

**ENGINEERING STANDARD**

**FOR**

**DETAILED DESIGN, ENGINEERING**

**AND**

**PROCUREMENT**

**ORIGINAL EDITION**

**DEC. 1997**

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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 a 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:** Feasibility Studies, Process Evaluation and the Basic Design Stages (containing six Standards).
- Phase II:** Detailed Design, Engineering and Procurement Stages (containing three 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>
<b>I: Manuals of Phase I (Numbers 1-6)</b>	
<a href="#">IPS-E-PR-150</a>	"Basic Design Package and Recommended Practice for Feasibility Studies"
<a href="#">IPS-E-PR-170</a>	"Process Flow Diagram"
<a href="#">IPS-E-PR-190</a>	"Layout and Spacing"
<a href="#">IPS-E-PR-200</a>	"Basic Engineering Design Data"
<a href="#">IPS-E-PR-230</a>	"Piping & Instrumentation Diagrams (P&IDs)"
<a href="#">IPS-E-PR-250</a>	"Performance Guarantee"
<b>II: Manuals of Phase II (Numbers 7-9)</b>	
<a href="#">IPS-E-PR-260</a>	"Detailed Design, Engineering and Procurement"
<a href="#">IPS-E-PR-300</a>	"Plant Technical and Equipment Manuals (Engineering Dossiers)"
<a href="#">IPS-E-PR-308</a>	"Numbering System"
<b>III: Manuals of Phase III (Numbers 10-11)</b>	
<a href="#">IPS-E-PR-280</a>	"Start-Up Sequence and General Commissioning Procedures"
<a href="#">IPS-E-PR-290</a>	"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 of this Standard may be changed, 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.

## 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)

<a href="#">IPS-E-GN-100</a>	"Units"
<a href="#">IPS-E-PR-150</a>	"Basic Design Package & Recommended Practice for Feasibility Studies"
<a href="#">IPS-E-PR-170</a>	"Process Flow Diagram"
<a href="#">IPS-E-PR-230</a>	"Piping & Instrumentation Diagrams (P&IDs)"
<a href="#">IPS-E-PR-290</a>	"Plant Operating Manuals"
<a href="#">IPS-E-PR-300</a>	"Plant Technical and Equipment Manuals (Engineering Dossiers)"
<a href="#">IPS-E-PR-460</a>	"Process Design of Flare & Blowdown Systems"
<a href="#">IPS-E-PR-450</a>	"Process Design of Pressure Relieving Systems Inclusive Safety Relief Valves"

### BSI (BRITISH STANDARDS INSTITUTE)

BS 5750: Part One "Quality Control"

### API (AMERICAN PETROLEUM INSTITUTE)

RP 520	"Recommended Practice for the Design and Installation of Pressure Relieving
Part I, 5th. Ed. 1990	Systems in Refineries"

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Part II, 3rd. Ed., 1988	
RP 521,	"Guide for Pressure-Relieving and Depressuring Systems"
3rd. Ed., 1990	
Std. 2000,	"Venting Atmospheric and Low-Pressure Storage Tanks"
3rd. Ed., 1982	

**ISA (INSTRUMENT SOCIETY OF AMERICA)**

S 5.1	"Instrumentation Symbols and Identification"
S 5.3	"Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems"

**3. DEFINITIONS AND TERMINOLOGY****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.

**Contractor**

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

**Sub-Contractor**

Any person, firm or company (other than the 'Contractor') named in the 'Contract' for any part of the 'Works' or any person to whom any part of the 'Contract' has been sub-let with the consent in 'Writing' of the 'Engineer', and the legal personal representatives, successors and assignees of such person.

**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'.

**Works**

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

**Project**

The equipment, machinery and all materials to be procured by the 'Contractor' and the 'Works' to be

performed and rendered by the 'Contractor' in accordance with the terms and conditions of the 'Contract' documents.

**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.

**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.

**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'.

**Specifications**

Drawings, Specifications, bills of materials 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, bills of material and any other technical documents.

**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'.

**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.

**Off-Shore**

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' for General Conditions. However, for the Special Conditions, this term is used for all activities on sea inside the territorial/and or Continental Shelf waters of the Islamic Republic of Iran.

**On-Shore**

Performance of all obligations covering the part of engineering services, field procurement of 'Materials' and Equipment, construction management and construction, Precommissioning work and commissioning services and remedy of defects inside the Islamic Republic of Iran, for the 'Project' for General Conditions. However, for the Special Conditions, this term is used for all activities on land outside the territorial/and or Continental Shelf waters of the Islamic Republic of Iran.

**Month**

Calendar month in accordance with the Iranian calendar.

**Days**

Means calendar days according to the Iranian calendar. Gregorian date can also be used in correspondences.

**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.

**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 and respective values.

**Progress Certificate**

The certificates to be issued by the 'Company's' authorized Representative' approving the progress report.

**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'.

**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'.

**Completion Certificate**

The certificate to be issued by the Engineer stating that part of the permanent works specified in the Certificate has been completed.

**Final Acceptance**

Completion of engineering and construction works, tests on completion, taking over, and the remedy of defects period.

**System**

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

**Dossier**

All inspections and test certificates, punch lists 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'.

**4. SYMBOLS & ABBREVIATIONS**

<u>Symbol/Abbreviation</u>	<u>Description</u>
ACS	Advanced Control System
AFC	Approved For Construction
API	American Petroleum Institute
BFW	Boiler Feed Water
BP	British Petroleum
CAD	Computer Aided Design
CIF	Cost, Insurance and Freight
CO	Change Order
COC	Cold Condensate
COR	Change Order Request
CPM	Critical Path Method
Cpms	Computerized Construction Planning Schedule
DCS	Distributed Control System
DN	Diameter Nominal, in (mm)
ESD	Emergency Shut Down
FOB	Free On Board
HPC	High Pressure Condensate
HPS	High Pressure Steam
HTRI	Heat Transfer Research Institute
HVAC	Heating, Ventilation and Air Conditioning
IPS	Iranian Petroleum Standards
ISA	Instrument Society of America
LPC	Low Pressure Condensate
LPS	Low Pressure Steam
MESC	Material Equipment Standard Code
MPS	Medium Pressure Steam
NACE	National Association of Corrosion Engineers
NPSH	Net Positive Suction Head
OSD	Overage, Shortage and Damage
PCO	Preliminary Change Order
PFD	Process Flow Diagram
P&IDs	Piping & Instrumentation Diagrams (P&IDs)
PLC	Programmable Logic Controller

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PM	Project Manager
PSA	Pressure Swing Adsorption Unit
QA	Quality Assurance
QC	Quality Control
R	Reproducible
RP	Recommended Practice
SCADA	Supervisory Control And Data Acquisition Systems
SI	International System of Units
SPIR	Spare Parts List and Interchangeability Record
UFD	Utility Flow Diagram.

## 5. UNITS

This Standard is based on International System of Units (SI), 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 Recommended Practice for Feasibility Studies" 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.

The detail designer shall perform all activities as outlined in this Engineering Standard. 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 "Work". The services performed by the Contractor may consist of the "Off-Shore" portion and the "On-Shore" portion. "Off-Shore" portion shall mean the services to be performed outside of the Islamic Republic of Iran and "On-Shore" portion shall stand for the services to be performed inside the Islamic Republic of Iran. 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.
- Engineering.
- Procurement.

In general Contractor shall provide the following main services as minimum requirement:

- 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 Vendor's drawings and other technical documents of 'Materials' for compliance with purchase order specifications.
- 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.
- Provide Specifications & Schedules for the Lubricating Oil Listed.
- Prepare computerized construction planning schedule (cpms), 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.
- Complete all relevant questionnaires.
- Supply all services to complete the above.

## **6.1 Project Management**

### **6.1.1 General**

For successful project execution, the following should be established at the outset:

- Work Plan (defined objectives).
- Execution Plan.
- Co-ordination Procedures.
- Work Schedule (Project Planning).
- Organization and Resources.

The responsibility for successful execution of the project is delegated to the Project Director who will lead the Project Directorate team. His minimum basic objectives in meeting this responsibility shall be as follows:

- Complete the project within schedule and budget costs.
- Ensure that the facilities are well engineered and can be constructed, operated and maintained in a safe, efficient and economical manner.
- Ensure that the facilities incorporate the requirements of the Company and the regulatory authorities.

#### **6.1.1.1 Work plan**

It will be necessary to ratify the basis on which project activity is to commence and early duties of the Project Director shall be to:

- Define project scope and objectives.
- Establish work plans, schedules, budgets, manning levels and project procedures.
- Hold a meeting with the Company shortly following job award to confirm the scope and objectives.
- Arrange an internal "Kick-Off" meeting with all department managers to ensure that the contractor is aware of the project objectives, schedule, priorities and all other criteria required to make the project a success.

In this and all similar meetings, it should be stressed that the four vital factors required to achieve a full satisfactory job will be:

- Proper Planning.
- Proper Co-operation.
- Superior Effort.
- Timely Decision.

Where necessary, a program for subsequent site visits to be arranged.

#### **6.1.1.2 Definitive project executive plan**

The main objectives in executing the work shall be to:

- Set up, and maintain throughout the project, the appropriate communications and transfer of information between the Company and the Contractor.
- 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 fulfill its terms and conditions.
- Ensure that the requirements of the Company and the Contractor; governmental regulatory agencies, certifying authorities; insurance underwriters and others are complied with.
- Control the scope, cost, schedule and quality of the project works.

Detailed aspects of the overall Execution Plan are developed by the contributing sections e.g. Engineering, Procurement and Construction (if required). These will be reviewed with the Project Director and his staff and, once approved, become the basis for the ongoing activity.

#### **6.1.1.3 Coordination procedures**

The Project Director and his team shall perform the key function of ensuring effective communications on the project to achieve unity of purpose and performance. Coordination at Project Directorate level shall be carried out by project coordination documents and regularly scheduled coordination meetings.

Shortly after contract award, project coordination procedures to be issued by the Contractor. These procedures shall identify and describe:

- The project's principal managers, both Company and Contractor, with their primary duties and responsibilities.
- The administrative, correspondence and general project procedures.
- The reporting systems and frequency, with identification of the Task Force members responsible for supplying, gathering and compiling the information required for the Company and Contractor reports.
- The procedure for obtaining the Company's approvals as the work progresses, including the identification of all documents requiring the Company's approval, the issuance of same and the time permitted by the schedule for such approvals.
- Any important factors, considerations or requirements of the Contract which are relevant to tight control of the project works.

Internally, the Project Manager shall hold 'action now' meetings on a weekly basis with his Directorate Coordinators. These will review the immediate time frame (past week/current week) to produce a coordinated response to any short term difficulties. A formalised progress meeting shall be held monthly with the Company in attendance.

See Article 7 of this Standard for basic requirements of coordination procedure which should be included in the coordination procedure in addition to the above.

#### 6.1.1.4 Project planning

Detailed schedules for the Project shall be completed at an early date based on the Master Project Schedule. Upon receipt of the Contract a project planning Task Force shall be established by the Contractor which will include the Project Director, the 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 and materials.
- Establish fabrication and contracting plans, and sequences so that engineering and procurement activities can be planned accordingly.

#### 6.1.1.5 Organization and resources

The contract works controlled by a Project Directorate shall be executed by a nominated project task force working in the designated project areas. The Project Task Force teams will be built-up from contract award as dictated by the scope and schedule. In addition to the team members, the Task Force shall be supported, as required, by Contractor's other specialist departments including:

- Office Services.
- Personnel.
- Information Services.
- Financial Controls.
- Communication/Printing Services.
- Legal and Insurance.

All project team members shall participate in the development of the definitive Project Execution Plan which will become the principle guideline reference for the execution of the balance of the project.

#### 6.1.2 Main activities

##### Contractor shall:

- Review project scope and objectives.
- Establish work plans, schedules, budgets, manning levels and project procedures.
- Establish all key procedures, distribution of all drawings and other documentation, detailed provisions for recommending and checking 'Materials' including statements as:
  - Quantity.
  - Process Design and Parameters.
  - Mechanical design.
  - Conformance to the Company's Standards.
- Prepare master project schedule.
- Ensure that all detailed services comply with safety standards.
- Liaise with the Company on engineering matters and provide information requested concerning the 'Detailed Services' including copies of working drawings, specifications, purchase orders, requisitions, schedules and procedures and engineering calculations.
- Prepare and monitor all 'Project' control documents.

