

# ارتقاء

المصنعين الوطنيين  
ERTQA of National Manufacturers  
Engineering Requirements for Technical and Quality Approval



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## PART I: ASSESSMENT GUIDELINES

### 1. Introduction

This Engineering Requirements for Technical and Quality Approval (ERTQA) handbook has been developed by Saudi Aramco Engineering Services (SAES), to provide clear approval guidelines for new and existing local manufacturers of engineering commodities. The handbook includes approval requirements based on Saudi Aramco (SA) and Industry applicable standards, as well as ISO 9001 Quality Management System (QMS) requirements. ERTQA is applicable to new facilities and for adding new materials to already approved facilities. It also introduces best practices to sustain manufacturing excellence and transform local manufacturers to be globally competitive.

The terms and conditions of any purchase orders or procurement agreements between Saudi Aramco or its contractors and manufacturers, shall supersede any understanding implied or given herein. The content of this guide is intended to help manufacturers ensure their facilities are ready for quality and technical assessments. In addition, it defines Saudi Aramco's post-approval expectations for manufacturers' performance. However, approval of a facility or material, does not guarantee purchase orders.

### 2. Manufacturer Communication

The Supplier Relationship Management Division (SRMD) is the entity within Saudi Aramco established to manage relationships with manufacturers. The SRMD deals with queries/requests from manufacturers that includes such things as lists of commodities allocated or copies of Saudi Aramco standards, technical, and inspection requirements. Please contact SRMD/Manufacturer Relations & Qualification Unit ([vendor-registration@aramco.com](mailto:vendor-registration@aramco.com), [Supplierhelpdesk@aramco.com](mailto:Supplierhelpdesk@aramco.com)) or 013-874-2222 for further information.

### 3. Assessment Process

For the assessment process, manufacturers must work with SRMD to complete the registration and application requirements. The manufacturer is then expected to allocate a confirmed assessment week, at which time, the manufacturer's organization will be ready to receive the Saudi Aramco assessment team at their premises. Afterwards, SRMD will create an internal assessment request to the responsible technical and quality entities. Subsequent communication will then be established between Saudi Aramco's assessors and the manufacturer's responsible contacts in order to prepare for the assessment. Then, the assessors will conduct a quality assessment (based on ISO 9001) and technical assessment to assess the manufacturer's capacities to supply the intended commodities. Finally, SRMD will then officially share the approval decision with the manufacturers' management.

### 3.1 Pre-Assessment

#### 3.1.1 Self-Assessment

Prior to applying for Saudi Aramco approval, manufacturers must perform a self-assessment against the quality and technical requirements set out in Parts II and III of this handbook. This should help manufacturers to identify the gaps in their technical and quality systems, and duly implement permanent corrective actions.

#### 3.1.2 Quality Documents

As per the ISO 9001 compliant documentation detailed below, manufacturers are required to make sure these current and duly approved documents are submitted as part of the application for approval:

1. Uncontrolled copy of the QMS manual.
2. Copies of the six mandatory quality systems procedures.
3. Complete list or index of all QMS procedures, work instructions, forms, exhibits, figures, attachments, or any other such documents.
4. Complete list or index of all documents of external origin such as statutory requirements, industry standards, or customer standards.
5. Complete organization chart including all QA/QC staff names.
6. Production and quality process flow charts.
7. List of key manufacturing equipment installed at the manufacturing facility.
8. Summary of most recent internal audit of QMS.
9. List of production nonconformities for the past year to date.
10. Minutes of last management review meeting.
11. Factory location map.
12. Copy of ISO 9001 certificate.
13. A completed Saudi Aramco Vendor's Manufacturing Plant Evaluation Questionnaire (see [Saudiaramco.com](http://Saudiaramco.com)).

#### 3.1.3 Technical Documents

Manufacturers must provide documentation in support of their critical manufacturing processes, critical equipment/human resources, and certifications and specifications. See Part III for a listing of these by commodity. This is also to be included in addition to the general documents detailed below:

1. Company overview.
2. Manufacturing facilities overview.
3. Fabrication shop layout.

4. Reference list of major customers, and major executed jobs.
5. Written formal confirmation to comply with applicable Company standards and materials specifications and inspection and testing requirements.

#### 3.1.4 Assessment Schedule

Manufacturers must confirm and commit their readiness for assessment during initial communication with Saudi Aramco. Manufacturers are considered ready when they complete the self-assessment and submit technical and quality documents.

### 4. During Assessment

Manufacturers need to make sure all respective department representatives, including the technical and quality department are available on the days of assessment. Moreover, production/fabrication/manufacturing must all be in operation.

### 5. Post-Assessment

Saudi Aramco expects manufacturers to deliver defect-free and on-time delivery material, in addition to competitive prices and technical support. The specific requirements will be clearly stipulated in the purchase orders either directly procured by Saudi Aramco or through its contractors. The following are the minimum general expectations of the manufacturer:

1. Maintain effective operating quality management system and sustain technical capabilities to assure product quality and full compliance with purchase orders requirements.
2. Comply with all Purchase Orders requirements and specifications during manufacturing. Keep Saudi Aramco timely informed in case of failure to meet any requirements.
3. Issue sub-orders as specified in main purchase orders and per Saudi Aramco requirements for specific equipment.
4. Report outsourcing plans that differ from the ones accepted during Saudi Aramco approval.
5. Report officially any major change in the production lines such as relocation, renovation, etc.
6. Notify Saudi Aramco directly with product nonconformities or deficiencies during any phase of production.
7. Utilize only qualified technical, production, quality, and inspection personnel.
8. Report officially major financial upsets potential to impact quality of production and equipment/materials.

## 6. Monitoring of Quality System Performance

Saudi Aramco monitors manufacturers' quality performance after Company approval and during purchase orders production, as well as when material is put into service. Monitoring activities are performed through different means such as the following:

### 6.1 Periodic Assessment

Pre-scheduled periodic assessment of QMS and/or technical capabilities for approved manufacturers to make sure they maintain an acceptable operating quality system.

### 6.2 Unannounced Assessment

Unplanned evaluation of QMS and/or technical capabilities for approved manufacturers to make sure they maintain an acceptable performance level.

### 6.3 Focused/Process Based Assessment

A focused evaluation of a manufacturer's quality control activities performed as an extra measure for critical material/equipment or to attend to high risk manufacturing and testing activities during manufacturing.

### 6.4 Quality Control Inspections

Inspection visits/reviews performed according to purchase order and Saudi Aramco's inspection requirements, and the approved inspection and test plans.

### 6.5 Quality Notifications

- Non-Conformance Report (NCR): A formal report issued by Saudi Aramco or its contractors to document material deficiencies and/or process incompliances during production execution.
- Equipment Deficiency Report (EDR): A formal report issued by Saudi Aramco during receiving inspection of material at project site or operating facility to document manufacturing/fabrication deficiencies and track progress on taken corrective actions. EDR can be also issued for poor After-Sale services and lack of responsiveness complaints.
- Rejection Notice: A formal notice issued by Saudi Aramco to reject material due to deficiencies and/or incompliance to purchase order requirements.

## PART II: QUALITY MANAGEMENT SYSTEM REQUIREMENTS

The following are the QMS approval requirements:

### 1. Certification

1.1 The manufacturer's QMS should be certified to latest ISO 9001 requirements.

### 2. Leadership & Accountability

2.1 Requirements:

2.1.1 The manufacturer shall effectively establish, document, implement, and maintain:

- Statement of quality policy
- Quality Objectives (consistent with quality policy)
- Quality Manual
- Control of Documents Procedure
- Control of Records Procedure
- Corrective Action Procedure
- Preventive Action Procedure
- Internal Audit Procedure
- Control of Non-Conformities Procedure

2.1.2 The manufacturer shall assign a quality leader (manager, or equivalent).

2.1.3 The manufacturer shall provide resources to implement and maintain the established QMS in terms of manpower, training, infrastructure, equipment, and measuring tools.

