.
- 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.

6.3.10 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.

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- Design electrical tracing where required.
 - 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.
 - 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.

6.3.11 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.

6.3.12 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.

6.3.13 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.
- 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.

6.3.14 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.

6.3.15 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.

6.4 Procurements Services

6.4.1 General

The procurement of Materials shall be carried out based on the engineering works inclusive but not limited to data sheets, specifications and drawings. The issued drawings and documents to vendors for requisition and purchasing shall be approved by Company.

The Contractor shall:

- Perform all procurement services for the purchase of all equipment and materials.
- Procure all of the Equipment and Materials including bulk Materials of the project based on the engineering works approved by the Company. The spare parts shall be in congruent with the Material codes indicated in the Company's MESC Books, unless otherwise approved by the Company.
- Utilize his own resources to carry out any expediting and inspection that may be necessary to insure that the Materials are delivered in accordance with the project schedule and the relevant specifications.
- Prepare Material Selection Guides based upon final process flow diagrams and submit to the Company for approval.
- Prepare material selection guides based upon project specification Materials requirements and data given in the Basic Design Package and published corrosion data by the acceptable international committee (e.g., NACE) approved by Company. In general, the materials shall be selected to reflect up-to-date, proven and established technology if not specified in the Basic Design Packages.
- Arrange third party inspection as foreseen in the Contract.

b) The procurement services main activities shall include but not be limited to:

- Establishing specific job specifications.
- Compiling all relevant Specifications and data sheets.
- Preparation of the requisitions for purchase of Materials
- Preparation of technical bid evaluation.

- Technical and commercial negotiations with vendors including clarification of technical questions that may arise from vendors.
- Preparation and issue of purchase order after Company approval.
- Checking of orders confirmation.
- Preparation and issue of variations to purchase order if necessary.
- Checking vendors' documents and drawings for conformance with Contract/purchase order requirements.
- Control, tracing and monitoring of Materials.
- Desk and outside expediting.
- Expediting of documents, drawing and spare part lists with vendors.
- Proper inspection of the Materials.
- Checking invoices.
- Provision and arrangements for all risk insurance up to Site where the Materials are to be installed.
- Cargo inspection.
- Arrangement for packaging.
- Arrangement for shipment with shipping agency.
- Preparation of necessary documentation for shipment/custom clearance/exportation / importation.
- Planning and co ordinations of all the procurement activities.
- Reporting on progress.
- Expediting delivery in such manner as to allow completion of the Works on time.
- Supply all other required services.
- Supply all other services as may be required to complete the above.

6.4.2 Enquiries/request for quotation

6.4.2.1 The Contractor shall prepare enquiries which shall be in accordance with the Contract requirements and shall state that Materials shall be required for the Company and for the Project.

6.4.2.2 Enquiries for Materials shall include the provision of approved job specifications, process duty specifications, data sheets, all other necessary documents and drawings as required and whenever applicable spare for construction, commissioning and one years operation.

The Vendor assistance required is to be defined. In general, Vendor assistance during commissioning is to be requested for major equipment such as major rotating machinery , Boilers, Furnaces, Internal of towers, Package units, high and medium voltage Panels, etc, that shall be

agreed upon by the Company before issuance of purchase. Enquiries shall also state requirements for items such as drawings and documentation.

6.4.2.3 Enquiries for major Equipment shall be issued to Company for review and approval.

6.4.2.4 The Contractor shall solicit competitive quotations from a sufficient number of approved vendors (Listed in the Contract's attachments) for the respective Materials to assure the receipt of a minimum of three acceptable bids. Exceptions to this would be subjected to approval of Company.

6.4.2.5 All requests for quotation are to contain the following note:

- Review all attachments with care. Strict compliance as requested is mandatory for bid evaluation .Any exceptions/deviation to Specifications and/or "Terms and Conditions of Purchase", must be clearly stated in a separate section titled "Exception/Deviation in the quotation".
- All engineering and design data including technical information of all quotations shall be in English with consistent use of metric units of measurements. All drawings, instructions for installation, operating manuals, maintenance manuals, and any other printed matter pertaining to the equipment furnished by Contractor / vendor/ and sub-vendor shall be in the English language"

Requests for Quotation shall state requirements for and shall request bidder to furnish of the following as well:

- Shipping promise.
- Shipping point .
- Method of shipment .
- Delivery Point.
- Spare parts (for two years operating spare part the price SPIR list shall be furnished by the vendors in the quotation).
- Free access to expeditors and inspectors, including Company's representatives .
- Drawings and data sheet.
- Installation, operating and maintenance instructions .

6.4.3 Bid analysis

6.4.3.1 Contractor shall prepare technical bid analysis and evaluation reports for the Materials inclusive of necessary tabulation from the three vendors for each case and submit the same to Company for review and approval. The said bid evaluation reports shall also include:

- Contractor proposed selected vendors with indication of reason for selection.
- In case where a Vendor's bid is not acceptable, a statement for the reason for its rejection.
- Un-priced vendor quotation.
- List of rejected vendors because of non conformity with the Contract requirements with non conformitance items in detail.

- Differences in operating costs and maintenance cost, including contractors procedures and methods to calculate all of the said parameters if requested by Company.
- Special tools and tackles required for erection, precommissioning, commissioning, operation and maintenance of the equipment wherever necessary.

6.4.3.2 Consideration of standardization of equipment in the interest of simplifying and minimizing the stock of spare parts of particular interest to Company will be the Contractor's efforts in dealing realistically with the following:

- a) Grouping together the various types and models of related functional equipment to encourage selection of a single vendor.
- b) Maximizing interchangeability in each unit.

6.4.3.3 Contractor shall submit one copy of all technical communications with vendors to Company.

6.4.4 The Company review and approval

The Company will review and check the submitted technical analysis and evaluation to ascertain the compliance of the quotations with the Contract requirements and approve Contractor vendor for respective Materials or otherwise will indicate the Company preferred vendor among the above mentioned three bidders provided that any cost consequent cost effective (if any) to be compensated as per Contract. For any deviation from the Contract requirements the Contractor shall obtain the approval of Company before the issuance of technical analysis and evaluation report. Such approval or ascertainment shall not relieve the Contractor from his responsibility and obligation under the Contract.