- Issue monthly progress report to the Company and review content and progress of detailed services with the Company.
- Furnish the Company with a piecemeal copy and the approved (by the Company) final bound copies of the "Project Specifications" for the 'Unit' as required in the Contract.
- Furnish the Company with the required copies in bound volumes and indexed of Plant Technical Manuals.
- Furnish the Company with the required copies in bound volumes and indexed of Plant Equipment Manuals.

Contents of Plant Technical Manuals and Plant Equipment Manuals shall be in accordance with IPS publications numbers [IPS-E-PR-300](#), "Plant Technical and Equipment Manuals (Engineering Dossiers)" as minimum requirement. The final packages shall be approved by the Company.

In addition Contractor shall:

- Furnish the Company with the required sets of individually bound copies of Plant Operating Manuals for all units of process, utilities, tankage, offsites, etc. Contents of Plant Operating Manuals shall include but not be limited to the requirements stated in [IPS-E-PR-290](#); "Plant Operating Manuals". The final manuals shall be approved by the Company.

Contractor shall:

- 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 shut-downs 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:
  - a) Lubrication of machinery and moving parts.
  - b) Topping up or refilling of filled systems.
  - c) Checking of flow in equipment and piping in services liable to fouling.
  - d) Checking of flows in drainage system.
  - e) Checking of wear in moving parts and electrical contacts.
  - f) Checking of calibration of instrumentation.
  - g) Checking of relay settings and operations.
  - h) Checking of wall thickness of equipment and piping in erosive or corrosive services.
  - i) Electrical insulation tests.
  - j) Checking of vibration in rotating equipment.
  - k) Scale formation in boilers.
  - l) Correct functioning of steam traps.
  - m) Checking of relief valve settings.

Contractor shall also:

- Furnish the Company with revised sheets of drawings of Plant Operating Manuals prepared as may be requested by the Company and/or due to the changes made by the Contractor.
- Furnish the Company with all other necessary drawings, specifications, 'Materials' requisitions, (the required copies as per Contract in each case) for all 'Materials' which will enter into construction of the 'Unit'.

- Furnish the Company with revised sheet/drawings of the project specifications and equipment data books as may be requested by the Company and/or due to changes made by the 'Contractor'.

- Provide and furnish the Company with two sets mylars and two sets of micro films of the drawings which are finalized and approved for construction by the Company. Drawing Sizes shall be per the Company's Standards. Contractor shall issue to the Company all technical documents including drawings, sketches, calculation and data sheets, cost data, etc.

**Note:**

**Any and all review, check and approval of the Company shall not relieve the 'Contractor' from his responsibilities, obligations and guarantees as outlined in the Contract.**

- Provide replies to any questions and queries that may arise from other 'Contractor'(s) with respect to the 'Contract'.

- Prepare computerized construction planning schedules (cpms) for the whole 'Project' comprising of engineering, 'Materials' procurement and handling and commissioning (if required by the Company).

- Prepare separate general composite progress schedule derived from (cpms) referred to above supported by bar charts.

- Furnish the Company with four (4) copies of his recommendations of spare parts required for commissioning and for two years operation and cost of same in currencies of expenditures as per requirements of Appendix A.

- Project specifications, manuals and equipment data books as specified in the Clause 6.1 shall be submitted to the Company in due time as requested in the "Contract" for review and approval.

## 6.2 Quality Assurance and Control

### 6.2.1 General policy

Project quality assurance engineers shall be responsible for all quality activities associated with their part of 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 and BS 5750: Part 1.

- 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 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 for their part of the project.

- 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 Responsibility of quality controller**

Quality Controller as a representative of contractor quality control, shall be responsible for overall operation of quality control activities and should have authority not only to halt, refuse or replace any defective work at the field but also to accept or reject materials and equipment at the time of submittals or order and thereafter when necessary. He is required to review and certify all concerned submittals to the representative/client.

### **6.2.3 Quality control system**

**6.2.3.1** 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.

**6.2.3.2** 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 are 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.

**6.2.3.3** 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.

**6.2.3.4** 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.

**6.2.3.5** 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.

### 6.2.4 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 Project Controls

### 6.3.1 General

The Contractor to use established project control techniques and procedures developed for use on major projects. 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.

In order to provide efficient control of the planning for the Project, the Project Planning Coordinator in the Project Directorate shall be responsible for establishing the planning basis for the project. Immediately after the project awarding his prime responsibilities shall be:

- Project master schedule identifying major milestones and interfaces.
- Control and reporting detailed procedures based on integrated computerized systems, common to all execution centers.

In carrying out this task, the Planning Coordinator shall work closely with the planners in the individual task force teams. During the project execution, the Planning Coordinator's main responsibility shall be:

- To monitor actual project execution versus project objective.
- To measure actual progress versus scheduled progress.

In more detail the principal methods used to plan and control the progress of the job shall include but not be limited to the following activities:

- Identify the scope of the project.
- Produce a master schedule for the project. This Schedule will be a single sheet bar chart which would be manually produced. Normally this would be limited to about 150 activities and would include all the key activities of engineering, procurement, fabrication, construction, pre-commissioning and commissioning (if required).
- Produce a 30 day Kick-Off schedule to direct and control the initial activities on the project to minimize front end delay and focus the attention of the project teams. This schedule should be updated weekly and used for project control until the detailed planning controls are implemented.
- Prepare Detailed Area Schedules. These schedules should initially be produced manually and then produced using the computer systems by consolidating the detailed network activities.
- Establish progress curves for engineering and procurement progress to monitor actual progress against the required progress to meet project objectives.
- 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 to control the satisfactory progress of the project and should be analyzed by the most appropriate computer systems.
- 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.
- 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.

### 6.3.2 Methods and procedures

The Contractor can implement its planning and scheduling activities on a tiered, or hierarchical basis consisting of four levels which are summarized as follows:

#### 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.

##### 6.3.2.1 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).

##### 6.3.2.2 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.

#### **6.3.2.3 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.

#### **6.3.2.4 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.

#### **6.3.2.5 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).

#### **6.3.2.6 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.

#### **6.3.2.7 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.

#### **6.3.2.8 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.

#### **6.3.2.9 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.

**6.3.2.10 Level 4(b):** Weekly work schedules applicable for construction stage.

**6.3.2.11 Level 4(c):** Deviation list applicable for construction phase.

**6.3.3 Reports**

The following reports should be provided as minimum requirement by the project controller:

**6.3.3.1 Project monthly progress report**

The primary management report for communication the status of the project to the Company shall be the project progress report. The project progress report shall include progress, performance, quality of work, planned schedule compared to forecast schedule, problems and proposed solutions. The report shall include an overall summary, status display, progress summary, detailed discussion by discipline, and progress photographs. Emphasis shall be placed on problem areas and actions being taken to resolve them and the critical execution issues. The report shall also include overall project progress broken down into major areas and activities.

Progress shall be measured physically for reporting purposes. 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 to remedy this.

**6.3.3.2 Engineering progress and productivity report**

This report totals the status of engineering by either work package, discipline or document type. Scheduled progress to be compared with the actual progress in order that management to be able to identify the specific contributory factors imparting any lack of progress.

Engineering are requested to reconcile lack of progress against individual documents; this is then reviewed against the networks to record the possible time impact. The engineering schedule progress to be plotted onto curves and actual plotted against the scheduled in order that trends can be identified and corrected. From the same base data the Project Manager will be able also to determine productivity.

### 6.3.3.3 Purchase order status report

The total procurement cycle to be fed onto the computer system and interfaced with the network at certain milestones. This report should be updated on a daily basis and acceptance reports issued weekly.

In order that management can identify procurement activities that have to be completed by early target dates, a report should be issued which lists activities to be completed by the date specified together with comments that indicate corrective actions that are being taken to meet the next scheduled milestone date within the procurement cycle.

### 6.3.4 Computer assisted controls

An acceptable International Computer System shall be used for CPM Networking throughout the entire engineering and procurement stages of the Project. The computer system shall be selected upon the Company's approval.

Throughout the detailed design period, and especially in the early stages of design, the Project Planning Engineer shall work closely with the design engineers and construction representatives (if any) to identify possible problem areas that need to be resolved early. This analysis and other studies will be carried out during the design period to optimize the final cost of the project and to maximize its constructability.

Cost control procedures shall be implemented from the outset of the project with the establishment of the Control Budget. For control purposes, a trend program shall be initiated at project award, and operated on a daily basis to identify at an early stage any projected deviations from the budget.

Weekly trend meetings shall be held to review trends and formulated remedial actions for cost or schedule overruns. Any variations to the original scope shall be treated as change requests and shall be estimated and submitted to the Company for approval prior to work commencing as indicated in Section 6.3.5 of this Standard.

Throughout the duration of the project, the following integrated computer applications shall be used for Project Control as minimum:

#### - Critical Path Methods (CPM) Networking

Full networking system to determine early and late start and finish dates for work items and resource/scheduling analysis to show project status, performance and trends.

#### - Cost and Commitments

Provides total project cost and commitment ledgers and shows period variances by detailed code of accounts. Budget and forecast data is also maintained which incorporates trends and change orders, thus showing integrated budget and forecast expenditure versus actual expenditures.

#### - Engineering Document and Manhour Control

Document register which displays forecast and actual issue dates of engineering products:

- Drawings.
- Requisitions.
- Specifications.

Each document is given a component manhour budget and each progressive issue of a document is related to 'earned manhours'. The total earned manhours are compared to 'manhours used' to provide production control, to forecast production due, and to identify targets which are overdue.

**- Procurement Control**

A database system which is used by Procurement to monitor material requisitions from point of inception through Purchase Order placement to receipt of materials at jobsite. It provides current status information, management sorts, suspense date monitoring and forecast delivery look ahead.

**- Management Graphics**

The utilized computer system shall encompass sophisticated management graphics. Full use of this facility shall be made by the Project Controls Group to supplement tabular reporting, e.g., network drawing, critical path highlighting, barcharts, float utilization, histograms, and XY plots.

**- 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/ underrun probabilities for each component.

**- Probability and Time Histograms**

This is a management tool that combines the concept of task inter-relationships (CPM) with probability technique to produce a range of probabilities concerning the time of project completion.

**6.3.5 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 can be presented as follows in sequential order:

- a) The Company identifies scope change requirement or the Contractor Project Manager identifies potential scope changes and advises the Company.
- b) The Company initiates Change Order Request (COR) detailing preliminary scope information.
- c) Contractor prepares Preliminary Change Order (PCO) including an order-of-magnitude estimate and schedule effect, and cost for preparing the PCO plus a separate lump sum cost for preparing the formal Change Order. Contractor enters COR and PCO numbers and descriptions in log; no work to proceed on change order scope at this stage.
- d) The Company evaluates Preliminary Change Order and decides:
  - 1) Not to proceed with scope change and advises Contractor to cancel PCO:
    - 1a) Contractor updates COR/PCO logs to show cancellation.
  - 2) To proceed with Formal Change Order (CO) approving lump sum cost for Change Order preparation
    - 2a) Contractor prepares a Formal Change Order including detailed scope, lump sum cost and schedule effect, and updates budget to reflect approval of CO preparation cost. No work to proceed on change order scope at this stage.
- e) The Company evaluates Change Order and decides:
  - 1) Not to proceed with scope change and advises Contractor to cancel:
    - 1a) Contractor updates CO log to show cancellation.
  - 2) To proceed with scope change approving cost and schedule effect:

**2a)** Contractor updates CO log to show approval up-dates budget to reflect approval of CO; starts work on scope change.

A "Typical Contract Change Flow Diagram" is demonstrated on the Appendix B of this Standard.

## **6.4 Engineering**

This engineering part of the implementation plan describes the organization of the Engineering Teams and the main activities and approach to the work in each of the engineering disciplines. Basic Design Packages shall be the starting point for the engineering effort of the Contractor.

The Engineering Teams shall arrange to submit all necessary engineering documents such as drawings, specifications and data sheets which are agreed upon to the Company for review and approval.

The organization and execution plan in the engineering disciplines which are required as minimum are described in detail in the following sections:

### **6.4.1 Project engineering**

- Project Engineers shall be responsible for the management of all the engineering aspects of the project, and shall provide direct support to their project Engineering Manager. Each project engineer may be assigned to a section, or area, of the project under the general supervision of the Project Engineering Manager or his deputy.
- Familiarizing of the personnel of each Engineering Team with the scope, aims and schedule of the project shall be under responsibility of the project engineers.

#### **6.4.1.1 Work sequence**

- One of the first tasks during the detailed design phase shall be the development of 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.
  - 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.