2.2 Best Practice:

2.2.1 It is recommended that the quality leader has the following qualifications:

- ISO 9001 Lead Auditor certification or equivalent.
- Minimum of 10 years of experience in manufacturing, QA/QC, and supply chain activities related to the product(s) in the facility.

2.2.2 Establish clear roles and responsibilities among management team to ensure acceptable quality performance is consistently maintained.

### 3. Contract/Sales Order Review

#### 3.1 Requirements:

- 3.1.1 The manufacturer shall establish and maintain a process for contract review to highlight any deviation prior to acceptance of a purchase agreement.

#### 3.2 Best Practices:

- 3.2.1 Maintain review results of purchase requisitions/sales order by multi-discipline engineering and quality teams, to prevent after the fact technical deviations.

### 4. Design Control

(If Engineering & Design are outsourced, then outsourcing requirements apply)

#### 4.1 Requirements:

- 4.1.1 The manufacturer shall maintain a process to control and verify product design.
- 4.1.2 The manufacturer shall prepare design and development plans which reference design activities and define responsibility for their implementation.
- 4.1.3 The manufacturer shall define the organizational and technical interfaces between different groups which input into the design process.
- 4.1.4 The manufacturer shall plan and conduct document design reviews at appropriate stages of product development.
- 4.1.5 The design changes/revisions shall be reviewed and approved by authorized personnel before implementation.
- 4.1.6 The issuance and approval of design documents shall be in-line with the document control procedures of the manufacturer.

#### 4.2 Best Practices:

- 4.2.1 Establish a tracking system for design changes to make sure interested parties are notified, and minimize the risk of utilizing outdated designs in the manufacturing.
- 4.2.2 Conduct periodical design reviews at pre-determined intervals.

### 5. Outsourcing

#### 5.1 Requirements:

- 5.1.1 In case of outsourcing, the manufacturer shall identify and define the outsourced processes in the QMS.
- 5.1.2 The manufacturer shall define and implement the extent of control applied to the outsourced processes.

#### 5.2 Best Practices:

- 5.2.1 Designate trained subject matter experts to manage/supervise any outsourced activities, including performing regular assessments.
- 5.2.2 Obtain Saudi Aramco feedback on any restriction on outsourcing activities.

### 6. Control of Nonconformities

#### 6.1 Requirements:

- 6.1.1 The manufacturer shall establish and implement a procedure to define the controls, responsibilities and authorities for dealing with nonconformities.
- 6.1.2 The manufacturer shall identify and control nonconforming product to prevent use or delivery.
- 6.1.3 The manufacturer shall apply a tool to deal with the nonconforming product - e.g. eliminate detected nonconformity, and prevent its original root causes. Disposal of a nonconforming product shall be approved by the client.

6.1.4 The manufacturer shall re-verify the conformity of the products when the nonconformity is corrected.

6.1.5 The manufacturer shall maintain records of the nonconformities nature and all subsequent actions taken, including obtained concessions.

## 6.2 Best Practices:

6.2.1 Perform root cause analysis to control product and audit nonconformities.

6.2.2 Perform data analysis of historical product nonconformities to improve manufacturing process by eliminating major deficiencies and repeated NCRs.

# 7. Purchasing Control of Raw Materials and Components

## 7.1 Requirements:

7.1.1 The manufacturer shall establish a process to ensure purchased material conforms to specified requirements.

7.1.2 The manufacturer shall evaluate and select sub-manufacturers on the basis of their ability to meet sub-contract requirements.

7.1.3 The manufacturer shall define control over sub-manufacturers.

7.1.4 The manufacturer shall establish and maintain records of sub-manufacturers inspection and testing records.

7.1.5 The manufacturer shall ensure purchasing documents contain adequate description of the product ordered, governing standards, and other details including where appropriate, the type, class, style, grade or other precise identification.

## 7.2 Best Practices:

7.2.1 Categorize sub-manufacturers based on risk assessment criteria to designate proper inspection involvement.

7.2.2 Review the purchase orders by concerned organizations (technical and quality).

## 8. Receiving Inspection

### 8.1 Requirements:

- 8.1.1 The manufacturer shall maintain a process to conduct receiving inspection for incoming raw material and components.
- 8.1.2 The manufacturer shall identify and segregate nonconforming materials designated and act according to the Control of Nonconformities Procedure.
- 8.1.3 The manufacturer shall release-for-production, or storage, material that meets all stated or implied requirements.

### 8.2 Best Practices:

- 8.2.1 Perform receiving inspection based on the original Material Test Certificates.
- 8.2.2 Develop receiving inspection checklists.
- 8.2.3 Quarantine and identify non-conforming materials to prevent their use during manufacturing.

## 9. Handling, Storage, Preservation of Raw Material and Components

### 9.1 Requirements:

- 9.1.1 The manufacturer shall maintain a process for handling, storage, and reservation of raw material and components.
- 9.1.2 The manufacturer shall furnish/provide methods of handling that prevent damage or deterioration.
- 9.1.3 The manufacturer shall designate only authorized personnel for materials receipt or dispatch.
- 9.1.4 The manufacturer shall identify and control designated areas to store raw materials depending on type, criticality and level of utilization.

9.1.5 The manufacturer shall provide required storage facility to meet special storage and preservation requirements from sub-manufacturer/customer for components/raw material.

9.2 Best Practices:

9.2.1 Develop handling and preservation procedures.

9.2.2 Designate a controlled area for storage of raw material only.

9.2.3 Develop a monitoring system to inspect condition of long storage material.

## 10. Special Processes Qualification and Inspection

(e.g. Welding, Coating, NDE, Heat Treatment, Brazing etc.)

10.1 Requirements:

10.1.1 The manufacturer shall identify special processes used in production stages.

10.1.2 The manufacturer shall make sure the work procedures, personnel qualifications, or personnel qualifications procedures are in compliance with international standards and customer requirements.

10.1.3 The manufacturer shall ensure all special processes are accomplished under controlled conditions as specified in the purchase orders.

10.1.4 The manufacturer shall make sure the work is performed and inspected by only qualified individuals.

10.2 Best Practices:

10.2.1 Assign inspection of these processes to inspectors with recognized certifications such as:

- Welding Inspectors: Certified to AWS QC1 or equivalent.
- Coating Inspectors: Certified to NACE or equivalent.

10.2.2 Develop and implement a monitoring checklist to verify process compliance to procedures/specifications, environmental conditions and control parameters.

## 11. Control of Inspection, Measuring and Test Equipment

### 11.1 Requirements:

- 11.1.1 The manufacturer shall maintain a process to control and monitor progress and quality of inspection and measurement activities.
- 11.1.2 The manufacturer shall determine the required minimum monitoring and measurement processes and avail the required equipment and qualified personnel to perform the process.
- 11.1.3 The manufacturer shall identify, calibrate, adjust, maintain calibration record, and protect equipment's that are used for monitoring and measurement purposes.

### 11.2 Best Practices:

- 11.2.1 Prepare a master log listing all machines/instruments. The log should cover necessary information about each measuring machine/instrument including, the calibration or preventative maintenance schedule. This log should trigger a smart/automated reminder to users in order to complete the calibration/preventive maintenance ahead of time.