6.4.5 Purchase orders

6.4.5.1 Purchase orders shall give a complete description of items required. Separate purchase orders shall be issued by Contractor for the vendor services inside Iran e.g., assistance in erection or commissioning of equipment.

6.4.5.2 Purchase orders shall include:

- a) Guarantees (Refer to Article 6.5.11 below) .
- b) Required drawings and data sheets .
- c) Schedule for drawings and data submitting.
- d) Expediting, inspection and shipping requirements (including test certificate required) .
- e) Spares parts information as per SPIR form in accordance with the original manufacturer's documents.
- f) Storage recommendations .
- g) Operating and maintenance manuals.
- h) Any other required mechanical catalogue information.

6.4.5.3 The Contractor shall indicate the following notes on all purchase orders:

- Progress Report:

Unless otherwise the delivery schedule is included in this purchase order, within thirty days from date of order, vendor shall submit the detail program for the engineering, Materials procurement, fabrication and delivery for this purchase order followed by a progress report issued each months until final delivery.

Items to be purchased are subject to inspection and approval by the Company and that any items not conforming to approve Specifications shall be rejected.

- Complete Order:

This order will not be considered complete until the Contractor is in receipt, in proper form, of all the engineering data requirements, drawings, spare parts lists and instruction manuals. Payment, or in the case of progressive payment, final payment will be withheld pending receipt of any or all of the above data".

- The following statement should be included on each purchase order as the last paragraph:

Notice of Shipment:

Supplier shall notify the Contractor and the shipping agent by facsimile and/or telex on the day of each shipment goes forward. Such notification must be identified by purchase order number.

6.4.5.4 All applicable specifications, standards, drawings and standard notes shall be listed on the purchase order and shall be attached to it unless it has been verified and confirmed jointly by Contractor respective vendors in writing that current issues are already in vendor's possession.

6.4.5.5 Purchase orders shall state the delivery date as a specific date and not as a period of time from the order date.

6.4.5.6 Copies of purchase orders shall be distributed in accordance with Project Coordination Procedure at the time that orders are placed. Purchase orders or attachments shall list details of Iranian authorities involved and Contractor shall forward copies of purchase orders to these Authorities.

6.4.5.7 Additions, deletions and corrections as approved by Company are to be made by supplement to the purchase order.

6.4.5.8 Purchase orders shall include following requirements:

a. Place of delivery.

b. Required spares for precommissioning, commissioning, two years operation and capital spare parts (if applicable).

c. Special tools and tackles required for erection, precommissioning, commissioning, operation and maintenance of the equipment wherever necessary.

d. Any other required mechanical catalogues/information to enable Contractor to fulfill his contractual obligations stipulated in Contract documents.

6.4.6 Provision of data

Contractor shall ensure that vendor provides all drawings and data requirements as stated on the respected purchase order. An order shall not be considered as completed until every such document has been received and accepted as satisfactory by Contractor and Company.

6.4.7 Inspection

- Inspection shall be made in accordance with the Contract requirements.
- The Contractor shall not accept from vendors any Materials which are not of acceptable quality of workmanship, or fails to comply with the Specifications and/or which are required to have the inspection as above but which have not performed satisfactory in such inspection.
- Shop inspection and testing report shall be delivered to Company not later than 30 days after performance of the inspection. However it must be delivered before issue of Contractor's invoice.
- The Company reserves the right for his representative and/or agent to visit vendor's shop, and those of their sub-suppliers, at any time, for the purpose of inspecting Materials. Arrangements for these visits shall in all cases be made through Contractor. Such visits will not relieve Contractor or any vendor or sub-contractor of his responsibility for inspection as detailed above. If the Contractor intends to subcontract inspection at vendor's shop partly or in whole, then the inspection agency to be used shall have the prior approval of the Company. Contractor shall, in conjunction with the Company make any necessary arrangements to obtain the approvals of statutory authorities where required in connection with inspection of Materials.
- Contractor shall give to the Representative Engineer advance 60 calendar days notice of any test per coordination procedure to be made by vendor and/or Contractor in order that Company representative may witness any such test.
- Third party inspection shall be arranged by the Contractor as foreseen in the Contract.
- The Contractor shall supply all other services as may be required to complete the above.

6.4.8 Shipment

- Contractor shall establish maximum allowable shipping dimensions and masses (weights and volumes), and any other specific requirements which may be needed for shipment of Materials.
- Contractor shall prepare a detailed Shipping Procedure for review and approval of the Company.
- Contractor shall provide for shipment all risk insurance for Materials shipment to the Site where the respective Materials are to be installed in Iran.
- Purchase orders shall be accompanied by copies of shipping instructions (i.e., Packing, Marking and Documentation attachment).
- Contractor shall provide all necessary documentation required for the export of the Materials from outside of Iran, import of Materials into Iran, custom clearance as well as inside Iran shipment and shall make all necessary arrangement for the said transportation and custom clearance.
- Contractor shall ensure that all necessary customs clearance documentations are available at the port of entry prior to arrival to custom to avoid delay in custom clearance. Materials going by air or overland shall be accompanied by the necessary customs clearance documentation.
- Contractor shall insure that the required custom clearance certificate issued by Iranian custom authorities (identified as Green Customs Document) have been handed over to

him and shall deliver the same to the Company immediately after custom clearance of the Materials.