- For the respective involvements of the Project Engineers, each area project engineer and each of the Task Force Managers and their deputies shall oversee the execution of the Detailed Design Phase, including preparation of Material Requisitions. The area project engineers shall monitor and steer the progress of their areas and arrange for corrective action, should deviations to schedule occur. In addition they shall monitor and coordinate each design discipline to ensure that one is not being delayed by another and shall resolve local priorities.

#### **6.4.1.2 Work methods**

- The Area Project Engineers shall monitor the progress in their 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 engineering progress meeting shall be held to outline the progress achieved, problems encountered, and solutions intended.

- The Area Project Engineers shall confirm that work is being carried out in accordance with Project Procedures and Design Guides, and shall act to identify and resolve problems. They shall also monitor any possible trends involving design changes and shall alert the Project of these potential changes.

- The Area Project Engineers shall be responsible for the quality and completeness of work of their area and shall review and sign all major drawings, data sheets, specifications and acquisitions after confirming that the requisite inter-discipline and in-discipline checks have been completed.

#### **6.4.2 Process engineering, utilities engineering, safety engineering and systems engineering**

##### **6.4.2.1 General requirements**

###### **6.4.2.1.1 Process and utilities engineering**

During the Detailed Design Phase, process and utility flow diagrams, P&I Diagrams, specifications, data sheets and process optimization and flow sheet development shall be completed to the maximum extent possible with inclusion of the Vendor data.

Process work pertaining to process and utilities engineering in the detailed engineering phase shall require but not be limited to the following main activities:

- Updating the Process Package.
- Relief and Flare System Design.
- Project Support.

###### **6.4.2.1.1.1 Updating the process package**

When the detailed vendor data becomes available, there shall be necessary updates to the process design to accommodate the mechanical design and layout requirements, to suit the characteristics of the purchased equipment. All such process changes shall be reviewed and approved by the responsible Process Engineer. The process flow diagrams, specifications and data sheets shall be updated to incorporate the changes, and shall be reissued periodically throughout the Detailed Design Phase of the project, ensuring that all members of the project team are informed of these developments.

###### **6.4.2.1.1.2 Relief and flare system design**

- Initial efforts shall be directed towards completing definition of the relief and flare systems, to provide relief valve and header sizes for layout work, to fix the height and location of the flare stacks for detailed design to proceed, and to permit the relief valves and flare equipment to be

purchased. The design and engineering shall include requirements of [IPS-E-PR-460](#), "Process Design of Flare & Blowdown Systems".

- Relief flow rates and preliminary valve sizes shall be calculated using the methods in API RP 520, API RP 521 and [IPS-E-PR-450](#), "Process Design of Pressure Relieving Systems Inclusive Safety Relief Valves". Tank venting rates shall be calculated in accordance with API Std. 2000. Data needed for relief load calculations will generally be available from the Basic Design work. However, where supplemental flash calculations are necessary to assess properties at relieving conditions, these shall be performed by the process engineer.

- Studies shall then be conducted to establish depressurizing rates ensuring that the plants can be safely relieved in an emergency. Special attention shall be given to the centrifugal compressors where rapid depressurization will be required to avoid gas blow through of the seal oil systems.

- After relief and depressuring flow rates are known, and studies have outlined the configuration of the relief system pipework, relief system PFDs shall be developed, and the header systems shall be analyzed for simultaneous relief occurrences and for plant-wide depressuring. Relief system PFD shall be provided separately for the following emergency cases such as power failure, power and cooling water failure, fire and etc. Node pressure, flow rate and temperature to be shown on the PFDs for all cases.

- The relief headers and subheaders shall be sized and back pressures shall be calculated using compressible flow equations. Relief valve sizes and types shall be reviewed for operations with the calculated back pressures. At this time the sizes of the relief knockout drums and flare equipment specifications shall be verified.

- Flare stack heights and locations shall then be confirmed in flare radiation studies. These will establish the radiation contours around each flare and shall be performed by computer.

#### **6.4.2.1.1.3 Project support**

Process Engineers shall provide process and operational input and participate in detailed design activities. In particular:

- Bid evaluations for process packages and major process equipment items.
- Review of key Vendor prints.
- P&IDs review meetings.
- Model review meetings (if any).
- Review of safety aspects, cause and effect charts and control instrument diagrams.
- Providing supplementary stream property information such as critical pressures for control valve sizing or surface tension for two-phase flow calculations when necessary.

#### **6.4.2.1.2 Safety engineering**

- Loss prevention and safety engineers shall be responsible for making sure that applicable safety and loss prevention codes as well as the Company's special requirements as expressed in the safety philosophy are applied in a systematic and effective manner by safety audits during the engineering design phase.

- Loss Prevention engineers shall take responsibility for the specification and overall design of fixed fire and gas systems, life safety systems and fire fighting equipment.

- The Loss Prevention Engineers shall also assist with the provision of documentation to support safety case and certification submissions as required by the applicable legislation.

- The starting point of this work shall be the preparation and/or completion of the overall safety philosophy. From the overall safety philosophy, the Contractor shall develop separate detailed safety documents for each section of the project facilities. They shall include hazards and 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, emergency shutdown, ESD (Emergency Shut Down) systems, toxic gas release, fire protection systems both active and passive, fire fighting equipment, 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.

- In general, three main sequences of safety and Loss prevention work as expressed herein below should be foreseen following approval of the Basic Design Manual:

- a) Coordination with other design disciplines to ensure that safety and loss prevention requirements and hazard audits are correctly integrated.
- b) Preparation of logic diagram, Cause and Effect Charts; preparation of safety documentation as required and continuing loss prevention review of other disciplines' work as it is issued for approval.
- c) Basic layouts of fire and gas systems; collection of up-to-date vendor information; preparation of enquiry packages for loss prevention systems; design meetings with vendors to resolve queries; review and approval of Vendor drawings and documentation.

#### 6.4.2.1.3 Systems engineering

- Systems Engineers, comprising mechanical and chemical engineers, shall be specialist in the development of P&IDs and the specification of related process equipment, data sheets, drawings, models and other disciplines' activities.

- Systems Engineers will receive the P&IDs developed during the Basic Design stage and shall develop them to provide the final design. Multi-discipline review meetings shall also be held to allow all relevant groups, including Construction and Start-up, (if required), to comment on the P&IDs, without adding unnecessary embellishments. The P&IDs shall show the interfaces at vendor supplied items.

- Vendors may provide their own P&IDs within their supply boundaries provided that the following requirements are taken into consideration:

- Compliance with the project procedures such as:
  - Numbering Procedure.
  - Drafting Procedures for PFDs and P&IDs.
  - Units of Measurement.
  - Others.
- Compliance with the relevant project specifications and Standards.

- The Contractor shall develop all other P&IDs which are not supposed to be prepared by the Vendor(s) upon approval of the Company.

- The Contractor shall review, check and comment all drawings developed by the Vendor for being in compliance with the project specifications and other Contract documents. However, provision of all P&IDs including the drawings prepared by Vendor(s) shall be fully in congruence with the Contract requirements and to be under responsibility of the Contractor.

- P&IDs shall be developed in accordance with the requirements stipulated in [IPS-E-PR-230](#); "Piping & Instrumentation Diagrams (P&IDs)".

- The Systems Engineers shall develop the equipment lists, line designation tables, in-line system components and safety data related to the P&IDs.

- The systems Engineers shall also review and coordinate the material selection, equipment spares, piping material specifications, platform and plant layouts, electrical load data, and shall contribute to their parts of the design manual.

- After preparing the P&IDs, the Systems Engineers shall assist in the preparation of an emergency shutdown philosophy, the hazard area drawings and the chemical hazard report.

#### 6.4.2.2 Main activities

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

- Develop P&IDs to approve for design based upon the Basic Engineering P&IDs and then follow through to approve for construction incorporating vendors information. These P&IDs shall be according to [IPS-E-PR-230](#); "Piping & Instrumentation Diagrams (P&IDs)".
- Assist in preparation of plot plan drawings for the "Unit".
- Establish all process data sheet formats and complete where necessary as a basis for detailed design and issue process data sheets.
- Review and develop basic requirements for plant drainage and disposal system.
- Provide equipment list and schedule for all equipment including driver where applicable.
- Compile utility data including-effluent data and prepare utility balances diagrams.
- Review process design safety and conduct P&I flow diagrams safety review.
- Review flare philosophy, size flare header and provide flare load data to the Company.
- Provide Flare System Process Flow Diagrams.
- Prepare line schedules for all piping, defining line number, origin and termination, size, material specification, (field test pressure, operating and design conditions), 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 for specifying lines on the P&I Diagrams.
- Develop instrument control system basic requirements.
- Complete utility summary tables. The summaries shall be provided for the following utilities:
  - Electrical Load.
  - Steam (All types).
  - Condensate (All types).
  - Boiler Feed Water (BFW).
  - Cooling Water, Potable Water and Plant Water.
  - Water Loss.
  - Instrument and Plant Air.
  - Nitrogen.
  - Fuels (Gas and Oil).

**Note:**

**Above summaries shall be per Unit and shall be included as applicable.**

- Prepare Utility Distribution P&I Diagrams showing distribution of the all utility services as mentioned in the above paragraph along the units separately. 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 be shown on the drawings. Each "Unit" shall have its own utility distribution drawings.
- 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 Unit 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 pressure profiles for all systems comprising the Unit based on the hydraulic design calculations.
- Review P&I Diagrams for start-up, shut-down and emergency operations of each "Unit" and catalyst regeneration procedures to ensure that all necessary processing, utility, and blowdown lines are included for safe operation.
- Review alternative operations of the Unit(s) when associated Unit(s) may be shutdown to ensure continued operation of each Unit.
- Assist in preparation of Material Requisitions containing all process and engineering data necessary to permit the purchase of equipment. Material Requisitions shall be updated with all relevant Vendor data before final issue.
- Tabulate each unit battery limit flow rate and conditions (operating and design) for process and utility lines.
- Establish process optimization philosophy.
- Provide Advanced Control System (ACS) and process optimization duty specifications.
- Complete process information on all equipment data sheets including instruments, vessels, heat exchangers, heaters, electrical motors, fans and blowers and all other miscellaneous equipment.
- Review and Coordinate the equipment and piping material selection and specification.
- Review and establish equipment spares philosophy (if needed).
- Review and Coordinate plant Layouts.
- Prepare overall design basis and specification of fixed fire and gas systems and fire fighting equipment and add the established job requirements to the general specifications.
- Develop process duty specifications for the packaged Units.
- Prepare catalyst and chemicals summary.
- Prepare effluent summary for each unit separately.
- Issue drawings for "AFC".
- Prepare start-up and operation procedures.
- Establish normal and emergency shutdown procedures.
- Assist in preparation of operating, technical and equipment manuals.
- Assist in start-up and acceptance test run (if required).

### 6.4.3 Civil engineering

Civil engineering shall include Civil, Concrete, Foundation, Structure and Fire Proofing design and engineering activities as outlined herein below.

#### 6.4.3.1 Basic requirements

- The first priority for civil engineering activities shall be preparation of scope of work and subcontract requisition for additional soils investigations and topographic surveys if required by the "Contract".
- Based on the site surveys, the rough grading drawings shall be provided. As the information becomes available from the civil disciplines and other engineering groups, final grading, paving and underground drawings shall be prepared. This shall co-ordinate the locations of:
  - Foundations.
  - Drainage and manholes.
  - Electrical trenches.
  - Roads and paving.
  - Fencing.
  - Firewater mains, etc.
- The Civil engineers shall be responsible for the design of all gravity underground drainage systems with assistance of process engineers; pressurized lines shall be handled by the Piping engineers. When designing the various drainage systems, the civil engineers and designers shall give full consideration to the provision that, during plant shutdown periods, each drain can be isolated without jeopardizing the integrity of other plants. They will also prepare initial quantity lists of drainage pipe and fittings.
- Concrete design work shall commence on the foundations for vessels, drums, columns, exchangers, fired heater and reactors for which setting plans are either predetermined or for which information is available from preselected vendors. At the same time structural design shall commence on the piperack structure and the compressor shelter/house to determine the loading required for foundation design. Design of foundations for pumps and compressors will commence when valid data are supplied.
- The civil engineering team shall prepare civil design packages for each discrete plot area in the sequence stipulated for the construction schedule.
- Concrete design work shall include:
  - Reinforced concrete foundations for vessels, exchangers, compressors, pumps, furnace, piperack, elevated structures.
  - Mass concrete below foundations, and around cable ducting.
  - Material quantity lists.
  - Subcontract scope for each construction area (if required).
- Civil engineers shall perform analysis of the dynamic behavior of the foundations of heavy rotating or reciprocating equipment, based on vendors data.
- Design drawings shall show setting out dimensions, member sizes, column base plate details and special connections. The fabricator shall produce shop drawings and erection marking drawings. Civil engineers shall audit the shop drawings for quality but will not carry out detailed checking other than for special details.
- The Civil engineers shall be responsible for all aspects of building design including:
  - Architectural layouts.
  - HVAC.
  - Building Services.