## 12. Inspection & Testing During Production

### 12.1 Requirements:

- 12.1.1 The manufacturer shall list the in-process inspection and testing in accordance with inspection/quality plans, applicable procedures, and purchase order requirements.
- 12.1.2 The inspection/quality plan shall list all applicable inspection and testing requirements along with level of involvement for each inspection entity.
- 12.1.3 The manufacturer shall maintain inspection and testing records and certificates as per defined procedure and per the customer requirements.
- 12.1.4 The manufacturer shall identify and document all products which have failed any inspection or test, as a nonconforming product and subject to nonconforming product procedures.

## 12.2 Best Practices:

- 12.2.1 Make available on-site, records for each equipment/material under manufacturing/fabrication. These records should include the inspection and test plan (ITP) with each completed test/inspection point checked out along with supporting objective evidence.
- 12.2.2 Standardized the inspection and test plans format to include as a minimum: inspection/test process description, applicable specification/procedure, acceptance criteria, sample size, inspection/test record, level of involvement (hold, witness, and review), and responsibility for test/inspection.

## 13. Identification and Traceability

### 13.1 Requirements:

- 13.1.1 The manufacturer shall maintain an identification and traceability process from raw material receipt and during all stages of production and testing.
- 13.1.2 The process shall provide unique identification of individual raw material, batches, components, and finished product.

### 13.2 Best Practices:

- 13.2.1 Implement bar/color coding identification and traceability systems.

## 14. Final Inspection and Testing

### 14.1 Requirements:

- 14.1.1 The manufacturer shall establish a process to conduct and document final inspection activities and testing in accordance with purchase order requirements.
- 14.1.2 The manufacturer shall exercise a controlled mechanism to authorize final release for shipment after fully comply with applicable procedures and customer requirements.

#### 14.2 Best Practices:

- 14.2.1 Prepare Material Records Book for ready-for-shipment products that include records and evidences of performed pre-production, in process, and final inspection and testing requirements. This book should include, as minimum, all inspection and test records, nonconformities closeout, and punch list items resolution completed during the production cycle.

### 15. Handling, Packing, and Preservation of Finished Product

#### 15.1 Requirements:

- 15.1.1 The manufacturer shall maintain a process for marking, packing and preservation of finished product.
- 15.1.2 The manufacturer shall furnish/provide methods of handling that prevent damage or deterioration during transportation.
- 15.1.3 The manufacturer shall designate only authorized personnel for finished product dispatch.
- 15.1.4 The manufacturer shall define and implement appropriate requirements of packing, preservation and storage of finished product.
- 15.1.5 The manufacturer shall define, needed requirements storage and preservation of finished product by the customer.

#### 15.2 Best Practices:

- 15.2.1 For sensitive and high cost materials, assign product packing to experienced/specialized personnel or hire third party specialty to perform the packing.

### 16. Improvement

#### 16.1 Requirements:

- 16.1.1 The manufacturer shall identify and implement improvement measures including the following:
- Establishing database for customer complaints.
  - Conducting customer feedback.
  - Conducting root cause analysis.

- Conducting internal audits.
- Conduction management reviews.
- Implementing the corrective and preventive action procedures.

## 16.2 Best Practices:

- 16.2.1 Establish KPIs for critical production processes.
- 16.2.2 Establish a platform to collect and share lessons learned.
- 16.2.3 Conduct weekly reviews of product nonconformities and customer complaints.
- 16.2.4 Benchmark production processes with renowned manufactures.

## PART III: TECHNICAL REQUIREMENTS

The following are the Technical approval requirements by commodities:

### I. Metallic Pipe, Flange & Fittings

#### 1. Carbon Steel Pipes – (Seamless, Straight Seam, Helical Seam, and Electric Resistance Welding)

##### 1.1 Critical Manufacturing Processes

###### 1.1.1 Raw Material Handling:

The manufacturer shall inspect incoming raw materials for compliance including review of materials certificates, marking, storage practice/segregation, and traceability. Furthermore, the manufacturer shall ensure proper storage and segregation. The manufacturer shall be able to perform procurement practice for ingots or hollow shells, sources, and inspection.

###### 1.1.2 Cold Forming (NOT APPLICABLE TO SEAMLESS):

The manufacturer shall perform the forming capabilities and techniques such as the edge preparation process, intermediate inspection, and dimensional checks.

###### 1.1.3 Piercing, Reducing and Sizing (APPLICABLE ONLY TO SEAMLESS):

The manufacturer shall perform the piercing process, reheating, reducing, sizing, process control, intermediate inspection, and dimensional checks.

###### 1.1.4 Welding (NOT APPLICABLE TO SEAMLESS):

The manufacturer shall perform the welding using the correct and qualified welding procedures, parameters and essential variables control.

###### 1.1.5 Stress Relieving Process (APPLICABLE TO STRAIGHT SEAM ONLY):

The manufacturer shall ensure stress relieving is conducted using mechanical expansion, or heat treatment with proper capacity of expander, procedure, extent of mechanical expansion, capacity of heat treatment furnace, selection of heat treatment parameters, temperature measurement and record.

#### 1.1.6 Testing and Finishing:

The manufacturer shall conduct the heat treatment ensuring proper procedure, heating, soaking, quenching, tempering cycles, heating temperature control and measurements, and recording chart.

Hydro testing shall be performed with proper safety measures and hydro test procedures, using adequate illumination levels, pressure gauges, capacity of hydro tester, timer and duration, calibration, end seals, and recording chart.

The non-destructive examinations (NDE) including radiographic examinations and dimensional measurements shall be performed ensuring proper methods and equipment, procedures qualification, availability of qualified/certified personnel, arrangement/calibration of NDE, examination coverage per SAMSS/code, and records/reports.

The manufacturer shall ensure establishing a marking system per requirements, and ensure durability of the marking.

The manufacturer shall establish a proper traceability system identifying as a minimum, the heat number, lot number, MTC's, marking, segregations.

The manufacturer shall ensure proper protection, storage and transportation using protective coating, packing, documentations, and shipping practices per SA requirements.

The machine shop for sample preparation shall have cutting and machining equipment, controlled drawings, and notch sample preparation as applicable.

The conditioning, storage, handling and exposure of welding consumables shall be conducted as per SA requirements (NOT APPLICABLE TO SEAMLESS).

The mechanical and chemical testing shall be as required by standards, examples: tensile, bending, hardness and impact testing, chemical analysis, metallographic sample preparation, and calibration of equipment.

The hydrogen induced cracking (HIC) testing as applicable\*, shall be performed as per 01-SAMSS-035 and NACE TM 0284 requirements, such as safety arrangement, testing setup, apparatus, concentration of H<sub>2</sub>S, pH measurement, use of control, samples for qualification and during testing, evaluation of results from cross sections, and qualification of personal.

*\*if the manufacturer does not have a HIC testing facility, then documentation must be provided supporting that testing was conducted by an independent third party lab meeting Saudi Aramco's approval.*

## 1.2 Required Certifications

The following are examples of the qualifications and certifications required, depending on the standard requirements as applicable:

- Valid API 5L license for pipes manufactured in accordance with API 5L specification.
- Manufacturing procedure qualifications.
- NDE procedures qualifications.
- Qualifications and certification levels of NDT personnel level III (technicians and operators, in NDE methods such as magnetic particle testing, liquid penetrant testing, ultrasonic testing, and radiographic testing).

## 1.3 Specifications

The manufacturer shall be able to comply with the API 5L and/or applicable ASTM specifications and the applicable Saudi Aramco Material Specifications (SAMSS) including 01-SAMSS-035, 01-SAMSS-043, and 01-SAMSS-333 as applicable.