6.4.9 Progress control and expediting

- Contractor shall expedite delivery in such manner as to satisfy the time for completion and to maintain the integrity of the Works.
- Any threatened delays that may affect the Project schedule shall immediately be brought to the attention of the Company, together with actions to be taken to improve the situation.
- Materials shall be inspected regularly and as a minimum monthly inspection shall be made to all vendors and sub-suppliers of major equipment and other Materials likely to be critical for the completion of the Project.
- The Company reserves the right for his representatives and/or agent to visit Vendor's and sub-suppliers' works, for the purpose of expediting Materials and Equipment. Arrangements for these visits shall in all cases be made through Contractor. Such visits shall in no way be construed as relieving Contractor of his responsibility for expediting as detailed above
- Contractor shall maintain Materials Progress Report to record the status of all items procured by Contractor. These reports shall be issued to Company at least monthly throughout the Project execution period until all Materials have been received at Site where the Materials shall be installed.
- Contractor shall establish the format of Materials Progress Report.
- Materials Progress Report shall include, as applicable, at least the following:
 - Requisition number, revision number and revision issue date.
 - Equipment item number.
 - Brief description of Materials.
 - Date of issue of enquiry.
 - Due dates for bids.
 - Planned and actual order placement date.
 - Purchase order number.
 - Name of Vendor, and country of origin.
 - Delivery schedule viz. Contractual promise, latest promise. Total slippage, slippage at last check.
 - Expediting activity details (viz. date of last check and nature. Of check-by telephone, cable, letter or personal visit).
 - Inspection date (or a note if inspection has been waived).
 - Date of issue of shipping instructions to the Vendor.
 - Ex-works date (actual).

- Iranian port receipt date (estimated and actual).
 - Custom clearance date.
 - SITE (Where the Materials shall be installed) receipt date (estimated and actual).
 - Any problem (anticipated or existing) at the date of report and Contractor solution and arrangement for solving problem.
- After order placement regular checks shall be made to obtain latest dates promised by vendors, and latest dates anticipated by Contractor.
- The promised delivery date must take into account time allocated for shop inspection, preparation for dispatch and any intervening holidays.
- Separate records shall be maintained for spare parts.
- Separate records shall be maintained for Overage, Shortage and Damage (OSD) of delivered items.

6.4.10 Vendor specialists

Contractor shall provide the services of vendor specialists as required for supervision and assistance of erection, pre-commissioning and commissioning of the Materials, e.g., Compressors, Rotating Machinery, Tower Internals, Boilers, Fired Heaters, high & medium voltage Panels, Packaged Units and complex instrumentation such as PCS/SGS/F&G/PLC, and Telecommunication equipment.

6.4.11 Guarantee

- Prior to order placement, Contractor shall obtain guarantee from vendors, and shall ensure that these guarantees are fully transferable to the Company. The guarantee shall not be less than the requirement stipulated in the conditions of Contract.
- In the event that Materials require repair/replacement but are not covered by vendor's guarantee, e.g., damage during transport or construction, Contractor shall ensure that necessary repair/replacement is carried out at no cost to Company.

6.5 Reimbursable Material

Contractor shall provide the services for items covered by provisional sum listed in the Contract in accordance with the provisions therein.

6.6 Supply of Materials

6.6.1 Contractor shall supply on the basis of delivery terms specified in the Contract.

6.6.2 Packaging, loading, unloading, transportation, insurance, customs clearance of Materials shall be carried out by Contractor.

6.6.3 All Materials shall be new.

6.6.4 Contractor shall not submit to Company shipping documents and shall not accept and supply any Materials subject to the conditions of Contract.

6.6.5 Contractor shall prepare and submit to Company for review and the approval procedures defining controls for the receipt, storage, custody and distribution of all Materials. Such procedures shall include as a minimum the followings:

- Receipt of Materials and documentations,
- Inspection at point of receipt and identification of overage/shortage and damaged (OS & D) items,
- Stock control,
- Storage and custody of Materials, external and internal, including environmentally controlled areas,
- Materials handling,
- Checking for conformity with Contract requirements.
- Quality control of vendor/supplier furnished item,
- Return or replacement of uncertified Materials.

6.6.6 Contractor shall submit Materials certificates for Company approval. Materials survey reports shall also be included as part of test and inspection dossiers.

7. PROCEDURES

The Contractor shall prepare procedures as set forth in Article 6.1.2(4) above and any other procedures as required for completion of the Works and submit for the Company for approval.

8. DETAIL DESIGN & ENGINEERING DOCUMENTS

8.1 Language

'The ruling language' shall be the English language. However from time to time the 'Company' may instruct that certain correspondence etc. shall be in both Farsi and English.

8.2 Documents Mutually Explanatory

The several documents forming the 'Contract' are to be taken as mutually explanatory. In case of discrepancies between the several documents forming the 'Contract', precedence shall take place in the order designated in the Contract. Any ambiguities in the documents and/or drawings shall be referred to the 'Engineer' for correct interpretation. In no case shall any ambiguities and/or discrepancies between the several 'Contract Documents' form the basis of a claim for additional payment under the 'Contract'.

8.3 Drawings and Approvals

8.3.1 The 'Contractor' shall submit to the 'Engineer' for approval, within the times named in the 'Contract', such drawings, samples, patterns and models as may be required by the Coordination Procedure as provided in Section 7 of this Standard, or as the 'Engineer' may reasonably require, provided that the 'Contractor' shall not be under any obligation to supply copies of shop drawings.

Within the ten (10) working days after receiving such drawings, samples, patterns and models the 'Engineer' shall signify his approval or otherwise. Copies of all drawings which require to be approved by the 'Engineer' shall be provided in triplicate by the 'Contractor'. The 'Contractor' shall supply additional copies of approved drawings in accordance with the details set out in the 'Contract'.

8.3.2 Drawings approved as above described shall not be departed from except as provided in the Contract.

8.3.3 The 'Engineer' shall have the right at all reasonable times to inspect at the premises of the

'Contractor' all drawings or any portion of the 'Works'.

8.3.4 The 'Contractor' shall, within the times named in the 'Contract', provide drawings showing the manner in which the 'Plant' is to be assembled and erected with information relating, unless otherwise agreed, only to the 'Works', required for preparing suitable access to the 'Plant' and any necessary equipment to the point on 'Site' where the 'Plant' is to be erected and for making all necessary connections to the 'Plant' (whether such connections are to be made by the 'Contractor' under the 'Contract' or not).

8.3.5 The title of all drawings, specifications and other documents prepared by the 'Contractor' shall be vested in the 'Company' and all such drawings, specifications, etc. shall be clearly marked to the effect, provided, however, that the 'Company' shall hold in confidence and cause its employees to hold in confidence all information disclosed by licensor and if required by licensor, will conclude a Secrecy Agreement with licensor.