- Structural Engineering.

#### **6.4.3.2 Main activities**

Contractor shall perform the following main activities pertaining to design and engineering of Civil, Concrete, Foundation, Structure and Fire Proofing portions of the "Project":

- Perform site survey if additional data is required according to the Contract.
- Review the site survey performed during Basic Design stage.
- Establish specific job requirements for civil work and add to general specification
- Design all foundations, elevated concrete floors, including arrangement and detailing of reinforcing, piping and sewer piping take off.
- Prepare area paving, sumps and drainage drawings complete with bills of material and specifications.
- Perform checks for equipment and structural drawings which are bolted to foundations.
- Provide Unit plot plan drawings.
- Prepare general arrangement drawings, specifications and design computations for all reinforced concrete pipe racks, equipment structures and platforms, in sufficient detail.
- Develop and design special equipment which may be necessary for handling materials of equipment items.
- Prepare general arrangement plants, elevations and specific details for concrete structures.
- Prepare arrangement of reinforcing for concrete structures and the necessary details.
- Prepare foundation location plan.
- Design pipe supports.
- Issue pipe support drawings.
- Co-ordinate foundation and structural steel drawings.
- Issue plot plans to other departments.
- Issue drawing status report.
- Review all reports relevant to concrete/soil compaction and civil/structural tests.
- Prepare fireproofing requirements for steel structure and vessel skirt or supports.
- Establish specific job requirements for fire-proofing and add to the general specifications.
- Prepare drawings covering specific details for fire-proofing.
- Co-ordinate with jobsite.
- Incorporate vendor information on drawings.
- Review, comment and approve Vendor documents.
- Design buildings.
- Prepare "Approved For Construction" drawings.
- Assist in preparation of plant technical and equipment manuals.

#### **6.4.4 Piping**

##### **6.4.4.1 General**

- Detailed plant layout and piping design shall follow the work done during the Basic Design

stage.

- If required by the Contract, a three dimensional CAD model shall be developed based on the Basic Design information and shall incorporate the detailed design data developed by all design disciplines. The model shall represent equipment, structures, piping and all relevant plant features.
- Piping isometric drawings shall be prepared in accordance with the Company's requirements.
- Piping specifications and material classification specifications shall be produced based on the Company's Engineering Standards incorporating all necessary special job requirements.
- Pipe wall thickness calculations shall be made where required.
- A supplementary table of calculated pipe wall thickness shall be produced and issued as a piping specification.
- Piping stress calculations shall be made using initial piping studies and overall piping schematics stress isometrics for critical systems.
- Pipe supports shall be according to the Project Engineering Standards. Special pipe supports shall be kept to a minimum and shall be upon the Company's approval. Spring supports shall also be specified by the Contractor where required.
- Assistance shall be given for small bore piping route selection, material take-off, and material requisitions, including:
  - Pipe.
  - Valves.
  - Fittings and Flanges.
  - Insulation Flanges.
  - Bends.
  - Internal coatings and linings (if required).

#### **6.4.4.2 Main activities**

Contractor shall:

- Prepare piping layout and general arrangement drawings.
- Establish mechanical and material specifications for each section of piping, including specifications and data sheet for expansion joints, spring support, shock arresters and other speciality items.
- Prepare-line numbering schedule.
- Design all piping system including special piping items and prepare all necessary arrangement and detail drawings.
- Where steam tracing is required, design the steam tracing system and provide details and specifications of steam tracing materials and details plus isometric drawing.
- Where electrical tracing is applied provide full details of design and drawings plus bill of material and specification.
- Design underground piping systems and prepare all necessary arrangement and detail drawings.
- Develop pipeway layout.
- Prepare initial, intermediate and final Material Take-off for all piping material.
- Prepare plan drawings of rack piping.
- Prepare cross-sectional drawings of all piping entering and leaving Unit Battery Limits.

- Prepare drawings and location of required supports, anchors, and guides for piping DN 50 mm diameter (2 inches nominal bore) above and/or which will be shop fabricated.
- Prepare typical drawings and locations for supports, anchors and guides for piping below DN 50 mm diameter (2 inches nominal bore) and which will be field fabricated.
- Provide schematic piping drawings for piping systems consisting of small bore piping e.g., for flushing, cooling water to pump jackets, steam tracing, etc. Such drawings to contain all information required for construction.
- Prepare As Built Drawings for all piping drawings and/or connections, to the extent required, due to the changes at the construction phase and resulting from the site activities.
- Check, review and finalize utility distribution drawings and assist in design of the utility distribution system pipings and prepare drawings showing arrangement of the utility distribution systems.
- Assist in design of cathodic protection system and prepare detailed specifications and drawings.
- Develop three dimensional CAD systems.
- Prepare isometric drawings suitable for fabrication of small and large bore piping.
- Prepare P&IDs for pressure testing giving required information for testing.
- Prepare bill of material sheets for each isometric.
- Prepare stress calculations and pipe support details.
- Prepare piping material list broken down by line number and also in consolidated form, complete with all quantities and comprehensive purchasing descriptions.
- 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 "P&I Diagrams" and "Unit Plot Plan Drawings".
- Finalize layout arrangement drawings.
- Develop vessel orientation.
- Install models if required by the Company.
- Prepare and finalize "Approved For Construction" drawings.
- Coordinate with jobsite.
- Compile information for plant technical and plant equipment manuals.

#### **6.4.5 Mechanical Engineering**

##### **6.4.5.1 General**

- Mechanical Engineers shall be responsible for the following areas:
  - Vessels, Towers and Storage Tanks.
  - Heat Transfer Equipment.
  - Pumps, Compressors and Their Mechanical Drivers.
  - Miscellaneous Equipment.

"Heat Transfer Equipment" will include the following major items:

- Fired Heaters (Furnaces and Other Types) and Incinerators.
- Boilers.
- Preheaters and Economizers.
- Heat Exchangers (Shell & Tube, Double Pipe, and etc.).
- Coolers (Water and Air).
- Condensers and Reboilers.
- Coils.
- Evaporators (Industrial & Power Plant).

Miscellaneous Equipment will cover all Package Units such as Nitrogen Plant, chemicals preparation and injection systems, Waste Water and/or Liquids Treatment and Disposal Facilities, Solid-Waste Treatment and Disposal Facilities, Blending & Additive Injection systems. Crude Oil Desalter, Mechanical Handling Equipment, Dryers, Mechanical Agitators, Caustic Soda Preparation & Distribution, Gas Dehydration, Refrigeration, and etc.:

- Mechanical Engineering activities in general shall include but not be limited to the following items:
  - Preparation of specifications.
  - Sizing and selection of equipment.
  - Analysis of vendor proposals.
  - Design audits.
  - Performance test assistance, if required.
  - Construction assistance, if required.
  - Start-up assistance, if required.
  - Maintenance and spares analysis.
  - Design studies input.
  - Noise control.

#### **6.4.5.2 Execution of the work**

- The mechanical engineers shall produce specifications, equipment data sheets and material requisitions for each item of equipment considered. The equipment shall be sorted into types and sizes and grouped into similar types and convenient quantities for optimum purchase.
- Shell and tube heat exchangers, surface areas, tube size, length and number of shells shall be pre-determined using the HTRI or equivalent thermal rating program upon the Company's approval. Nozzle location, size and setting plans shall be generated by computer to produce early information for plot plans and enable plant detail design to proceed. The thermal guarantees shall be given by the Contractor or by the selected Vendor(s) who shall be required to independently confirm the required surface areas.
- Rotating equipment engineers shall work closely with the process engineers to ensure an optimum match between process needs and machinery constraints.
- The Mechanical Engineers shall also work closely with the control instrument engineers to ensure proper integration of machinery control with the plant control, and, where required, shall participate in dynamic simulation modeling to verify stability of operation thermodynamic performance, and driver dynamics.
- To aid streamlining of future maintenance, standards shall be agreed with the Company for common items equipment such as main motor drivers, couplings and pump seals.
- An engineer shall be assigned to supervise noise control. Equipment producing noise shall be carefully selected in order to minimize the use of acoustic enclosures. Estimates shall be

obtained for the noise spectrum emitted from each item. The total noise levels in work areas, control rooms, offices and other occupied or sensitive locations shall be established and checked carefully against the Company's requirements.

- Pressure Vessel Engineers shall be responsible for both pressure vessels and bulk storage (API) tanks. Lead Vessel Engineers shall coordinate the vessel and tank design work for all areas of the project to provide conformity to the engineering procedures and the requirements of the international codes as stated in the Contract.
- Vessel data sheets shall be prepared from summary design information and revised where necessary. The Contractor to include in equipment requisitions, where appropriate, internals (excluding trays and packing), and any other miscellaneous items such that a complete package is requisitioned. Each Vendor's major fabrication drawings shall be reviewed for conformity to specifications and for details which interface with other disciplines such as structures, Piping and Plant Layout.
- All vessel trays and packings in the refinery and/or plant should be purchased from one supplier upon the Company's approval.

### **6.4.5.3 Main activities**

#### **6.4.5.3.1 Vessels, towers and storage tanks**

Contractor shall:

- Develop vessel standards.
- Establish specific job requirements for towers, pressure vessels and storage tanks and add to the general specifications.
- Design each vessel and prepare drawings showing wall thickness, heads, shells, nozzles, supports, internals, platforms clips, insulation clips and angles, etc. in sufficient details to permit vendors to prepare shop details.
- Check Vendor's drawings for conformance with design drawings and specifications.
- Perform checks for:
  - Vessel foundation drawings.
  - Drawings for steel work and platform supporting vessels.
  - Nozzle sizes and location/orientation.
- Compile vendor information on the drawings, data sheets and specifications.
- Check all tower capabilities in design, normal and turn down throughputs based on the tower load calculations performed by the tray or packing supplier.
- Prepare ladder and platform drawings.
- Finalize vessel drawings with orientation and lugs.
- Check all drawings including Vendor's drawings to be virtually complete and issue drawings for "AFC".
- Check and confirm test reports for all equipment.
- Compile information for manuals.

#### **6.4.5.3.2 Heat transfer equipment**

The following main activities shall be performed by the Contractor for Heat Transfer Equipment as defined in Article 6.4.5.1 above.

Contractor shall:

- Establish specific job requirements for heat transfer equipment and add to general specifications.
- Perform thermal and mechanical optimization.
- Supply thermal and mechanical design.
- Supply bills of material.
- Supply setting plans.
- Prepare detailed drawings.
- Review Vendor's drawings, data sheets and setting plans for conformance with specifications, orientation of nozzles and location of supports.
- Provide and complete data sheets.
- Compile vendor information on the drawings, specifications, data sheets and other project documents.
- Check and confirm test reports for all equipment.
- Compile information for manuals.

#### **6.4.5.3.3 Pumps, compressors and their mechanical drivers**

Contractor shall:

- Establish specific job requirements for pumps, compressors and their mechanical drivers and add to general specifications.
- Review Vendor's data sheets and drawings for conformance with specifications.
- Complete data sheets.
- Compile Vendor information on the drawings, specifications and other project documents.
- Check and confirm test reports.
- Compile information for manuals.

#### **6.4.5.3.4 Miscellaneous equipment**

Contractor shall:

- Prepare duty specification for each item.
- Review Vendor's drawings and technical documents for conformance with the job specifications.
- Compile vendor information on the drawings specifications and other project documents.
- Check and confirm test reports.
- Compile information for manuals.

#### **6.4.6 Materials and quality services**

- Materials and Quality Services shall comprise of metallurgical expertise in the following areas:
  - Materials selection/corrosion engineering.
  - Materials specifications.
  - Fabrication/welding technology-Vendor and field construction.
  - Corrosion protection-cathodic, coatings.
  - Corrosion monitoring.

- Non-destructive testing.

The Contractor shall prepare Material Selection Guides based upon final process flow diagrams and submit to the Company for approval.

- Material selection shall be based upon project specification materials requirements data given in the Basic Design Manuals and published corrosion data by the acceptable international committee (e.g., NACE). In general, the Contractor shall select materials that reflect up-to-date, proven and established technology if not specified in the Basic Design Packages.