# 2. Stainless Steel and Nickel Alloy Pipe – (Seamless and Welded)

## 2.1 Critical Manufacturing Processes

### 2.1.1 Raw Material Handling:

The manufacturer shall inspect the incoming raw materials for compliance, including review of materials certificates, marking, storage practice/segregation, and traceability. Furthermore, the manufacturer shall ensure proper storage and segregation. The manufacturer shall be able to perform procurement practice for ingots or hollow shells, sources, and inspection.

### 2.1.2 Forming (NOT APPLICABLE TO SEAMLESS):

The manufacturer shall perform the forming capabilities and techniques such as edge preparation, capacity of forming rolls, process control and intermediate inspection, and dimensional checks.

### 2.1.3 Welding (NOT APPLICABLE TO SEAMLESS):

The manufacturer shall perform the welding, using the correct and qualified welding procedures, parameters and essential variables control.

#### 2.1.4 Heat Treatment (NOT APPLICABLE TO SEAMLESS):

The manufacturer shall ensure heat treatment is conducted with capabilities of annealing process and availability of batch-type furnace for stabilized grades of stainless steel pipes such as 321SS and 347SS.

#### 2.1.5 Melting and Casting:

The manufacturer of stainless steel melting and casting\* shall follow steel making routes including EAF/AOD/LAF/continuous casting/slab and bloom castings/billet casting/ingot casting, scrap sources/segregation, and chemical composition control.

*\*Note: Not necessary to be part of facility unless it is integrated plants*

The manufacturer shall establish a traceability system for the ingots or hollow shells such as control of traveler sheet for manufacturing process/control, traceability and marking, inspection, PMI, storage practice and segregation, cutting, product control, means to verify hard phases such as sigma or delta phases, and machining/boring.

The manufacturer shall perform reheating using a furnace with proper capacity, temperature variation control and measurement, procedure, and recording.

#### 2.1.6 Extrusion:

The manufacturer shall perform the extrusion\* process using proper equipment size, temperature, tube diameter/thickness, thickness uniformity, and precautions to prevent formation of hard phases such as sigma or delta phases.

*\*Note: Extrusion is the most common step in making seamless stainless steel pipes. Very few mills may use piercing technique.*

The manufacturer shall ensure when conducting quenching after extrusion to have proper condition of quenching tank, water cleanliness, and agitation.

The manufacturer shall ensure the extruded tube preparation and cleaning is conducted with proper method, surface condition, thickness uniformity, and traveler sheet.

#### 2.1.7 Testing and Finishing:

The manufacturer shall perform the pilger milling process with proper capacity of pilger mill, dimension control, surface condition, intermediate solution annealing, and inspection.

The manufacturer shall perform the cold drawing process with proper capacity of cold drawing equipment, dimension control, surface condition, intermediate solution annealing, inspection, and maximum allowed cold drawing reduction.

The manufacturer shall perform heat treatment by solution annealing with proper black annealing or bright annealing, procedures, equipment capacity, heating control and monitor, quench tank and cleanliness, stabilization heat treatment for S.S. grades 321/347, and precautions to prevent formation of hard phases or excessive grain growth.

The manufacturer shall perform the pipe straightening with proper procedures and equipment capacity. The manufacturer is not allowed to perform any weld repairs.

The manufacturer shall perform pipe pickling and passivation with proper procedures, acid types/concentration, cleanliness of acids and water tank.

The manufacturer shall perform Non Destructive Testing: UT or Eddy current equipment, other NDE methods as applicable, with proper procedures, qualification of UT operators, availability of level III personal, calibrations, automatic marking of defects, examination coverage and frequency.

Hydro testing shall be performed with proper safety measures and hydro testing procedures, using adequate illumination levels, pressure gauges, capacity of hydro tester, timer and duration, calibration, end seals, recording chart, and water chloride content.

Pipe end beveling shall be performed by beveling machines with proper capacity, bevel drawing, bevel appearance, and inspection.

The dimensional and final Inspection activities shall be done by the manufacturer. This includes testing such as visual inspection of internal and outer diameters, dimensional measurements, tolerances, ultrasonic testing gauge, positive material identification, and traceability per the traveler sheet shall be done by the manufacturer.

The manufacturer shall ensure that the marking system is performed as per requirements with consideration to durability of marking.

The manufacturer shall ensure that a traceability system includes review of heat numbers, lot numbers, material test certificates, marking, and segregations.

The manufacturer shall ensure that manufacturing activities ensure proper protection, storage and transportation using protective coating, packing, documentations, and shipping practices per SA requirements.

The machine shop for sample preparation shall include cutting and machining equipment, availability of controlled drawings, and notch sample preparation as applicable.

The mechanical and chemical testing shall be as required by standards, examples: tensile, bending, hardness and impact testing, chemical analysis, metallographic sample preparation, and calibration of equipment.

The corrosion testing shall be conducted with proper safety measures, lab equipment, procedures, lab technicians qualifications, and understanding of ASTM testing methods per ASTM G48 for pitting and crevice corrosion, ASTM A262 for intergranular corrosion, ASTM E562 for ferrite content test, and ASTM A923 for ferric chloride test.

## 2.2 Required Certifications

The following are examples of the qualifications and certifications required, depending on the standard requirements as applicable:

- Manufacturing procedure qualifications.
- NDE procedures qualifications.
- Qualifications and certification levels of NDT personnel level III (technicians and operators, in NDE methods such as magnetic particle testing, liquid penetrant testing, ultrasonic testing, and radiographic testing).

## 2.3 Specifications

The manufacturer shall be able to comply with the applicable ASTM specifications and the applicable Saudi Aramco Material Specifications 01-SAMSS-046.

# 3. Fittings (Elbow, Tee, Reducer, and Cap)

## 3.1 Manufacturing Processes

### 3.1.1 Design:

The manufacturer shall ensure design engineering and proof tests as per the applicable ASME codes.

### 3.1.2 Raw Material Handling:

The incoming raw materials shall be inspected for compliance with applicable SAMSS and referenced to international and industry standard requirements. Proper inspection shall include a review material test certificate, marking, segregation and traceability.

### 3.1.3 Forming and Forging:

The manufacturer shall ensure proper capacity of forming machines, process control, intermediate inspection, and dimensional checks.

### 3.1.4 Welding:

The manufacturer shall perform the welding using the correct and qualified welding procedures, parameters and essential variables control.

### 3.1.5 Forging:

The manufacturer shall ensure forging is conducted with proper capacity, ratio, steps, and sketches.

### 3.1.6 Heat Treatment:

The manufacturer shall ensure heat treatment is conducted with proper procedure, heating, soaking, quenching, tempering cycles, heating temperature control and measurements, and recording chart.

### 3.1.7 Finishing and Testing:

The manufacturer shall ensure proper machining of end bevels.

The manufacturer shall perform Non Destructive Testing: UT or Eddy current equipment, other NDE methods as applicable, with proper procedures, qualification of UT operators, availability of level III personal, calibrations, automatic marking of defects, examination coverage and frequency.

Hydro testing shall be performed with proper safety measures and hydro test procedures, using adequate illumination levels, pressure gauges, capacity of hydro tester, timer and duration, calibration, end seals, recording chart, and water chloride content.

Pipe end beveling shall be performed by beveling machines with proper capacity, bevel drawing, bevel appearance, and inspection.

The dimensional and final Inspection activities shall be done by the manufacturer. This includes testing such as visual inspection of internal and outer diameters, dimensional measurements, tolerances, ultrasonic testing gauge, positive material identification, and traceability per the traveler sheet shall be done by the manufacturer.