8.3.6 Any expenses resulting from an error or omission in or from delay in delivery of the drawings and information mentioned in this Clause 8.3 shall be borne by the 'Contractor'.

8.4 Job Specifications, Manuals and other Engineering Documents

Contractor shall:

-Furnish Company with the piecemeal hard copies and electronic file of the Job Specification and fifteen (15) (approved by Company) final bound copies and three (3) sets of editable type electronic files of the Job Specifications.

-Furnish Company with the piecemeal hard copies and electronic file and three (3) sets of editable type electronic files and fifteen (15) copies of (approved by Company) separately bound volumes and indexed Plant Technical Manuals for each Unit.

-Furnish Company with three (3) sets of editable type electronic files and five (5) copies in bound volumes and indexed Plant Equipment Manuals.

The Contents of Plant Technical Manuals and Plant Equipment Manuals shall as a minimum, satisfy the requirements of [IPS-E-PR-300](#).

-Furnish Company with four (4) copies of Spare Parts List and Interchangeability records for two years operating Spare Parts duly and completely recorded (inclusive of actual price figures) in the SPIR form included in Appendix F of this Standard.

-Furnish Company with three editable type electronic files and fifteen (15) sets of separately bound copies of Operating Manuals for each Unit. Operating Manual shall be submitted to Company at least three (3) months prior to Completion of the respective Unit.

The contents of Operating Manuals shall as a minimum satisfy the requirements of the [IPS-E-PR-290](#).

Note: Contractor shall also furnish Company with revised sheets and drawings of Operating Manuals prepared, as may be requested by Company and / or due to changes made by the Contractor.

-Furnish Company with 4 hard copies and 3 editable electronic files of Operability and Performance Test Procedures and submit for Company's approval not later than 3 months prior to Completion of the respective part of the Works.

-Furnish Company with three hard copies and two 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 three months before Completion of the relevant Unit.

-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 Company with calculation methods and procedures, all drawings, data sheets, specifications, calculation, cost data, Materials requisitions and all other technical and commercial information.

-Furnish unpriced purchase order (3 copies in each case) for Materials before shipment of the respective Materials to the Site (for two years operating spare parts, the priced purchase orders shall be furnished).

-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 with four (4) sets of as-built drawings in hard copies and three (3) sets of editable type 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.

Note: Drawing sizes shall be per [IPS-E-PR-230](#) unless otherwise specified in [IPS-E-PR-290](#) and [IPS-E-PR-300](#) for the inclusion in the Operating Manual and Plant Technical Manual respectively.

-Produce the required copies of maintenance schedule for each unit of the plant. This schedule shall state routine inspection and maintenance requirements during operation, routine shutdowns and general overhauls. Schedules shall be in English and in a format agreed with the Company. The schedule shall give the timing and outline the action for inspection and maintenance in respect of items such as:

- Lubrication of machinery and moving parts,
- Topping up or refilling of filled systems,
- Checking of flow in Equipment and piping in services liable to fouling,
- Checking of wear in moving parts and electrical contacts,
- Checking of calibration of instrumentation,
- Checking of relay settings and operations,
- Checking of wall thickness of Equipment and piping in erosive or corrosive services,
- Electrical insulation tests,
- Checking of vibration in rotating Equipment,
- Scale formation in boilers,
- Correct functioning of steam traps,

- Checking of relief valve settings.
 - Coordinate with Basic Designer/Licenser of unit in case of discrepancies in Technical documents provided by them for rectification the same.

8.5 Format

All drawings and manuals prepared by the 'Contractor' shall be prepared in English and shall be in accordance with the 'Company's' standards with regards to sizes, titles, etc.

8.6 Mistakes in Drawings

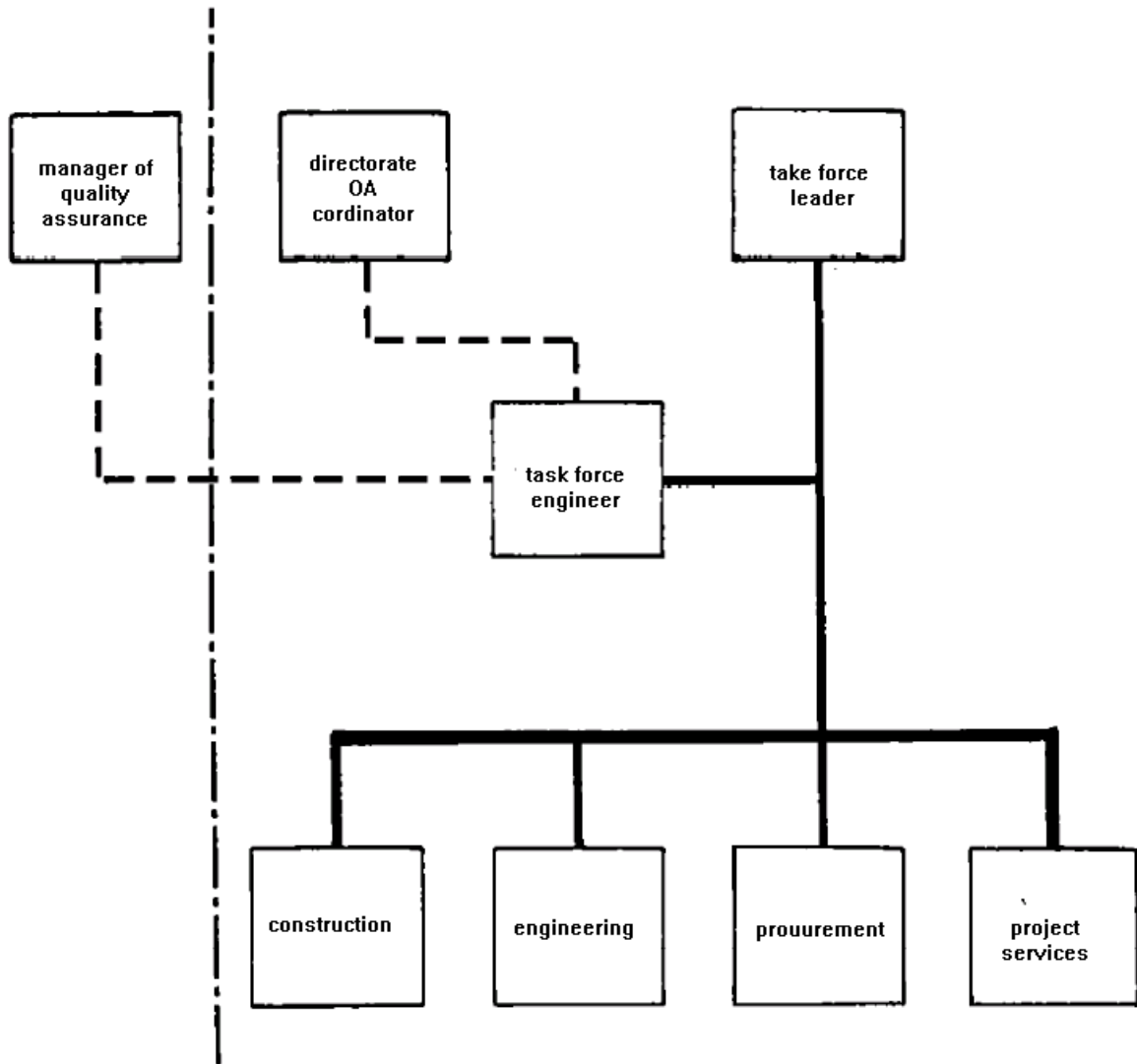
The 'Contractor' shall be responsible for any discrepancies, errors, or omissions in the drawings and other particulars supplied by him, whether such drawings and particulars have been approved by the 'Engineer' or not, provided that such discrepancies, errors, or omissions be not due to inaccurate information or particulars furnished in 'Writing' to the 'Contractor' by the 'Company' or the 'Engineer'. The 'Company' shall be responsible for drawings and information supplied in 'Writing' by the 'Company' or the 'Engineer' and for the details of special work specified by either of them.