#### **6.4.7 Insulation and painting**

The Contractor shall perform the following main activities as minimum requirements:

- Establish type, thickness and covering of insulation for each equipment item.
- Establish specific job requirements for all insulation items and add to general specifications.
- Prepare insulation schedules for each equipment and piping, showing operating temperature, insulation, service, type and thickness of insulation and reference to the applicable specifications.
- Prepare insulation bill of materials.
- Establish specific job requirements for painting and add to the general specifications.
- Prepare painting schedule and paint/painting application specifications.
- Prepare bill of material for painting.
- Compile information for manuals.

#### **6.4.8 HVAC and plumbing**

##### **6.4.8.1 General**

- Basic Design Manuals shall be basis of design for HVAC systems through the buildings.
- All the areas to be air conditioned or ventilated shall be identified and designed to ensure adequate environmental conditions for the protection/safety of equipment and the comfort of personnel. The design shall include:
  - HVAC design philosophy specification and environmental schedule.
  - Technical specifications and data sheets for equipment.
  - Specification for HVAC systems operations.
  - Flow schematics and controls for the systems.
  - Schematic-duct pre-sizing and route diagrams.
  - Equipment layout drawings.
- The HVAC system design and construction shall conform to all current codes, regulations, and the Company's standards.

##### **6.4.8.2 Main activities**

Contractor shall:

- Review Architectural drawings.
- Establish basic requirements of HVAC specified in the Basic Design Manuals.
- Establish specific job requirements for HVAC and plumbing and add to the general specifications.

- Develop general energy distribution system.
- Perform overall load calculations.
- Calculate individual space loads.
- Consult manufacturers of HVAC equipment.
- Select terminal equipment for spaces.
- Co-ordinate for required utilities.
- Prepare water piping and ducting layout.
- Prepare cooling water piping layout.
- Prepare steam and air piping layout.
- Prepare independent/central mechanical room drawings.
- Prepare material list.
- Check main distribution piping and make hydraulic calculations for pump selection.
- Check final drawings with architectural and electrical drawings.
- Issue drawings for "AFC".
- Issue As Built drawings.
- Place purchase order.
- Review and check test reports.
- Compile information for manuals.

#### **6.4.9 Instrument and control engineering**

##### **6.4.9.1 General**

The control systems engineers in liaison with the process and project systems engineers shall finalize the P&IDs with the required controls and instrumentation for safe and efficient operation. The instrumentation symbols shall generally conform with the Company's standards and ISA S5.1 and ISA S5.3. Instrument assemblies shall be computerized in order to ensure consistency with P&IDs.

- In line with the Company's Specifications, detailed specifications shall be prepared for:
  - Field instrumentation.
  - Control/relief valves.
  - Supervisory Control and Data Acquisition systems(SCADA).
  - Distributed Control System (DCS) and Advanced Control System (ACS).
  - Normal operation and shutdown/interlock systems.
  - General package unit specification.
  - Installation/calibration specification for the field commissioning work.
  - Tank gaging system.
- Control Systems engineers shall specify and design instrumentation systems and produce instrument data sheets, liquid level coordination drawings and prepare calculations to determine instrument air and electrical power consumption, control valve sizes, relief valve sizes, orifice plate and in-line flowmeter sizes, for all items not included in the vendor packages. Control systems engineers shall also be responsible to review and check all works performed by the vendor against the Contract requirements and give final approval for instrumentation and control parts.

- The Distributed Control System (DCS), Advanced Control System (ACS), SCADA communication specialist and control system engineer shall prepare specifications and shall outline the system configurations for the complete system including the central computer. Requirements for data transmission, automatic control, emergency shutdown (ESD), remote monitoring, communications, equipment standby philosophy and automatic switching shall be addressed. This work shall be carried out by experienced engineers in this area of technology.
- The control systems work shall commence with defining the functions of the systems and continue with the preparation of material requisitions for quotation.

The requisitions shall be grouped by equipment type as far as possible, to reduce the total number. Enquiries shall be issued as early as possible to correspond with P&ID issues and project schedule requirements. On receipt of bids, full technical analysis shall be completed and purchase requisitions shall be issued after bid tab approval.

- Maximum use shall be made of CAD for design drawings, including:
  - Control room layouts and cable route diagrams.
  - Block cable diagrams.
  - Typical block configuration diagrams.
  - Logic and schematic diagrams.
  - Process instrument hook-ups.
  - Control panel schematic layouts.
  - Pneumatic instrument location drawings showing instrument and air headers.
  - Interconnection diagrams.
  - Instrument cable schedules multicore and telecommunication.
  - Fire and gas schematic layouts, for system sizing.
- Vendor drawings shall be reviewed for conformity to specification and relevant design details added to data sheets.
- Control systems engineers shall perform shop acceptance testing of the DCS, metering, SCADA, PLC, fire and gas, as well as other sophisticated control equipment.

#### **6.4.9.2 Main activities**

Contractor shall:

- Establish specific job requirements for instruments and add to general specifications.
- Assist in preparation of P&IDs and utility diagrams including instrument numbering symbols and identification.
- Develop standard drawings.
- Prepare instrument lists, and indexes 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.
- Prepare layouts for instrument panels, etc.
- Prepare instrument location drawings showing positions of instruments not mounted in the control room, indicating recommended routing for major cable and tubing runs and instrument air header take-off valves.
- Provide instrument cable/tubing schedules.

- Prepare junction box locations.
- Prepare instrument hook-up sketches with material requirements.
- Prepare instrument transmission loop details. - Prepare control room layout, showing all necessary details.
- Develop electrical system for instrumentation.
- Prepare process optimization specifications.
- Review and check technically all package units inquiries and purchase order requisitions where instrumentation is to be furnished by a vendor as part of the package unit with the Company's Engineering Standard and provide recommendations.
- Check instrumentation Vendor prints/drawings and specification for compliance with required specification.
- Provide tank gaging specification.
- Perform checks on vessel drawings for instrumentation.
- Prepare auxiliary panel layout drawings to scale with overall dimensions and show the locations of instruments, push buttons, lights, annunciators, alarms, etc.
- Prepare logic diagrams for sequence and program control.
- Prepare logic diagrams for interlock and alarm systems.
- Finalize process optimization specifications.
- Prepare all other data sheets drawings and diagrams required for installation maintenance and operation of instrument and control items.
- 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 materials.
- Prepare material requisitions for instruments and instrument materials.
- Prepare all analyzers specifications and job requirements and place analyzers purchase orders.
- Check panel and analyzers at Manufacturer's shop.
- Finalize drawings and issue "AFC" and "As Built" instrument and P&I Drawings.
- Compile information for manuals.

#### **6.4.10 Electrical engineering**

##### **6.4.10.1 General**

- The Electrical engineers shall prepare a preliminary electrical load demand study to determine generation/local power requirements.
- The overall electrical system one line diagram, together with the individual voltage one line diagrams, shall then be prepared as a design basis. All necessary short circuit and motor starting calculations shall be performed.
- The overall electrical design specification and major electrical equipment specifications shall be produced in the order of priority determined by the Project Master Schedule. Using these electrical equipment specifications, the Electrical engineers shall prepare material requisitions for the major electrical equipment to be issued for quotation.
- Based on the agreed plot plans, the necessary hazardous area classification drawings and schedules shall be produced for the selection of electrical equipment and as a design aid in the location of electrical equipment items.

- Guide installation drawings and cable summary tabulations shall be prepared to enable the installation Contractor to perform his work.
- Electrical engineers shall coordinate closely with the Civil (underground services) engineers to cover the requirements for cable trenching. The Civil engineers shall be responsible for coordinating cable trenches along with other underground services and foundations.
- Discussions shall be held with the Piping engineers to identify cable tray/rack space reservations for the routing of above-ground electrical and instrument cabling.
- The moto/power user summary and electrical load summary shall be reviewed at regular intervals and updated as necessary.
- As soon as major equipment sizes are available, substation building sizes shall be established and located on the plot plans.
- All Vendor drawings shall be fully reviewed for compliance with equipment specification and general requirements laid down in the material requisitions.
- A comprehensive electrical power system study shall be carried out and a detailed protective relay study, including time/current discrimination curves shall be produced.

#### **6.4.10.2 Main activities**

Contractor shall:

- Establish specific job requirements for all electrical services and add to the General Specifications.
- Prepare Standard drawings.
- Prepare single line diagrams for the whole generation and distribution system, and also for each area substations.
- Develop motor list and prepare data sheets.
- Prepare relay setting schedule.
- Prepare system design report including voltage profile, re-acceleration, fault studies.
- Prepare system study and short circuit calculations.
- Prepare lighting system and prepare drawing showing arrangement of lighting panels, lighting requirement at grade, on platforms and structures with specific details as required.
- Prepare layout drawings of power cables including lighting and earthing and specific requirements for switchgear and motor control center.
- Prepare cable schedules and routing.
- Prepare grounding drawings and details.
- Prepare schematic wiring diagrams for all circuit breakers and electrical items having internal wiring or relays.
- Prepare layout of switch room.
- Complete list of all starters with capacity requirements and specifications for each.
- Complete list of switchgear with capacity requirements and specifications.
- Prepare electrical power supply systems and layouts for instrumentation.
- Check Vendor's drawings and data for conformance with specifications.
- Prepare area classification drawings.
- Prepare all lighting, earthing ,control station and other miscellaneous fixing and mounting details.
- Perform checks for underground drawings of piping and civil where underground electrical

cable is to be laid.

- Prepare initial and final Material Take-off for all electrical materials.
- Prepare Material requisitions for electrical equipment and materials.
- Establish power control house & building layout.
- Issue substation and switchgear drawings.
- Provide system shutdown connection diagrams.
- Prepare electrical instrument drawings.
- Issue connection diagrams.
- Prepare and issue heat tracing drawings.
- Prepare electrical heat tracing job requirements and add to the general specifications.
- Prepare and issue cathodic protection drawings.
- Prepare cathodic protection job requirements and add to the general specifications.
- Issue drawings for "AFC" and "As Built".
- Compile information for manuals.

#### **6.4.11 Telecommunication**

Contractor shall:

- Establish specific job requirement and add to the General Specification.
- Design telecommunication system and prepare detailed drawings.
- Perform checks for underground drawings of piping and civil where underground telecommunication cable is to be laid.
- Check Vendor's drawings and data for conformance with Specifications.
- Issue telecommunication drawings for "AFC".
- Compile information for manuals.

### **6.5 Procurement**

#### **6.5.1 General**

- The procurement of all of the materials and equipment including bulk materials of the project shall be carried out based on the engineering works approved by the Company, and shall be in congruent with the materials indicated in the Company's MESC Books, unless other wise approved the Company.
- The Contractor shall utilize his own resources to carry out any expediting and inspection that may be necessary to provide that the materials are delivered in accordance with the project schedule and the relevant specifications.
- Third party inspection (if required) shall be arranged by the Contractor as foreseen in the Contract.
- Interchangeability for spare parts and grouping by specific Vendor shall be taken into account.
- All materials shall be ordered on an FOB basis and the Contractor shall carry out all of the shipping for the materials to be imported into Iran according to the Contract. Where possible, Iranian vessels shall be utilized and materials shall be consolidated to provide efficient and cost effective transportation.
- The expediting group of the procurement organization shall be responsible to see that vendors

produce drawings and data as required by engineering. This activity shall be closely controlled and monitored to make certain that there are a minimum of delays for obtaining technical input to the design and to enable manufacturers to proceed as effectively as possible with approved drawings and documentation.

- The Contractor shall establish the necessary controls such that all materials are adequately tracked and monitored from the time they are first requisitioned until they are delivered to the jobsite. This control system shall provide information to the Contractor's project team at all times to provide maximum awareness of the status of all materials and for management to be aware of any significant details or problems that may become apparent well before they occur.

- In general the procurement main activities shall include but not be limited to:

- Establishing specific job requirements.
- Compiling all relevant specifications and data sheets.
- Preparation of the requisitions for purchase of materials.
- Technical and commercial negotiations with vendors including clarification of technical questions that may arise from vendors.
- Preparation and issue of purchase order.
- Checking of orders confirmation.
- Preparation and issue of variations to purchase order.
- Checking vendors' data and drawings for conformance with design drawing and project specifications.
- Expediting of documents, drawing and spare part lists with manufacturers.
- Proper inspection of the materials purchased.
- Checking invoices.
- Arrangements for insurance.
- Cargo inspection.
- Arrangement for packaging.
- Arrangement for shipment with shipping agency.
- Preparation of necessary documentation for shipment/exportation/importation.
- Planning and coordinations of all the procurement activities.
- Reporting on progress.