The manufacturer shall ensure that the marking system is performed as per requirements with consideration to durability of marking.

The manufacturer shall ensure that a traceability system includes a review of heat numbers, lot numbers, material test certificates, marking, and segregations.

The manufacturer shall ensure that manufacturing activities ensure proper protection, storage and transportation using protective coating, packing, documentations, and shipping practices per SA requirements.

The machine shop for sample preparation shall include cutting and machining equipment, available controlled drawings, and notch sample preparation as applicable.

The mechanical and chemical testing shall be as required by standards, examples: tensile, bending, hardness and impact testing, chemical analysis, metallographic sample preparation, and calibration of equipment.

The manufacturer shall ensure proper conditioning, storage, handling and exposure of welding consumables per SA requirements, including inspection and testing of incoming materials, storage temperature and humidity control, and practice of issuing consumables

### 3.2 Required Certifications

The following are examples of the qualifications and certifications required, depending on the standard requirements as applicable:

- Manufacturing procedure qualifications.
- NDE procedures qualifications.
- Qualifications and certification levels of NDT personnel level III (technicians and operators, in NDE methods such as magnetic particle testing, liquid penetrant testing, ultrasonic testing, and radiographic testing).

### 3.3 Specifications

The manufacturer shall be able to comply with the applicable ASTM, MSS specifications and the applicable Saudi Aramco Material Specifications 02-SAMSS-005 or 02-SAMSS-006, as applicable.

## 4. Flanges

### 4.1 Critical Manufacturing Processes

#### 4.1.1 Design:

The manufacturer shall ensure that design engineering as per the applicable ASME codes.

#### 4.1.2 Raw Material Handling:

The incoming raw materials shall be inspected for compliance with applicable SAMSS, and referenced to international and industry standard requirements. Proper inspection shall be conducted for a review of material test certificates, review of MTC's, marking, segregation and traceability.

#### 4.1.3 Forging Process:

The manufacturer shall conduct forging operations in controlled conditions for using the applicable forging machine and furnaces capacities to have steel reduction meeting standard requirements.

#### 4.1.4 Heat Treatment:

The manufacturer shall ensure heat treatment is conducted with proper procedure, heating, soaking, quenching, tempering cycles, heating temperature control and measurements, and recording chart.

#### 4.1.5 Finishing and Testing:

The manufacturer shall ensure proper machining of flange end preparation and then related inspection activities shall be carried out to confirm the machine is done in accordance with engineering drawings.

The manufacturer shall perform Non Destructive Testing (NDT) and Dimensional measurements. The NDT shall be carried out by using Ultrasonic Testing (UT) or Eddy current equipment, or other NDE methods as applicable. NDT shall be performed in controlled conditions which include as minimum proper NDT procedures, qualified UT operators, availability of level III personal, calibrations, automatic marking of defects, examination coverage and frequency.

The manufacturer shall ensure the marking system is performed as per requirements and ensure the marking durability for the flanges.

The manufacturer shall establish a proper traceability system identifying as a minimum, the heat number, lot number, MTC's, marking, and segregations.

The manufacturer shall ensure proper protection, storage and transportation using protective coating, packing, documentations, and shipping practices as per SA requirements.

The machine shop for sample preparation shall have cutting and machining equipment, controlled drawings, and notch sample preparation as applicable.

The mechanical and chemical testing shall be as required by standards, examples: tensile, bending, hardness and impact testing, chemical analysis, metallographic sample preparation, and calibration of equipment.

The corrosion testing shall be conducted with proper safety measures, lab equipment, procedures, lab technicians qualifications and understanding of ASTM testing methods per ASTM G48 for pitting and crevice corrosion, ASTM A262 for intergranular corrosion, ASTM E562 for ferrite content test, and ASTM A923 for ferric chloride test.

#### 4.2 Required Certifications

The manufacturer shall have the required qualifications and certifications for related forging processes. The following are required certification, as applicable, which include international certifications, e.g. ISO, calibration of all testing machines, manufacturing procedure qualifications, NDE procedures qualifications, qualifications and certification levels of NDT personnel for technicians and operators in NDE methods, availability of level III personnel, maintaining qualification records of NDE technicians and operators as required by the code.

#### 4.3 Specifications

The manufacturer shall be able to comply with the applicable ASTM specifications and the applicable Saudi Aramco Material Specifications, including 02-SAMSS-011.

## 5. Clad Pipe (Metallurgically Cladded Pipes, Lined Pipes, Weld Overlaid Pipes)

### 5.1 Critical Manufacturing Processes

#### 5.1.1 Raw Material Handling:

The incoming raw materials shall be inspected for compliance with applicable SAMSS, and referenced to international and industry standard requirements. Proper inspection shall be conducted for a review of material test certificates, marking, segregation and traceability.

#### 5.1.2 CRA Pipe Manufacturing:

The manufacturer shall control the sources of CRA pipe/coil, welding, insertion, expander, gripping, seal weld, and weld overlay min number of passes and min thickness.

The manufacturer shall demonstrate capabilities to perform the expansion process, including capacity of expander, procedure, and extent of mechanical expansion, etc.

The manufacturer shall demonstrate capabilities to perform Seal Weld Overlay process including grinding of pipe ends, overlay welding procedure qualification, weld overlay min number of passes and min thickness, inspection.

#### 5.1.3 Forming:

The manufacturer shall perform the forming in a controlled environment and process, in accordance to forming rolls capability, and edge preparation. The manufacturer shall carry out dimensional checks and intermediate inspections throughout the process.

#### 5.1.4 Welding:

The manufacturer shall have qualified welding procedures and welding machine, and welding consumables in accordance to the welding procedures. Welders and operators shall be qualified according to the procedure. Welding processes shall be carried out in a controlled environment to ensure the parameters are controlled during production.

#### 5.1.5 Cold Expansion:

The manufacturer shall have a mechanical expansion machine with identified expander capacity, procedure, and extent of mechanical expansion.

#### 5.1.6 ID Surface Grinding and Cleaning (ONLY FOR WELD OVERLAID PIPES):

The manufacturer shall ensure availability of proper blasting and cleaning procedures for grit, sand, or shot blasting.

The manufacturer shall have charting surface roughness, numbering of blasting stations, grit recirculation, air blowing and water washing.

#### 5.1.7 Weld Overlay:

The manufacturer shall have enough numbers of welding stations, number of wires in the welding head, and number of welding layers and minimum CRA thickness.

The manufacturer is required to have qualified welding procedures, procurement of welding consumables, operators' qualifications, welding parameters control during production, availability of real time camera and video recording during welding processes.

#### 5.1.8 Finishing and Testing:

For weld overlaid pipes: the manufacturer shall perform pickling processing by having available an acid cleaning procedure, defined duration of pickling for different material specification, identified number, size, and temperature of pickling paths, and water rinsing.

Hydro testing shall be performed with proper safety measures and hydro test procedures, using adequate illumination levels, pressure gauges, capacity of hydro tester, timer and duration, calibration, and end seals

The manufacturer shall perform Non Destructive Examination (NDE) with proper procedures, qualified and certified personnel, required calibration of NDE, control of records and reports, examination coverage as per applicable SAMSS and international codes.

The manufacturer shall conduct dimensional measurements of the pipe.

The manufacturer shall ensure establishing a marking system per requirements, and ensure durability of the marking.

The manufacturer shall establish a proper traceability system, identifying as a minimum, the heat number, lot number, MTC's, marking, segregations.