APPENDICES

APPENDIX A

TYPICAL PROJECT QUALITY ASSURANCE ORGANIZATION/INTERFACE

(Typical only for Task Force Undertaking Full Range of Engineering/Procurement and Construction)



LEGEND:

FUNCTIONAL GUIDANCE
REPORTING RELATIONSHIP

APPENDIX B
PROJECT CONTROL AND SCHEDULING
METHODS AND PROCEDURES (TYPICAL)

Level 1: Milestone Level Control

- a) Project Master Schedule.
- b) Progress Curves.

Level 2: Summary Level Controls

- a) 90-day Kick-Off Schedule.

Level 3: Detail Level Controls

- a) Critical Activity Listing.
- b) Manpower Histograms.
- c) Schedule Trend Meetings.
- d) 90-day Bar Charts.
- e) Subcontract Preparation Schedule (if required for the construction phase).

Level 4: Working Level Controls

- a) Physical Progress Measurement.
- b) Weekly Work Schedules.
- c) Deviation List.

B.1) Level 1:

B.1.1) Level 1(a): Project master schedule

The project master schedule shall be in bar chart format and limited in detail, but shall highlight all major project milestones as agreed with the Company and provide sufficient information to allow management to evaluate the overall status of the project at a glance. It shall be updated to show progress achieved and issued as part of the Monthly Progress Report. It shall clearly identify:

- Start and complete dates for engineering by discipline and for procurement.
- Material delivery and shipping periods.
- Site mobilization and construction activities (if required).
- Mechanical Completion and ready for startup dates (if required).

B.1.2) Level 1(b): Progress curves

As an aid in planning and control, overall progress and manpower curves shall be developed to monitor Engineering and Procurement progress.

The development of these curves shall be based on the approved Master Schedule and shall include breakdowns for all disciplines and sub-contracts to cover:

- Engineering document release.
- Equipment and material purchase, manufacture and delivery.
- Fabrication/construction progress (if required).

The curves shall be updated monthly to display actual progress throughout the project duration and issued with the Monthly Progress Report.

B.2) Level 2:

B.2.1) Level 2(a): 90-day kick-off schedule

At the start of the project, a 90-day Kick-Off schedule shall be issued which shall illustrate in detail all work anticipated within that period. This schedule shall be updated weekly and used for project control until the detailed planning effort has been implemented.

B.3) Level 3:

B.3.1) Level 3(a): Critical activity listing

The computer produced critical path printout shall include a listing of activities at negative and zero float or up to a predetermined level of positive float which enables detailed analysis of the activities, and the formulation of action plans to reduce criticality and ensure completion of the project on schedule.

B.3.2) Level 3(b): Manpower histograms

Actual manpower should be plotted against current forecast requirements, as generated by the CPM (Critical Path Methods) network, so that sufficient resources are being mobilized to accomplish the work planned. The histograms indicate manpower for Engineering, Procurement and Construction (if required).

B.3.3) Level 3(c): Schedule trend meetings

Weekly meetings should hold between all key members of the project team to:

- Review possible scope changes.
- Review the critical activity list.
- Review progress achieved.
- Identify current and potential future problem areas.
- Formulate action plans to resolve problem areas.
- Follow-up on previous action plans.

B.3.4) Level 3(d): 90-day bar charts

The action plans identified at the schedule trend meetings to eliminate negative float such that activities are achieved to schedule and include any scope changes, shall be entered into the computer system. The computer shall then be used to generate a bar chart schedule, sorted by discipline, showing the planned activities for the next 90-day period. The bar charts shall be used so that all personnel on the project implement the agreed activities for completion of the overall project

on schedule. The 90-day bar charts shall be re-issued on a monthly basis to the Engineering and procurement task force teams.

B.3.5) Level 3(e): Subcontract preparation schedule (if required)

A subcontract preparation schedule shall be printed in bar chart form and shall show the activities required by all project groups to formulate subcontracts, review bids received and place the subcontracts according to the agreed milestone dates for the commencement of construction.