## **6.5.2 Procurement basic requirements**

### **6.5.2.1 Enquiries/request for quotation**

**6.5.2.1.1** Enquiries shall be in accordance with the contract documents and shall state that materials shall be required for the "Company" and for the subject "Project".

**6.5.2.1.2** Wherever applicable enquiries for equipment shall include the provision of spare parts, approved job specifications, process duty specifications, data sheets, all necessary project documents as required and/or (in a separate quotation) assistance by Vendor in erection and/or commissioning.

The Vendor assistance required is to be defined. In general, Vendor assistance during commissioning is to be requested only for complicated equipment which shall be agreed upon by the Company in advance. Enquiries shall also state requirements for items such as drawings and documentation and for Vendor's reference a list of experience in the case of critical items, e.g.,

compressors, reactors, etc.

**6.5.2.1.3** In case of major equipment such as fired heaters, vessels, pumps, DCS system, etc., the Company shall be sent a copy of each requisition as released for review and approval.

**6.5.2.1.4** The Contractor shall solicit competitive quotations from a sufficient number of qualified approved bidders to assure the receipt of a minimum of three bids. Exceptions to this would be as directed by Project Management and approved by the Company.

**6.5.2.1.5** The following elements are to be contained in all Requests for Quotation:

**FOB\* Point Specified**

Bids from all suppliers outside of Iran are to be solicited FOB Dock, name port of export with estimated mass (weight), cube and dimensions shown in the metric system for each item, including export packing and inland freight as separate items as required.

**6.5.2.1.6 Terms and conditions**

All Requests for Quotation are to contain the following notes:

**a)** Please review all attachments with care. Strict compliance as requested is mandatory for final bid evaluation. Any exceptions to specifications and/or "Terms and Conditions of Purchase", must be clearly stated in your quotation.

**b) Price Basis**

Wherever possible quotations shall be submitted on a FIRM PRICE BASIS. If, however, a price escalation formula is quoted then full details of such escalation formula and the maximum percentage of escalation must be included.

**\* Requests for Quotation shall have reference equipment and/or tag numbers. Type of tag or other identification requirements shall be clearly specified in the body of the inquiry or reference made to attachment describing the requirements. Metal tags will be required when applicable.**

**6.5.2.1.7** The following statement shall be shown on all Requests for Quotations:

"The following items will be considered in the evaluation of bidder's quotation: Price, freight, operating and maintenance costs, field installation costs, quality, delivery, terms of payment, compliance with specifications, guarantees and experience, and adherence to other conditions."

**6.5.2.1.8** Requests for Quotation shall state requirements for and shall request bidder to furnish:

- Firm prices and/or escalation formula.
- Shipping promise.
- Shipping point.
- Method of shipment.
- FOB point.
- Separate price for inland freight to exit port.
- Terms of Payment, including cash discounts.
- Trade discounts.
- Fabrication in-transit rates.
- Free access to expeditors and inspectors, including Client's representatives.

- Drawings and data.
- Installation, operating and maintenance instructions.
- Separate price for packing and crating, when required.
- Basis for establishing cost of additions to and/or deletions from initially indicated requirements, i.e., vessel nozzles.

#### **6.5.2.1.9 Spare parts**

The following notes shall be shown on all Requests for Quotation on equipment items:

- a) "A price list of recommended spare parts for commissioning is required and will be so noted on the purchase order to the successful bidder."
- b) "A price list of recommended spare parts for two years operation is required and will be so noted on the purchase order to the successful bidder."

#### **6.5.2.1.10 Language**

The English language shall be used exclusively. All engineering and design data including technical information of all quotations for major equipment shall be in English with consistent use of metric units of measurements as specified in [IPS-E-GN-100](#) "Units". The following statement is to be included on all requests for 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 shall be in the English language."

#### **6.5.2.2 Bid analysis**

A Bid Analysis is required for all major engineered items and selected number of minor items requested by Owner including electrical equipment and instruments except as indicated under 6.5.2.2.5. Contractor shall prepare a bid comparison showing:

**6.5.2.2.1** Contractor proposed selection indicating reasons for selection.

**6.5.2.2.2** Difference in installed cost, plus 3 years of operational costs for heaters and compressors. The Company reserves the right to elect alternates on other than the 3 years payout evaluated cost basis.

**6.5.2.2.3** In case of cost plus or reimbursable contracts for equipment involving a substantially higher capital investment to provide a lower operating cost, Contractor shall compute the payout period for the incremental investment.

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

- 1) Grouping together the various types and models of related functional equipment to encourage selection of a single Vendor.
- 2) Maximizing interchangeability.

**6.5.2.2.5** Unacceptable quotations because of lack of conformance to requirements or specifications.

**6.5.2.2.6** In case where an Iranian Vendor's bid is not acceptable a statement is to be provided stating the reason for its rejection.

**6.5.2.2.7** All related technical information of vendors such as manuals, cataloges, etc. where needed.

**6.5.2.2.8** Spare part information according to Appendix C of this Standard.

### 6.5.2.3 The Company review and approval

Copies of consolidated bid analysis, together with copies of all Vendor's supporting technical information, and the required spare part information, shall be forwarded to the Company for review. The Company will determine whether equipment selections by Contractor meet specifications and are in the best over-all interest of Owner including equipment standardization.

Should the Company direct the purchase of equipment other than that chosen by Contractor for reasons other than failure to meet project requirements, the cost differential will be for Owner's account in case of Lump-Sum Price Contracts. The company's representative will return the bid analysis approving Contractor's choice or indicating preferred Vendor.

### 6.5.2.4 Purchase orders

**6.5.2.4.1** Purchase orders shall give a complete description of items required. This may be done by requisition attachment. Separate purchase orders shall be issued for onshore Vendor services e.g., assistance in erection or commissioning of Vendor equipment.

**6.5.2.4.2** Purchase orders shall state full requirements as outlined in Article 7.5.3 and shall include:

- a) Guarantees (Refer to Article 6.5.3 below).
- b) Required engineering drawings and data sheets.
- c) Schedule for drawings and data.
- d) Expediting, inspection and shipping requirements (including test certificate required).
- e) Required spares information.
- f) Storage recommendations.
- g) Required operating and maintenance instructions.
- h) Any other required mechanical catalogue information.

### 6.5.2.4.3 Schedule

The following note shall be placed on all purchase orders for engineered items:

#### **Progress Report**

Seller will submit within thirty days from date of order a reproducible copy of the engineering, material procurement, fabrication and delivery schedule established for this order followed by a progress report every thirty days until final delivery of equipment. In the event of a schedule change, the seller shall advise the Contractor by telephone (and confirm in writing) the reason for such change.

**6.5.2.4.4** The 'Contractor' shall indicate on all purchase orders and suborders that items to be purchased are subject to inspection and approval by the Company and that any items not conforming to approved specifications may be rejected.

**6.5.2.4.5** Where applicable, the following note is to be added to the purchase order:

#### **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."

**6.5.2.4.6 Changes**

Additions, deletions and corrections are to be made by supplement to the purchase order.

**6.5.2.4.7 Cost coding**

Appropriate account numbers shall appear on all purchase orders. The initiating engineer shall be responsible for furnishing this information on the purchase request and Cost Engineering shall confirm its accuracy.

**6.5.2.4.8 Freight**

If included in the price, inland freight charges are to be shown as separate item on all purchase orders.

**6.5.2.4.9 Liquidated damages/penalty (as applicable) and bonus clauses**

The Contractor may wish to impose a Liquidated Damages/Penalty clause and/or a Bonus clause under his responsibility for certain equipment critical to the job completion schedule.

**6.5.2.4.10 Notice of shipment**

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 each shipment goes forward. Such notification must be identified by purchase order number.

**6.5.2.4.11** 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 that current issues are already in Vendor's possession.

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

**6.5.2.4.13** Purchase orders for items of local supply shall be on a delivered-site basis wherever possible.

**6.5.2.4.14** Purchase orders for items of other than local supply shall be on FOB delivery basis unless otherwise specified.

**6.5.2.4.15** 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.

**6.5.2.5 Provision of data**

Contractor shall ensure that Vendor provides drawings and other data requirements stated on the purchase order. An order shall not be considered to have been completed until every such document has been received and accepted as satisfactory by Contractor.

**6.5.2.6 Progressing and expediting**

- Contractor is responsible for having all equipment, materials, Vendor's drawings and documentation, spare parts, special tools, etc. within his scope of work delivered in time to meet the Project Schedule.

- Materials shall be progressed regularly and as a minimum, monthly personal visits 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. Any threatened delays which may affect the construction schedule shall be brought to the attention of the Company immediately, together with actions to be taken to improve the situation.
- The Company reserves the right for his representatives 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.
- In the event of equipment delivery dates causing concern, personal visits shall be made to the Vendor by a senior representative of Contractor at such frequencies as may be justified by the situation.

#### 6.5.2.7 Inspection

- Inspection shall be made in accordance with the Contract requirements and procedures agreed upon.
- Contractor shall accordingly carry out inspection of all equipment and materials in his scope of work at the works of vendors or their sub-suppliers, prior to shipment to Site, and shall ensure that all equipment and materials fully comply with the purchase order.
- Contractor's inspector shall reject any equipment or material which is not of acceptable quality of workmanship or which fails to comply with the requirements of the purchase order and the applicable specifications.
- Equipment or materials found at site to be defective or not in accordance with the purchase order in the equipment guarantee period as specified in the purchase order may only be accepted with appropriate qualification or shall be returned to the supplier for repair or renew and subsequent delivery to site, all as agreed with Owner and at no cost to the Company.
- The Company reserves the right for his representative and/or agent to visit Vendor's works, and those of their sub-suppliers, at any time, for the purpose of inspecting equipment and materials. Arrangements for these visits shall in all cases be made through Contractor, Such visits will not relieve Contractor or any vendor or subcontractor of his responsibility for inspection as detailed above. If the Contractor intends to sub-contract inspection at Vendor's works 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 'Engineer's Representative' 15 calendar days' notice of any test per coordination procedure to be made by vendor and/or 'Contractor' in order that 'Engineer's representative' may witness any such test.
- During the course of manufacturing, fabrication and construction for any 'Material', Contractor shall make or cause to be made all tests required by the 'Contract' documents and approved job specifications.
- 'Contractor' shall provide 'Engineer's Representative' with the 4 copies of purchase orders and suborders, working drawing and fabricating and testing procedures in sufficient time to enable the 'Engineer's Representative' to carry out examination of above documents. The 'Engineer's Representative' shall advise the 'Contractor' which 'Materials' shall be inspected.
- 'Contractor' shall not waive an inspection or test called for under the "Inspection Procedure" (prepared by the Contractor and approved by the Company), or otherwise agreed with the Company without written approval of the "Engineer".

#### 6.5.2.8 Shipment

- Shipping shall be made in accordance with the outline given in the Contract. Contractor shall produce a detailed Shipping Procedure for review and approval of the Company based on the

Shipping requirements stated in the Contract.

- Contractor shall arrange for shipment to Iran and through customs clearance and delivery to Site of all equipment and materials of other than local supply, from FOB delivery.
- Purchase orders shall be accompanied by copies of shipping instructions (i.e., Packing, Marking and Documentation attachment).
- Contractor shall establish maximum allowable shipping dimensions and masses (weights), including any specific requirements for particular items of equipment where considerations (such as construction requirements) may dictate the allowable shipping size.
- Contractor shall make all necessary arrangements for the import of materials into Iran and shall be responsible for preparing all documentation required for importation of such materials on behalf of Owner.
- Contractor shall ensure that all necessary customs clearance documentation is in the hands of the appointed shipping or clearing agent at the port of entry prior to the arrival of the carrying vessel, to avoid delay in customs clearance. Materials going by air or overland shall be accompanied by the necessary customs clearance documentation.
- Contractor shall advise on transit insurance and arrange this as necessary.

#### **6.5.2.9 Record of purchase orders and material progress**

- Contractor shall maintain Material Progress Chart to record the status of all items procured by Contractor. This Chart shall be issued to Owner at least monthly throughout the Project until all materials have been received at Site.
  - Contractor shall establish the format of Material Progress Chart.
  - Material Progress Chart 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
    - 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)
    - Site receipt date (estimated and actual).
- 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.

#### **6.5.2.10 Spare parts procedure**

Spare parts procedure shall be in accordance with Appendix C of this Standard.

#### **6.5.2.11 Chemicals, catalysts, special tools and test equipment**

Contractor shall procure chemicals, catalysts, special tools and test equipment (including test equipment for shell and tube exchangers) as per requirements of Appendix C of this Standard.