The manufacturer shall ensure proper protection, storage and transportation using protective coating, packing, documentations, and shipping practices per SA requirements.

The manufacturer shall ensure proper conditioning, storage, handling and exposure of welding consumables per SA requirements, including inspection and testing of incoming materials, storage temperature and humidity control, and practice of issuing consumables

The machine shop for sample preparation shall have cutting and machining equipment, controlled drawings, and notch sample preparation as applicable.

The mechanical and chemical testing shall be as required by standards, examples: tensile, bending, hardness and impact testing, chemical analysis, metallographic sample preparation, and calibration of equipment.

The manufacturer shall ensure proper machining of end bevels.

Pipe end beveling shall be performed by beveling machines with proper capacity, bevel drawing, bevel appearance, and inspection.

The dimensional and final Inspection activities shall be done by the manufacturer. This includes testing, such as visual inspection of internal and outer diameters, dimensional measurements, tolerances, ultrasonic testing gauge, positive material identification, and traceability per the traveler sheet shall be done by the manufacturer.

The manufacturer shall ensure that the marking system is performed as per requirements with consideration to durability of marking.

The manufacturer shall ensure that a traceability system includes review of heat numbers, lot numbers, material test certificates, marking, and segregations.

The manufacturer shall ensure that manufacturing activities have proper protection, storage and transportation using protective coating, packing, documentations, and shipping practices per SA requirements.

The machine shop for sample preparation shall include cutting and machining equipment, availability of controlled drawings, and notch sample preparation as applicable.

The mechanical and chemical testing shall be as required by standards, examples: tensile, bending, hardness and impact testing, chemical analysis, metallographic sample preparation, and calibration of equipment.

The manufacturer shall ensure proper conditioning, storage, handling and exposure of welding consumables per SA requirements, including inspection and testing of incoming materials, storage temperature and humidity control, practice of issuing consumables

## 5.2 Required Certifications

The following are examples of the qualifications and certifications required, depending on the standard requirements as applicable:

- Valid API 5L license for pipes manufactured in accordance with API 5L specification.
- Manufacturing procedure qualifications.
- NDE procedures qualifications.
- Qualifications and certification levels of NDT personnel level III (technicians and operators, in NDE methods such as magnetic particle testing, liquid penetrant testing, ultrasonic testing, and radiographic testing).

## 5.3 Specifications

The manufacturer shall comply with international codes and Saudi Aramco standards, such as API-5LD and holding a valid license, 01-SAMSS-048, API-5LD License, and 01-SAMSS-044.

# 6. Weld Overlay Spool

## 6.1 Critical Manufacturing Processes

### 6.1.1 Raw Material Handling:

The incoming raw materials shall be inspected for compliance with applicable SAMSS, and referenced to international and industry standard requirements. Proper inspection shall be conducted for a review of material test certificates, review of MTC's, marking, segregation and traceability.

### 6.1.2 Fabrication and Welding:

The manufacturer shall have auto weld overlay and girth welding with qualified welding procedures, procurement of welding consumables, qualified welders and operators. The welding processes shall be controlled throughout the processes.

### 6.1.3 Finishing and Testing:

The manufacturer shall perform Non Destructive Examinations with proper procedures, qualified and certified personnel, required calibration of NDE, control of records and reports, examination coverage as per applicable SAMSS and international codes. The manufacturer shall conduct dimensional measurements of the pipe.

Hydro testing shall be performed with proper safety measures and hydro testing procedures, using adequate illumination levels, pressure gauges, capacity of hydro tester, timer and duration, calibration, and end seals

The manufacturer shall ensure establishing a marking system per requirements, and ensure durability of the marking.

The manufacturer shall establish a proper traceability system identifying as a minimum, the heat number, lot number, MTC's, marking, and segregations.

The manufacturer shall ensure proper protection, storage and transportation using protective coating, packing, and shipping practices per SA requirements.

The manufacturer shall ensure proper conditioning, storage, handling and exposure of welding consumables per SA requirements, including inspection and testing of incoming materials, storage temperature and humidity control, and practice of issuing consumables

The machine shop for sample preparation shall have cutting and machining equipment, controlled drawings, and notch sample preparation as applicable.

The mechanical and chemical testing shall be as required by standards, examples: tensile, bending, hardness and impact testing, chemical analysis, metallographic sample preparation, and calibration of equipment.

## 6.2 Required Certifications

The following are examples of the qualifications and certifications required, depending on the standard requirements as applicable:

- Manufacturing procedure qualifications.
- NDE procedures qualifications.
- Qualifications and certification levels of NDT personnel level III (technicians and operators, in NDE methods such as magnetic particle testing, liquid penetrant testing, ultrasonic testing, and radiographic testing).

### 6.3 Specifications

The manufacturer shall comply with applicable ASTM specifications and 01-SAMSS-044.

## 7. Tubes

### 7.1 Critical Manufacturing Processes (Seamless and Welded)

The manufacturer shall be able to perform the following manufacturing operations processes in-house:

#### 7.1.1 Raw Material Handling:

The incoming raw materials shall be inspected for compliance with applicable SAMSS, and referenced to international and industry standard requirements. Proper inspection shall be conducted for a review of material test certificates, marking, segregation and traceability.

#### 7.1.2 Piercing (FOR SEAMLESS TUBES ONLY):

The manufacturer shall be able to perform hot rolling (piercing), hot extrusion, cold drawing and pilger milling as applicable.

#### 7.1.3 Forming (FOR WELDED TUBES ONLY):

The manufacturer shall perform the forming in a controlled environment and process in accordance to forming rolls capability and edge preparation, with qualified and experienced manpower. The manufacturer shall carry out dimensional checks and intermediate inspections throughout the process.

#### 7.1.4 Welding (FOR WELDED TUBES ONLY):

The manufacturer shall have qualified welding procedures and welding machine, and welding consumables in accordance to the welding procedures. Welders and welding operators shall be qualified according to the procedure. Welding processes shall be carried out in controlled environments to ensure the parameters are controlled during production.

#### 7.1.5 Heat Treatment:

The manufacturer shall ensure heat treatment is conducted with proper procedures, heating, soaking, quenching, tempering cycles, heating temperature control and measurements, and recording chart.

#### 7.1.6 Finishing and Testing:

Hydro testing shall be performed with proper safety measures and hydro testing procedures, using adequate illumination levels, pressure gauges, capacity of hydro tester, timer and duration, calibration, end seals, recording chart, and water chloride content.

The manufacturer shall perform Non Destructive Testing: UT or Eddy current equipment, other NDE methods as applicable, with proper procedures, qualification of UT operators, availability of level III personal, calibrations, automatic marking of defects, examination coverage and frequency.

Marking (marking system per requirements, durability of marking, etc.), the manufacturer shall ensure the marking system is performed as per requirements and ensure the marking durability for the flanges.

The manufacturer shall establish a proper traceability system identifying as a minimum, the heat number, lot number, MTC's, marking, and segregations.

The manufacturer shall ensure that a traceability system includes review of heat numbers, lot numbers, material test certificates, marking, and segregations.

The manufacturer shall ensure proper protection, storage and transportation using protective coating, packing, documentations, and shipping practices per SA requirements.

The manufacturer shall ensure proper conditioning, storage, handling and exposure of welding consumables per SA requirements, including inspection and testing of incoming materials, storage temperature and humidity control, and best practice of issuing consumables.

The machine shop for sample preparation shall include cutting and machining equipment, availability of controlled drawings, and notch sample preparation as applicable.

The mechanical and chemical testing shall be as required by standards, examples: tensile, bending, hardness and impact testing, chemical analysis, metallographic sample preparation, and calibration of equipment.