B.4) Level 4:

B.4.1) Level 4(a): Physical progress measurement

All disciplines on the project shall prepare detailed control documents for major activities. The following areas of effort shall be measured and compared with the detailed schedules:

Engineering

- Drawings to be issued for approval.
- Drawings to be issued for construction.
- Requisitions to be issued for quotation.
- Requisitions to be issued for purchase.
- Model progress.
- Piping isometrics issued.
- Physical percentage complete by discipline.
- Overall percent complete.

Procurement

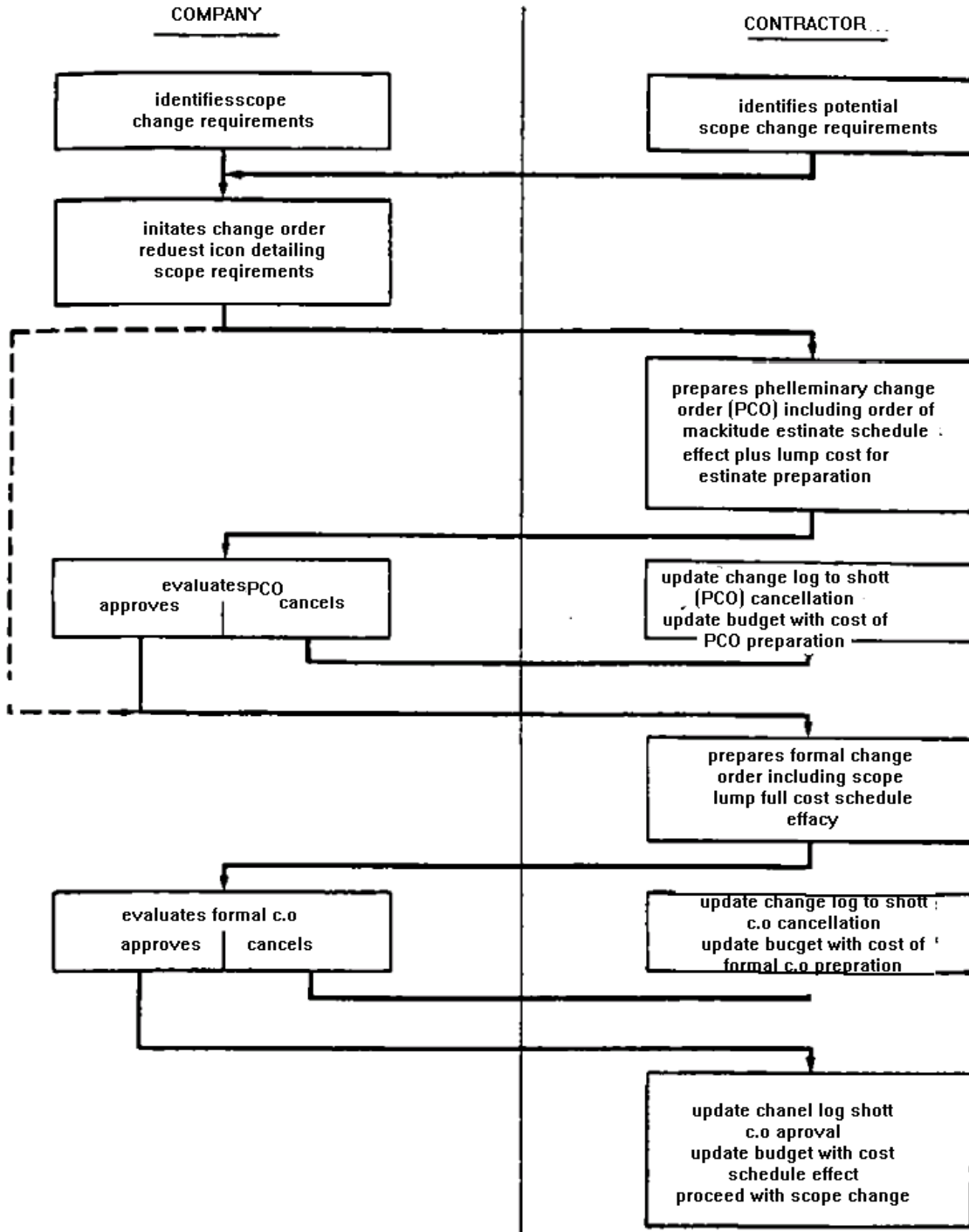
- Material requisitions enquiries issued.
- Purchase orders issued.
- Pieces of equipment and bulk materials delivered to site.
- Subcontracts placed.

B.4.2) Level 4(b): Weekly work schedules applicable for construction stage.

B.4.3) Level 4(c): Deviation list applicable for construction phase.

APPENDIX C

TYPICAL CONTRACT CHANGE FLOW DIAGRAM



APPENDIX D**SUPPLY OF SPARE PARTS, MISCELLANEOUS EQUIPMENT AND MATERIALS, CHEMICALS AND CATALYSTS****D.1 General**

Supply of spare parts and other special items may be included in the Contract in the lump sum price and/or as reimbursable items. However, in any case, an expert team of the Company consisting of the necessary specialists in the various fields is required to review the Contractor and/or Vendor(s) recommendations and issue final Company's approval for supply of spare parts.

This Appendix outlines minimum requirements for supply of spare parts, miscellaneous equipment and materials, chemicals and catalysts, if all procurement activities of such materials to be carried out through the Contractor.

D.1.1 For the supply of materials and equipment hereinafter provided, the Contractor shall act as purchasing agent of the Company, providing also for the relevant payments to the supplier, forwarding agent, shipper and insurer. The Contractor shall submit to the Company a program of his services under this section and, when this is agreed by the Company it shall be included, in the Contract.

D.1.2 The Contractor shall not be responsible for:

- The supply of any guarantee other than those of the manufacturer. These guarantees to be transferred directly to the Company.
- The time of delivery.

D.1.3 The Contractor shall report to the Company monthly the value of materials and equipment ordered.

D.1.4 The Contractor shall invoice monthly to the Company in the currency requested the amount of the fee due to the Contract for the services rendered based upon the purchase orders issued during that month.