#### **6.5.2.12 Vendor engineers**

Contractor shall provide the services of Vendor engineers as required to supervise erection and commissioning of equipment, e.g., compressors, Packaged Units and complex instrumentation.

### **6.5.3 Guarantees**

**6.5.3.1** Prior to order placement, Contractor shall obtain guarantees from vendors, and shall ensure that these guarantees are fully available to the Company. The guarantee shall be at least equal to the guarantees stipulated in Conditions of Contract. In the event that a Contractor is not able to obtain a guarantee from a Vendor equal to those stipulated on Conditions of Contract and in purchase order, Contractor shall bring this to Owner's attention prior to order placement, specifically to obtain the Owner's approval for the guarantee offered.

**6.5.3.2** In the event that equipment or 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 Owner. Contractor shall negotiate and retain the benefit of any sums recovered under insurance policies.

**6.5.3.3** For equipment and machinery the 'Contractor' shall guarantee to repair or replace all faults of design, manufacture or packing for a period of twelve (12) months following the issuance of the Provisional Acceptance Certificate or 60 months after the award of Contract, whichever comes first.

**6.5.3.4** 'Contractor' shall secure above guarantees and render all effort and assistance to enforce the same throughout period of the guarantees as set out in the Contract.

### **6.5.4 Supply of equipment & material**

**6.5.4.1** Contractor shall supply CIF "Unit" site:

- All "Materials" required for realization of the "Unit".
- Spare parts required for commissioning.
- Spare parts required for two years of operation per Appendix A of this Standard.
- All catalysts, lubricants and chemicals required for initial loading.
- Supply of miscellaneous equipment and materials and all catalysts, lubricants and chemicals required for two years of operation per Appendix C of this Standard.

**6.5.4.2** Packaging, loading, unloading, transportation, customs clearance of all equipment and material including 'Materials' shall be carried out by 'Contractor'.

**6.5.4.3** All "Materials" shall be new.

**6.5.4.4** Contractor shall expedite delivery in such manner as to allow completion of the "Unit" on

time.

## 7. CO-ORDINATION PROCEDURE

The Contractor shall prepare Coordination Procedure based on the following minimum requirements in conjunction with Article 6.1.1.3 above and submit to the Company for approval.

### 7.1 General

**7.1.1** The Coordination Procedure shall be applicable to the detailed design and engineering and procurement as covered by the Contract between the Contractor and Company. Detailed job procedures that affect both parties to the Contract may be incorporated into a job procedure manual prepared by the Contractor.

**7.1.2** The official language of the Contract shall be English. However, upon the Company's request for the nontechnical and contractual correspondences both English and Farsi languages shall be used.

**7.1.3** International System of Units (SI) in accordance with [IPS-E-GN-100](#); "Units" shall be used.

**7.1.4** Drawings and documents shall be per project numbering procedure approved by the Company. Drawings shall have the Company's standard title block.

### 7.2 Company's Review Requirements

**7.2.1** The Company may require to review and/or approve any of Contractor's drawings, calculations and other documents in connection with the Work. Such review and/or approval shall in no way relieve Contractor of any liabilities, obligations and responsibilities.

As soon as practical after Effective Date, Contractor shall set up, agree with the Company and implement a procedure for submitting documents as required by the Company for review. Two levels of review and approval will apply (depending upon the importance of the document), covering:

**7.2.1.1** Key documents which require formal approval before detailed development of design or procurement can proceed, being:

- All equipment data sheets
- Hydraulic design calculations
- Plot Plans
- Engineering Flowsheets (P&I Diagrams) and PFDs (if required) for all units
- Electrical Area Classifications
- Noise and effluent control measures
- Building Layouts
- Utility Balances and utility flow diagrams for all units
- Inquiry Requisitions for major equipment
- Technical Bid Tabulation for major equipment
- Purchase Order Requisitions for major equipment
- Control Panel Layout and Design
- Project Specifications and Standard drawings
- Reactor circuit and other high-cost pipe sizing calculations

- All drawings and documents required for review by Consultants/Licensors, as specified in the Licensor's Basic Design Specifications.
- Package units project specifications including process duty specifications.

**7.2.1.2** Documents which require review without holding up development of design or procurement, including:

- Pressure Balance Profiles
- Material Requisition for bulk items
- Layout drawings
- Instrument/electrical one-line diagrams
- Complete detail Mechanical Specifications for Package Units (including engineering flowsheets; control, alarm and safety systems; layouts)
- Bulk Materials tabulations
- Bills of Quantity
- Inquiry and Purchase Order Requisitions for all items not included in 7.2.1.1 above
- Piping Isometric Drawings
- Piping arrangement drawings
- Vendor drawings
- Line Classification Lists
- Welding Procedures
- Foundation drawings for elevated tanks and vessels, vibrating machinery and stacks
- Detail drawings of buildings
- Other drawings called for by the Company's Engineering Standards

**7.2.2** Four copies of drawings and documentation of 7.2.1.1 and one copy of drawings/documentation of 7.2.1.2 shall be issued for the Company's review, comments and/or approval as they are prepared and not later than the date of issue for inquiries.

The Company may require at his option and on a reimbursable basis, additional copies of drawings and documentation. Revisions to documents shall be handled as for the original documents.

**7.2.3** The Company shall forward the comments and/or approvals within ten working days of receipt of documents, except those requiring Licensor's comments and/or approvals provided that the Contractor does not accumulate materials requiring approval and shall not submit them in large quantities. The documents and/or drawings shall be submitted to the Company in accordance with the documents submission schedule established in advance between the Company and Contractor.

The Contractor shall review the comments made by the Company and shall make required changes, deletions, additions, and modifications, and prepare new revisions of the documents and drawings necessary to obtain the Company's approval based on a due time as agreed upon by the Company but not less than three weeks. Special attention shall be made by the Contractor to the documents quality and Contract project schedule. If the next revisions of the documents constitute a change from the Contract specifications or other contractual requirements, they shall become a subject of change in accordance with the provisions of the Contract.

**7.2.4** The Contractor shall supply to the Licensor(S) those portions of the detailed design specified by the Licensor(S) for review and approval.

After final approval by the Company, the foregoing shall form the basis upon which the Contractor shall proceed with the production engineering. Such approval will be indicated by an appropriate stamp and the date and signature of the Representative of the Company.

**7.2.5** If the Company fails to advise Contractor of his approval or disapproval within this specified period, the document shall be deemed approved and Contractor then shall advise the Company in writing, that he is proceeding on the assumption that the item has been approved.

If the Contractor fails to perform the Company's requirements within the specified period, the document shall be deemed disapproved and the Contractor will be responsible for any delay in this regard.

**7.2.6** Contractor shall submit for the Company's Design Representative's information Contractor's detailed engineering work to the extent that Representative finds it necessary to ensure contractual compliance. If a question arises to the design adequacy, the Contractor must provide data or otherwise satisfy Employer of the soundness of the design.

**7.2.7** The Contractor shall make such modifications as are necessary to conform with the approved final planning drawings, specifications, and data and to correct errors, faulty design, or other conditions which may adversely affect the operation and safety of the facilities.

**7.2.8** The Contractor shall submit for the Company's Design Representative's review an English copy of the installation operating and maintenance manual of each supplier of major equipment such as compressors, generators, boilers and packaged Units.

### **7.3 Vendor Drawings and Documents**

**7.3.1** Vendor drawings and documents shall be certified for all equipment and shall be approved by the Contractor.

**7.3.2** Vendor drawings shall include foundation loading plans, general arrangements and all detail drawings as required for completion of the work.

**7.3.3** Vendor shall provide all procedures, calculations, reports, instructions and documents required in the purchase order and/or relevant inquiry.

**7.3.4** The equipment installation, maintenance and operating instructions to be issued at least eight weeks prior to shipping of the respective item of equipment.

**7.3.5** Vendor drawings shall be marked with the Contractor, Company and project identification designations. Contractor shall number Vendor drawings in a system agreed with the Company and stated in the project numbering procedure. Contractor shall maintain an index to the Vendor drawings appropriate to the work. The indexes shall be updated and issued to the Company on a monthly basis.

### **7.4 Correspondence and Transmittals**

#### **7.4.1 General**

**7.4.1.1** Each correspondence shall contain the following information:

Name of addressee, title and address:

Project Title:

Date:

Subject:

Reference No:

**7.4.1.2** Each correspondence shall be limited to one subject in so far as possible.

**7.4.1.3** All letters shall be airmailed.

**7.4.1.4** Telephoned or other oral instructions or agreements shall be confirmed in writing, mentioning the names of the parties involved.

**7.4.2 Correspondence numbering**

All letters, telex and telefax shall be numbered in accordance with a system to be agreed upon between the Contractor and Company. Each office will maintain a register of outgoing and incoming correspondence, recording the number, date, subject, and type of communication.

**7.4.3 Purchasing and shipping documents numbering**

All inquiries, purchase orders, invoices, expediting reports, etc. shall bear a serial number. The system shall be per Project Numbering Procedure.

**7.4.4 Drawing and specification numbering**

All drawings and specifications shall be numbered as per project drawing numbering system. Drawings of equipment including Vendor's drawings shall in addition to the above bear the equipment number as well. This numbering system shall also be per Project Numbering Procedure.

**7.4.5 Company's copy requirements**

Company's copy Requirements will be as per the following table. The numbers required, in the table below, include originals:

Documents	Total	PM	Design Repr.	Site Repr. (If Required)
- Letters to Project Manager	2	2	--	--
- Letters to Design Representative	4	2	2	--
- Letters to Site Representative	4	2	--	2
- Transmittal of Design Document	4	2	2	--
- Site Document	4	2	--	2
- Copies of Enquiries for Major Equipment	3	1	2	--
- Technical Bid Analysis	3	1	2	--
- Purchase Orders, Unpriced	4	2	1	1
- Specifications	4	1	2	1
- Shop Inspection and Test Reports	3	1	1	1
- Progress Schedules	4	2	1	1
- Payment Requests	3	3	--	--
- Minutes of Meeting	4	2	1	1

**7.4.6 Authorized signatures**

**7.4.6.1** All Contractor's correspondence shall be for the signature of Contractor's Project Director or his designee.

**7.4.6.2** All Company's correspondence shall be for the signature of Company's Project Director or his designee.

**7.4.7** Plant and equipment numbering system shall be as per project numbering procedure approved by the Company.

**7.5 Purchasing**

**7.5.1 General**

The major equipment is to be purchased from suppliers on the Contract vendors list. In the event the Contractor is obliged to go to different suppliers, the Contractor shall obtain the written approval of the Company for the purchase under consideration prior to issuing a "letter of intent" entering into

an agreement or issuing purchase order. The Contractor shall furnish copies of all inquiries for major equipment to the Company for review and approval.

### **7.5.2 Quotation and bid tabulations**

Prior to placing a letter of intent or order for major equipment, Contractor shall furnish the Company with technical bid analysis showing his choice of the supplier and indicating which offers from technical and delivery points of view are acceptable to him. The Company will have a maximum of ten (10) working days from the receipt of this bid tabulation to study it and submit his acceptance or comments.

In the event that the Company's approval or comments are not received by the Contractor within the specified time, the selection shall be deemed approved and Contractor shall advise the Company in writing that he is proceeding on the assumption that the selection has been approved.

### **7.5.3 Purchase orders**

**7.5.3.1** Contractor shall indicate on all purchase orders and suborders that equipment and installation are subject to inspection by the Company for approval and that any equipment or installations not conforming to the Project specifications may be rejected.

**7.5.3.2** Purchase orders and suborders for equipment subject to inspection by the Company or his appointed representative shall include the provisions of the Contract and shall provide for issue to the inspecting authority of four (4) copies of orders and suborders and of working drawings and fabricating and testing procedures.

**7.5.3.3** The Contractor shall also indicate on all purchase orders the supplier's delivery promise for all data required, such as spare parts lists, installation and maintenance instructions, operating instructions and any other pertinent data.

**7.5.3.4** The purchase order shall contain a guarantee clause required by the Contract.

**7.5.3.5** The purchase order number shall include a code to identify types of equipment as per project numbering procedure.

### **7.5.4 Shop drawings**

**7.5.4.1** The Contractor shall be required to review fabricator's shop drawings to the extent necessary to ensure compliance with Contractor's drawings and specifications.