#### 7.2 Required Certifications

The manufacturer shall have the following certification and qualifications as applicable: ISO, calibration certificates for all testing machines, qualifications for manufacturing procedure and welding procedures, and NDE procedures qualifications.

### 7.3 Specifications

The manufacturer shall comply with ASTM specifications as applicable and 01-SAMSS-47 for SS tubes.

## 8. Cathodic Protection

### 8.1 Critical Manufacturing Processes

The manufacturer shall ensure the coating thickness (galvanizing) measurements for TR and JB enclosures are:

- CP anode cable pull test for impressed current anodes
- CP cable Holiday testing (18,000 VDC)
- Cable to anode resistance test
- TR heat rise test and insulation current leakage test
- Helium leak test for MMO pyramid anodes
- Pre-packaged (Mg/Zn) anode backfill process
- (HSCI) canister anode manufacturing Process
- 5,000 V insulation leakage test for TR
- Drain test for batteries
- Mg anode capacity testing (ASTM G 97 or equivalent Salam test)
- Al/Zn anode capacity testing (NACE TM 0190 or equivalent Salam test)
- Galvanic anode dry chemical composition testing, electrochemical and solution potential tests
- Impressed current MMO NACE TM 0108 test

### 8.2 Required Certifications

The manufacturer shall obtain the dry chemical composition certifications of all manufactured anodes.

### 8.3 Specifications

Shop drawings for all galvanic and impressed current anode and anode junction box, test station and multipurpose junction boxes.

## II. Non-Metallic Pipe, Flange & Fittings

### 1. Thermoplastic Pipe & Fittings

#### 1.1 Critical Manufacturing Processes

##### 1.1.1 General:

The manufacturing processes' are mainly heat, melting, mixing, and conveying the raw materials into a particular shape which hold that shape during the cooling process. These are the necessary processes to produce solid wall and profile wall pipes, as well as compression and injection molded fittings.

##### 1.1.2 Extrusion:

The manufacturer shall have an extruder to heat melts, mix, and convey the material to the die, where it is shaped into a pipe. Typically a single-screw extruder is used. The quality of the end product pipe depends on the extruder screw design. The mixing sections of the screw are important for producing a homogeneous mix that forms the pipe.

The manufacturer shall ensure the resin is pneumatically conveyed from the silos to the pipe extruder by a vacuum transfer system.

In one form of this process, the extruded profile is wrapped around a mandrel. As the mandrel rotates, the extruded profile is wrapped such that each turn overlaps the previous turn. In some other techniques, the turns are not overlapped.

##### 1.1.3 Cooling:

The manufacturer shall ensure the pipe must be cool enough so that it maintains its circularity before it exits the cooling tank. Various methods of cooling are utilized to remove the residual heat out of the PE pipe. Depending upon the pipe size, the system may use either total immersion or spray cooling. Spray cooling is usually applied to larger diameter pipes where total immersion would be inconvenient. Smaller diameter pipes are usually immersed in a water bath.

##### 1.1.4 Pulling:

The manufacturer shall ensure the pullers provide the necessary force to pull the pipe through the entire cooling operation. It also maintains the proper wall thickness control by providing a constant pulling rate. The rate at which the pipe is pulled, in combination with the extruder screw speed, determines the wall

thickness of the finished pipe. Increasing the puller speed at a constant screw speed reduces the wall thickness, while reducing the puller speed at the same screw speed increases the wall thickness.

#### 1.1.5 Manufacturing Fittings:

The manufacturer should produce the fittings by either:

- Injection molding machine;
- Compression molding machine; or
- Fabricated fittings which are made from pipe sections welded together.

#### 1.1.6 Testing:

The manufacturer shall ensure the following tests are carried out:

- Hydrostatic testing of the pipe and fittings.
- Dimensional measurement.

#### 1.1.7 Packing:

The manufacturer shall ensure to carry out the following packing requirements:

- Small size pipe ( $\leq 6"$ )
  - Pipe can be coiled for handling and shipping convenience.
  - Packing equipment allows the pipe to be coiled in various lengths.
- Large size pipe ( $>6"$ )
  - Pipe usually cut into typical lengths of 40 to 50 feet to allow storage and shipping by rail or truck.
  - The pipe is usually bundled before it is placed on the truck or railcar.
  - Bundling provides ease of handling and safety during (un)loading.

### 1.2 Required Certifications

The manufacturer shall have the FM certificate for pipe and fittings used in underground firewater systems. The manufacturer shall have the NSF certificate for potable and raw water.

### 1.3 Specifications

The manufacturer shall comply with ISO 4427, Part 1, 2, 3 and 5.

## 2. Elastomeric lined Tanks & Vessels

### 2.1 Critical Manufacturing Processes

#### 2.1.1 General

The tank and vessel elastomer lining is usually carried out in a factory or on site, but in either case usually involves the following operations:

- Clean out the tank/vessel (usually by steam)
- Prepare the tank/vessel surface (usually by shot blasting)
- Apply rubber solution, or bonding agent (usually toluene or n-hexane based)
- Place sheets of rubber in position (sometimes pre-warmed)
- Vulcanize (using hot water or steam)

#### 2.1.2 Internal Mixing:

The manufacturer shall ensure the raw ingredients are fed into an enclosed mixing chamber via a feed hopper and mixed by the shearing action of two winged rotors and the walls of the mixing chamber. The manufacturer shall ensure the mixed compound is discharged via a sliding or hinged door below the mixing chamber, usually onto a two-roll mill, roller die, twin-screw extruder, conveyor, skip hoist, or wheeled truck.

#### 2.1.3 External or Open Mill Mixing (horizontal two roll mills):

The operator shall place the various ingredients in the nip formed between the rolls, mixes the compound by cutting it off the rolls and re-feeding it into the nip until all the ingredients are added. The mills are used not only for blending of compound (open mill mixing) but also warming of pre-mixed compound (known as warming or cracker mills), or for cooling compound mixed in an internal mixer (known as dump mills).

#### 2.1.4 Extrusion:

The manufacturer shall ensure the extrusion involves forcing uncured rubber through a die under pressure to form a shaped profile or sheet. The rotating knives can then convert extruded material into pellets or slugs for further processing. The rubber can be dumped direct from an internal mixer into an extruder below it as an alternative to two roll mills for feeding calendars. An extruder feeding directly into a two-roll calendar is known as a roller die extruder.

### 2.1.5 Calendar:

The manufacturer shall use a calendar machine with a number of horizontal rolls (sometimes called bowls), heated or unheated, through which material and/or rubber is passed under pressure. They can create either a rubber sheet of a required thickness that could be used for tank and vessel lining, or apply a thin layer of rubber onto a cloth liner.

### 2.1.6 Rubber lining operations:

The manufacturer shall ensure that a rubber sheet is bonded to metal components including valves, pipes, tanks, vessels, and rollers, and then vulcanized to provide a tough, corrosion resistant lining.

### 2.1.7 Autoclaves:

The manufacturer shall use autoclaves, known as 'curing pans' or 'vulcanizers', pressure vessels filled with steam that are used to cure medium size elastomer lined tanks/vessels and rubber articles not contained in molds.

## 2.2 Required Certifications

A test certificate, signed and dated by the contractor shall be provided with each unit and shall contain, but shall not necessarily be limited to, the following information:

- The contractor's name
- The contractor's job number/reference number
- The customer's company name
- The customer's order reference number
- The unit description
- The unit's identification number

## 2.3 Specifications

The manufacturer shall comply with the following:

- 01-SAMSS-041 "Specification for Lining of Tanks and Vessels with Elastomeric Materials".
- BS 6374-5 "Lining Equipment with Polymeric Material for the Process Industries Part 5: Lining with Rubbers".
- DIN EN 14879Organic coating systems and linings for protection of industrial apparatus and plants against corrosion caused by aggressive media.