D.1.5 The Contractor shall arrange for marine insurance in accordance with the provisions of the Contract.

D.1.6 Spare parts, miscellaneous equipment & materials, catalysts and chemicals as listed in Appendix D may be purchased on reimbursable basis if required by the Contract, In case, those items to be supplied as lump sum price, detail specification and conditions of purchasing to be defined in the Contract.

D.2 Supply of Spare Parts

D.2.1 The Contractor shall arrange as a condition of each purchase order for suppliers of equipment and from each Manufacturer of parts bought by suppliers, complete recommendation and interchangeability record forms according to the Spare Parts List and Interchangeability Record Forms (SPIR Forms) as shown in Appendix E. Completion of these forms shall be based on the manufacturing drawings for the order and the completed forms shall be accompanied by copies of such drawings and the parts lists certified as being applicable to the order.

D.2.2 The Contractor shall include his own recommendation in the space provided on the form referred to above after reviewing the suppliers proposals and quotation and interchangeability between all orders placed on the same supplier except as provided for herein below.

D.2.3 The Contractor shall prepare interchangeability charts for those items which occur in significant numbers between different suppliers and between different categories of equipment and are of significant cost such as seals, furnace and exchanger tubes, safety valves and instruments. Contractor shall compile a consolidated summary of spare parts for all equipment to determine maximum interchangeability and minimize spare parts inventory.

(to be continued)

APPENDIX D (continued)

D.2.4 The Contractor shall prepare his own recommendations for spares for general materials such as pipes, valves, pipe fittings, bolts, gaskets packing, electrical material, etc.

D.2.5 The Company shall complete the form with purchasing instructions after consultation with his coding adviser.

D.2.6 The Company shall provide the Contractor with an identification code and the Contractor shall arrange with the supplier for each item to be tagged according to this identification code and for inclusion of the same identification in packing lists and invoices.

D.2.7 When submitting bid analyses for engineered equipment, Contractor shall also submit priced spare parts list(s) including lubricants, chemicals, etc. and recommended Spare parts list for start-up and two years operation.

D.2.8 The Company may withhold consideration of any bid tabulations unless they are recommended by the required spare parts information, and will not be responsible for any delays which result due to this requirement not being met.

D.2.9 Vendor spare parts recommendations must be complete with prices, complete parts list and sectional drawings showing interchangeability of parts. Standard items, (e.g., bearings, oil seals, gaskets, packing, valves, fittings, etc.) shall be identified with manufacturers size, catalogue or part number and description.

D.2.10 The Contractor shall expedite the delivery, inspect the major spare parts, inspect all tagging of the spare parts, check invoices and forward one copy of each packing list to the Company as soon as possible after shipment. One copy of packing list shall be packed with each shipment. The Contractor shall provide shipping documents made out in the name of the Company.

D.3 Supply of Miscellaneous Equipment and Materials

D.3.1 The Contractor shall prepare and issue enquiries and purchase orders for the items listed in Appendix D, as the Company will require and for their spares, providing for delivery FOB including packing for ocean shipment.

D.3.2 The Contractor shall follow the same procedure for spare parts as in Section 2 above.

D.3.3 The Contractor shall expedite the delivery, inspect, accept the equipment and spares, check invoices, arrange shipment and insurance and forward one copy of each invoice and of each packing list to the Company as soon as possible after shipment.

D.3.4 The Contractor shall provide shipping documents made out in the name of the Company.

D.4 Supply of Chemicals and Catalysts

D.4.1 The Company shall provide the Contractor with a detailed list stating quantities and types of catalysts and quantities and specification of chemicals.

D.4.2 The Contractor shall prepare and issue inquiries and purchase orders for the items according to the above list.

D.4.3 The Contractor shall submit the quotations to the Company who shall issue purchasing instructions to the Contractor.

D.4.4 The Contractor shall expedite the delivery and accept the catalysts, check invoices, arrange shipping and insurance and forward one copy of each invoice and of each packing list to the Company as soon as possible after shipment.

D.4.5 The insurance shall include the platinum content of platformer (Catalytic Reformer) catalyst and/or any high value material content of other catalysts as required by the Company. The Contractor shall also arrange for guarding as may be required during loading.

D.4.6 The Contractor shall provide shipping documents made out in the name of the Company.

(to be continued)

APPENDIX D (continued)**D.5 Spare Parts-MESC Numbering and Spir Forms**

Contractor shall be responsible for preparing spare parts interchangeability list, as follows:

D.5.1 Contractor's responsibility

D.5.1.1 The Contractor shall give procurement services, and assist in shipping FOB (1) all construction/ commissioning spares and (2) a recommended two years operating supply.

D.5.1.2 Delivery

The Contractor shall assist the Company for the timely delivery FOB of all spares in order that by means of regular and normal transportation they will be on hand at the site in advance of the time for the start of precommissioning.

D.5.1.3 Recommendations

The Contractor shall assist in obtaining vendors recommendation of the amount of all spares required. He shall pass on to the Company his own independent recommendation.

D.5.2 Spare parts list and interchangeability record (SPIR) form

All spare parts recommendations shall be made on a spare parts list and interchangeability record (SPIR) form, a copy of which is attached in Appendix E, this applies to construction/commissioning spares, as well as operating spares.

D.5.2.1 The Contractor shall assist in having the SPIR form filled out by the manufacturer/supplier of the equipment.

D.5.2.2 The Contractor shall verify the completed form from the manufacturer/supplier for accuracy and completeness, fill in his spare parts recommendation, forward it to the Company.

D.5.2.3 The completed SPIR forms shall be supported by the following documents:

- a) Complete manufacturer's parts list.
- b) Relevant drawings, cataloges, pamphlets and bulletins of the main of primary equipment.
- c) Relevant parts lists, drawings, sketches and pamphlets of subsuppliers of auxiliary equipment.

D.5.2.4 Guidelines for completion of the "SPIR" form is presented in the Appendix E.