## **7.6 Production Engineering**

**7.6.1** All drawings, data sheets, standards, specification, expediting and status reports etc. prepared by Contractor for the project shall be sent to the Company as follows:

**Drawings, Specifications and Data Sheets**

	<b>Total</b>	<b>PM</b>	<b>Design Repr.</b>	<b>Site Repr (If Required)</b>
For approval	3	1	2	---
For construction	4	1	1	1 + 1R
Vendor's drawings	4	2R	1	14
Specifications, expediting and status reports	4	1	1	1

**Note:**

"R" above means reproducible.

**7.6.2**

**Data Furnished Under Spare Parts Requirements**

	<b>PM</b>	<b>Design Repr.</b>
Part Lists	2	2
Manufacturer's Sectional Drawings and Manuals	2	1
Spare Recommendations	2	2

**7.6.3 Manufacturer's drawings and data sheets**

The Contractor shall show on all Manufacturer's drawings and data sheets the equipment number, and the Contractor's purchase order number.

**7.6.4** Contractor shall furnish the Company with the lubrication schedule in due time as agreed upon. Lubrication schedule shall give specifications of qualities and quantities required.

The Lubricants specified in the Company's product Specifications should be adhered to as far as practicable. Contractor should make every effort to obtain vendor's approval during guarantee period of the oils as listed, and furthermore attempt to minimize number of types used. Vendor supplying equipment requiring special oils which are technically justified to be used shall give the recommended Shell, BP or Exxon equivalent. Many such oils are manufactured in Iran.

**7.6.5** English language and metric system shall be applied in the design of equipment, in producing drawings and in specifications.

**7.6.6** English version of installation operating and maintenance manuals, shall be supplied.

**7.6.7 Format of manuals**

- All pages, drawings, etc. shall be of a size suitable for insertion in an A4 (210 mm x 297 mm) hard cover binder. In general all drawings shall be reduced to 297 mm x random Length size for convenience in handling.
- Large size folded drawings will not be acceptable.
- All reduced drawings, data, etc. must be readable.
- Lettering shall be provided on the binder according to the Company's requirements.

### **7.6.8 Disposal of originals**

The originals of all drawings provided by Contractor shall be the property of the Company and shall be handed over to the Company on request.

## **8. DETAILED DESIGN & ENGINEERING DOCUMENTS**

### **8.1 Language**

'The ruling language' shall be the English language. However from time to time the 'Employer' 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 'Employer' and all such drawings, specifications, etc. shall be clearly marked to the effect, provided, however, that the 'Employer' 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 Plant Manuals**

**8.4.1** The Contractor shall furnish to the "Employer" before the "Works" are taken over, plant operating, plant technical and plant equipment manuals together with drawings (other than shop drawings) of the "Works" as completed, in sufficient detail to enable the "Employer" to operate, maintain, dismantle, reassemble and adjust all parts of the "Works".

**8.4.2** The 'Contractor' shall carry out all corrections, amendments and additions to such manuals as may be instructed by the 'Engineer', and within fifteen (15) days after the 'Engineer's' approval he shall deliver to the 'Engineer', the required copies of approved manuals as per Contract.

**8.4.3** Contents of all plant manuals shall be as outlined in Clause 6.1.2 of this Standard.

## **8.5 Format**

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

## **8.6 Mistakes in Drawings**

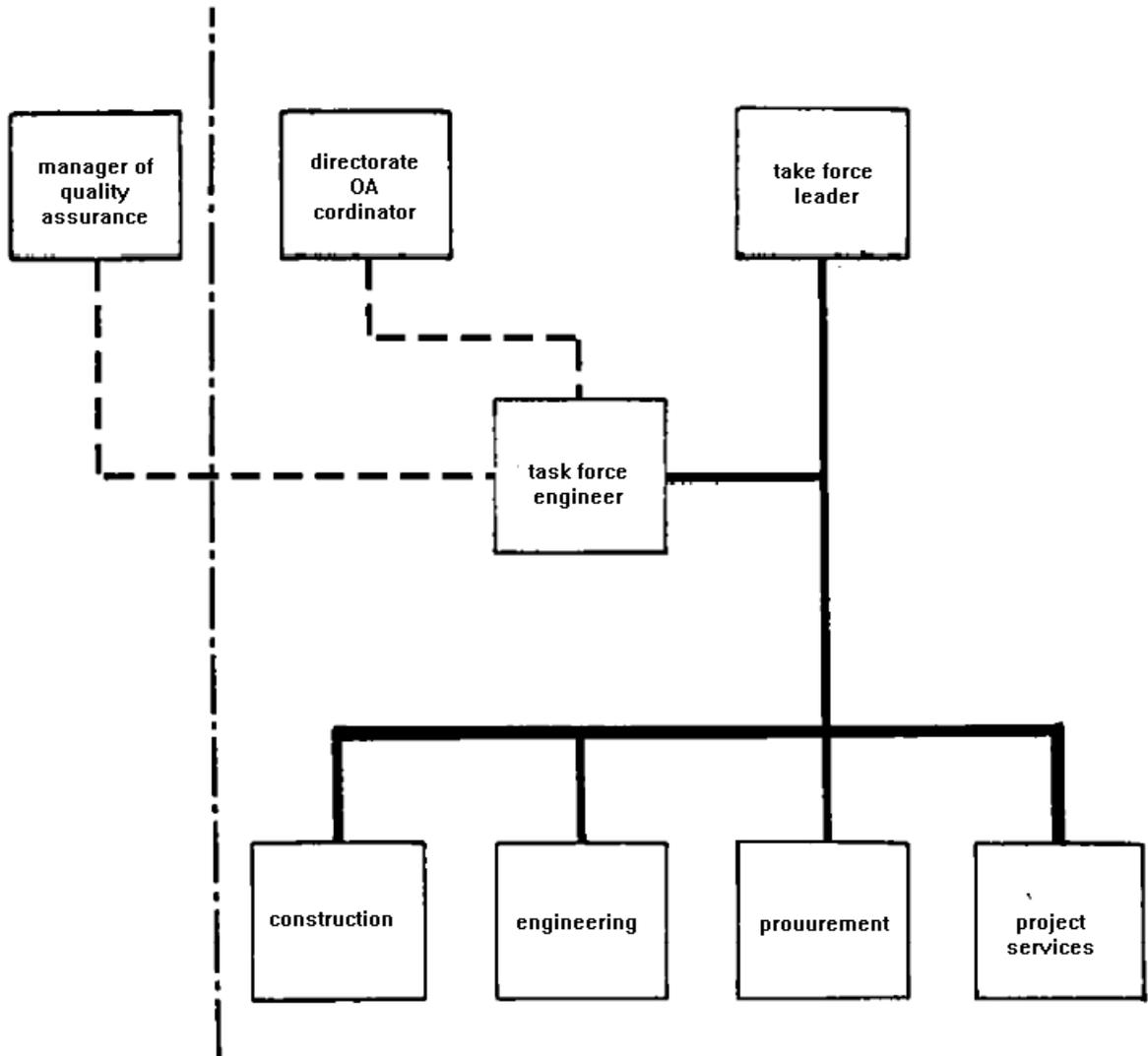
The 'Contractor' shall be responsible for any discrepancies, errors, or omissions in the drawings and other particulars supplied by him, whether such drawings and particulars have been approved by the 'Engineer' or not, provided that such discrepancies, errors, or omissions be not due to inaccurate information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

APPENDICES

APPENDIX A

TYPICAL PROJECT QUALITY ASSURANCE ORGANIZATION/INTERFACE

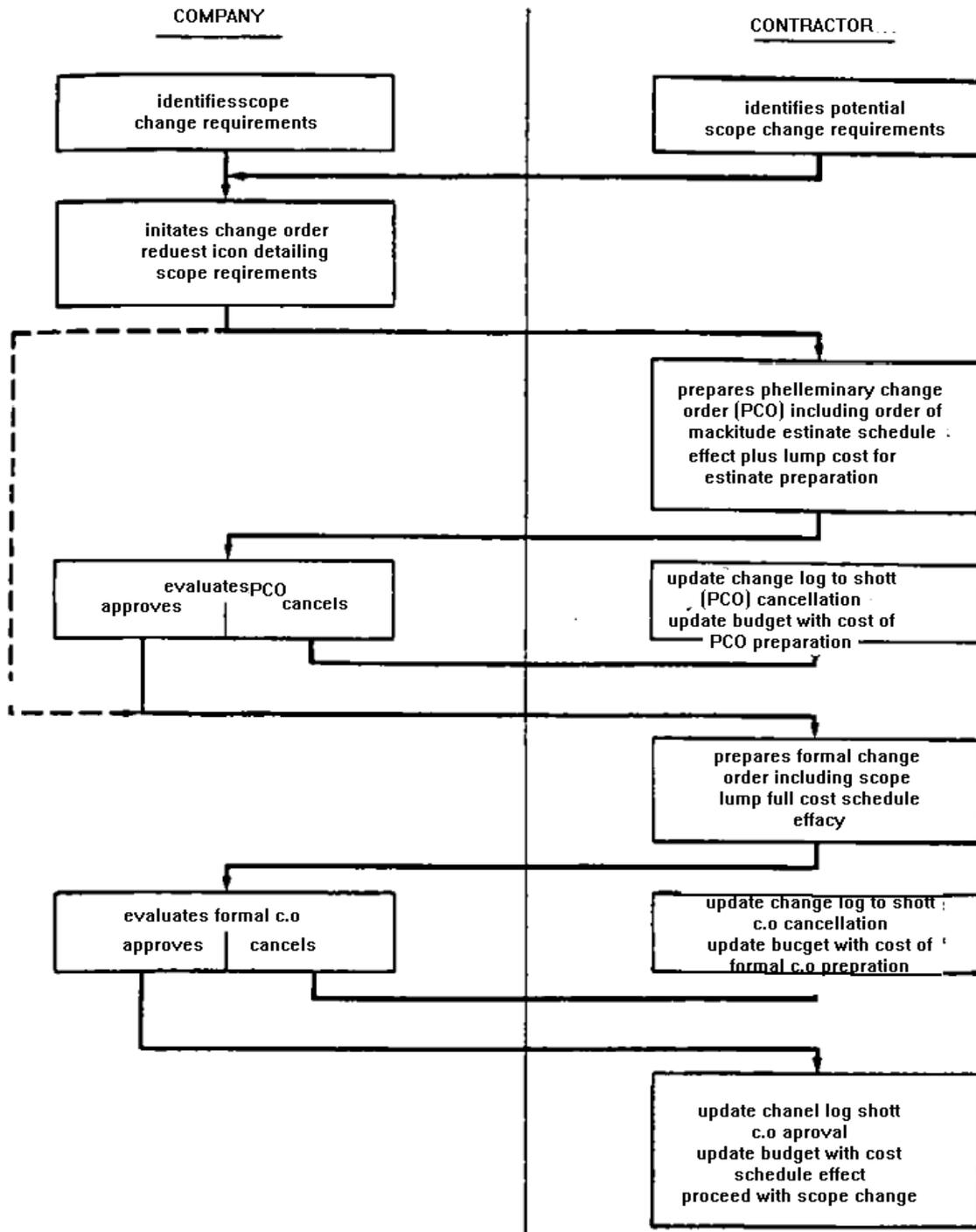
(Typical only for Task Force Undertaking Full Range of Engineering/Procurement and Construction)



LEGEND:

FUNCTIONAL GUIDANCE  
REPORTING RELATIONSHIP

APPENDIX B  
TYPICAL CONTRACT CHANGE FLOW DIAGRAM



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**APPENDIX C**  
**SUPPLY OF SPARE PARTS, MISCELLANEOUS EQUIPMENT AND MATERIALS, CHEMICALS AND CATALYSTS**

**C.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.

**C.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.

**C.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.

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

**C.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.

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

**C.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.

**C.2 Supply of Spare Parts**

**C.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.

**C.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.

**C.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)**

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**APPENDIX C (continued)**

**C.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.

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

**C.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.

**C.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.

**C.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.

**C.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.

**C.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 Employer 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.

**C.3 Supply of Miscellaneous Equipment and Materials**

**C.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.

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

**C.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.

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

**C.4 Supply of Chemicals and Catalysts**

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

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

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

**C.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.

**C.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.

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

**(to be continued)**

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

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

**C.5.1 Contractor's responsibility**

**C.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.

**C.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.

**C.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.

**C.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.

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

**C.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.

**C.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.

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

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**APPENDIX D**  
**REIMBURSABLE ITEMS**

**D.1** The following items purchased in accordance with the provisions of this Section, will be payable on reimbursable basis, if required by the Contract. 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.

- 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).

**D.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.

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

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

**E.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.

**E.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 E (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.

**E.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.

**E.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 E (continued)

SPARE PARTS LIST AND INTERCHANGEABILITY RECORD