APPENDIX E**REIMBURSABLE ITEMS**

E.1 If required by the Contract, the following items purchased in accordance with the provisions of this Section, will be payable on reimbursable basis. Detail specifications and conditions of purchasing in each case shall be foreseen in the Contract if these items to be supplied based on lump sum price.

- One or two years spare parts for permanent plant equipment and material.
- Laboratory equipment.
- Laboratory chemical.
- Laboratory books, manuals, etc.
- Laboratory furnishings, consisting of permanently installed counters, sinks, cabinets, and vent hoods.
- Fire trucks, trailers and accessories.
- Foam liquid
- Portable monitors
- Fire fighting tools and spares.
- Fire extinguishers.
- Fire hose reels for buildings.
- Fire fighting supplies and spares.
- Main workshop equipment and spares.
- Mobile maintenance equipment and spares.
- Safety equipment and spares.
- Inspection tools and spares.
- Instrument shop fixed and portable equipment, tools and spares.
- Electrical shop equipment, tools and spares.
- Miscellaneous maintenance tools and spares.
- Catalysts for Licensed Units as may be requested by the Company.
- Portable maintenance tools that may be required for specific equipment, such as:
 - Diaphragm seal cutting tool for high pressure heat exchangers in accordance with the Company's specifications.
 - Portable skyladders and cables for stacks.
 - Portable equipment and materials for loading and unloading catalysts, etc.
 - Bolt tensioners, with accessories and spares.
 - Test pumps.
- Bins and racks for workshop and stores building.
- Clinic equipment.
- Cafeteria and kitchen equipment (fixed and movable).
- Transport and Mobile Plant equipment (fixed and movable).

E.2 The followings are excluded from the reimbursable items and may be included in the Lump-Sum Prices as required by the Company:

- Cost of initial charge of chemicals and lubricating oils for the first year of operation.
- Cost of catalysts involving precious materials such as molecular sieves/catalysts for PSA "Pressure Swing Adsorption Unit, etc.
- Cost of spare parts for construction period and refinery and/or plant commissioning.

E.3 Costs for the supply of spare parts, miscellaneous equipment and materials, catalysts and chemicals in accordance with Appendix E hereto, shall be payable to the Contractor on reimbursable basis.

APPENDIX F

**GUIDELINES FOR THE COMPLETION OF THE SPARE PARTS LIST AND
INTERCHANGEABILITY RECORD FORM**

F.1 The Manufacturer/Supplier shall complete the following part of the "SPIR" form attached as Fig. E.1 as per listed sequence in English language.

- Line 1:** Plant registration/item number or tag number of equipment/instruments/etc. as stated on requisitions and/or purchase orders.
- Line 2:** Model, type or other identification of equipment/instruments/etc., ordered.
- Line 3:** Serial number of each equipment/instruments/etc., ordered.
- Line 6:** Purchase order number reference of equipment/instruments/etc.
- Line 6A:** Unit of measure, i.e., No., set, pair, roll, etc.
- Line 4:** Number of identical equipment/etc., of particular model or type being supplied against purchase order number mentioned under Line 6.
- Column 8:** Parts description of all component parts considered by supplier as being required for maintenance of equipment/etc., listed in Lines 1, 2 and 3. However all items specified in the appropriate equipment list shall be shown separately.
- Column 9:** Drawing number/Part number as per supplier's parts list or drawing.
- Column 10:** Part identification number showing interchangeability within equipment Manufacturer's organization.
- Note:** Identical parts, regardless of whether they have the same part number or drawing number, should be shown only once (see also line 5).
- Column 11:** Material specification of parts listed in Column 8.
- Line 5:** Enter in appropriate square the number of parts (listed in column) fitted in each applicable Unit, for groups of identical Units, denote quantity per Unit below quantity shown in Line 4.
- Column 7:** Total number of identical parts listed in Column 8 for all equipment/etc. for identical units multiply quantity in Line 5 by number in same column in Line 4 and enter overall total of each line in Column 7.
- Column 12:** Total spare parts recommended for 2 years operation and commissioning period.
- Column 18:** Unit price (up to two decimals) for recommended spare parts of Column 12.
- Column 20:** Original identification number for all items of third party Manufacture (Bought-out items), such as ball/roller bearings mechanical seals, couplings, bearing locknuts, bearing lockwashers, v-belts, bolts/nuts, gaskets, O-Rings and the like, these items should be fully identified by Manufacturer's numbers, types, sizes, etc.

F.2 The Contractor shall complete the following part of the "SPIR" form:

- Column 13:** Contractor's recommended spare parts for 2 years operation.
- Column 14:** Contractor's recommended spare parts for the commissioning period.

(to be continued)

APPENDIX F (continued)

Column 19: Total price (up to two decimals) of the spare parts for 2 years operation and the commissioning period set upon the quantities approved by the Company (see Column 15).

Column 22: This column has to be filled out for the respective spare parts purchase order-item reference. This number should be tagged to the respective material for easy identification upon receipt at site.

F.3 The following parts of the "SPIR" form shall be completed by the Company:

Column 15: Final quantity to be ordered and approved by the Company.

Column 21: This column has to be used to indicate the equipment class:

V-For: Vital equipment, a breakdown of which would mean an immediate and serious interruption of vital operations in field or plant and with no risk in the ordering and stocking of spare parts can be justified.

E-For: Essential equipment, engaged in primary operations, but with which a calculated risk can be taken in ordering and stocking of spare parts.

A-For: Auxiliary, general purpose-and stand-by equipment, for secondary operations, the temporary lack of spare parts would not have a serious effect.

Under this heading also comes the equipment of which there is a large number of Units in use, thus ensuring a sufficient degree of protection in case of failure of one or more Units.

F.4 The MESC Project team should complete the following parts of the "SPIR" form:

Column 16: For allocation of the final MESC number.

Column 17: For the classification of spare parts, i.e.:

C-For: Parts wearing out or deteriorating during normal operations, thus showing a fairly regular consumption.

Q-For: Parts not normally stocked, but ordered on request only.

I-For: Insurance items.

O-For: Temporary code number.

(to be continued)

APPENDIX F (continued)

SPARE PARTS LIST AND INTERCHANGEABILITY RECORD