### 3. Reinforced Thermoplastic Pipe (RTP)

#### 3.1 Critical Manufacturing Processes

##### 3.1.1 General

The RTP comprises of high performing inner and outer plastic pipe layer with high strength reinforcement in the middle. The pipe is generally spoolable and manufactured in lengths up to 1.5 KM.

##### 3.1.2 Liner Extrusion:

The manufacturer shall ensure the liner extrusion, polymeric liner, is manufactured by using direct extrusion. Long length liner is manufactured and wrapped over a reel.

##### 3.1.3 Reinforcement Layer Interweaving:

In the middle layer, reinforcement (glass fiber, aramid, steel cord/strip) are helically wrapped. In some RTP construction, the thermoplastic liner is reinforced with glass fibers which are orbitally wound, and embedded in a thermoset matrix material.

##### 3.1.4 Jacket Extrusion

The manufacturer shall ensure jacket extrusion over the reinforcement so as to protect from external damage.

##### 3.1.5 Testing:

The manufacturer shall ensure the following tests are carried out: hydro testing jig, high temperature oven, and high pressure burst equipment.

#### 3.2 Required Certifications

- MRS test report/certificate of thermoplastic material from raw material manufacturer.
- RTP pipe testing is executed in accordance with API Recommended Practice 15S or Specification API 17J; all qualification tests must be either witnessed or carried out by a third party.

### 3.3 Specifications

The manufacturer shall comply with the following:

- API Recommend Practice 15S, Qualification of Spoolable Reinforced Plastic Line Pipe.
- ANSI/API Specification 17J, Specification for Unbonded Flexible Pipe.

## 4. Thermoplastic Lined Piping

### 4.1 Critical Manufacturing Processes

Various technologies can be used in lining process including roto molding, micro-powder paste extrusion, transfer molding, and isostatic molding. However, rotomolding is preferably used industrywide.

Rotomolding: rotational molding, also called rotomolding or rotocast is a process that places chemically modified thermoplastic powdered resin into a hollow mold and then rotating that mold bi-axially in an oven forms a bond with metals. The bonded plastic can be used to line metal vessels, tanks, pipes or other components for corrosion protection and chemical resistance.

PTFE, PFA, EFTFE, PP, PVDF, ECTFE and HDPEX materials are normally used in lined pipe and fittings.

### 4.2 Required Certifications

All qualification tests must be either witnessed or carried out by third party.

### 4.3 Specifications

The manufacturer shall comply with the following:

01-SAMSS-025 - Specification for Heavy Duty Polytetrafluoroethylene (PTFE) and Perfluoroalkoxy (PFA) Lined Carbon Steel Pipe and Fittings.

## 5. Subsea Flexible

### 5.1 Critical Manufacturing Processes

#### 5.1.1 Carcass Profile:

The manufacturer shall ensure the carcass is a corrugated metallic tube with a specified internal diameter.

The carcass is then taken upon a reel, ready for the extrusion operation. The carcass supports the extruded fluid barrier and prevents collapse from pressure or crushing loads applied during pipe operation.

#### 5.1.2 Polymer Fluid Barrier Extrusion:

The manufacturer shall ensure the carcass is passed through the extruder cross-head, where the resin melts is applied over the carcass.

The control of extruder volume and line speed, coupled with use of specially sized dies; determine the thickness of the wall around the carcass.

The High Density Polyethylene (HDPE), Nylon (PA11 or PA12), or polyvinylidene fluoride (PVDF) as well as other polymers can be applied in this process depending service fluid.

#### 5.1.3 Pressure Armor:

The manufacturer shall ensure the pressure armor is a shaped, rolled, carbon steel wire which is preformed and interlocked as it is wound around the pipe, providing a smooth, flexible, continuous layer to support the barrier and increase pipe burst pressure.

When design and pressure requirements demand higher burst strengths, Flexpress, a wide flat wire, may be wound over the armor layer.

#### 5.1.4 Taping Head:

The manufacturer shall ensure tape heads are suitable for application of either two or four tapes.

The manufacturer shall ensure that a fabricated steel frame supports the rotating head.

The following tapes are applied as manufacturing aids:

- Anti-birdcaging (Deepwater)
- Anti-wear (Dynamic Risers)
- Thermal Insulation.

#### 5.1.5 Tensile Armor:

The manufacturer shall ensure that a layer of helical steel armor wires to the pipe. The flat wires increase burst strength and give the pipe axial strength.

There are two machines that apply the flat wire contra-helically. The flat wire can be of various sizes and tensile strengths depending on the pipe design.

As the wire is applied, it runs through preform tooling heads which twist the wire so it lays flat against the pipe's surface.

#### 5.1.6 Insulation Application:

The manufacturer shall ensure that the first layer melt is extruded onto the pipe and the second layer wrapped onto the pipe.

#### 5.1.7 Outer Sheath Extrusion:

The manufacturer shall ensure the outer sheath is an external polymer barrier applied to resist mechanical damage and intrusion of seawater. These could be HDPE (PE100), & PA-11 or PA-12 Metallic components; Stainless 304L, 316 L and Duplex & AL6XN.

#### 5.1.8 Testing:

The manufacturer shall ensure unbonded flexible pipe testing is executed in accordance with API Recommended Practice 17B, including three classes of test types:

- Class I – basic tests identifying ultimate capacity under simple loading.
- Class II – tests verifying specific aspects of a flexible pipes performance.
- Class III – tests characterizing the flexible pipe behavior.

The manufacturer shall ensure conducting factory acceptance tests in accordance with API 17 J, including: gauge test, hydro test, electrical continuity/resistance, and gas venting test. All tests must be either witnessed or carried out by a third party.

#### 5.1.9 Packing:

The pipe can be coiled in a carousel for handling and shipping convenience.

## 5.2 Required Certifications

The manufacturer shall have API 17J certification - Specification for Unbonded Flexible Pipe

## 5.3 Specifications

The manufacturer shall comply with the Flexible Pipe Standards:

- API 17J - Specification for Unbonded Flexible Pipe
- ISO 13628 - Petroleum natural gas industries - drilling and production equipment - design and operation of subsea system-Part 2: Flexible pipe systems for subsea and marine applications
- Bureau Veritas NI 364 DTO ROO E - Non-bonded Flexible Steel Pipes used as Flowlines
- DNV Rules for Flexible Pipe
- RP17B - Recommended Practice for Unbonded Flexible Pipe

### III. Valves

#### 1. Critical Manufacturing Processes

##### 1.1 General:

The manufacturer shall ensure the sub-manufacturers and outsourcing activities lists shall be approved, controlled, and monitored by the vendor.

The manufacturer shall have packaging equipment with the capability to perform packaging activities. Also, the facility shall have a suitable storage area.

##### 1.2 Design:

The manufacturer shall have an engineering department to handle/perform design, material selection, stress analysis, torque calculation, and other related design activities.

##### 1.3 Machining:

The manufacturer shall have machining capabilities including, but not limited to, equipment (e.g. vertical and horizontal CNC machines), personnel, and skills.

##### 1.4 Assembly:

The manufacturer shall have the capabilities to perform assembly activities including, but not limited to, equipment, personnel, and skills. The equipment includes crane, and assembly benches equipped with the needed tools, etc.

##### 1.5 Welding:

The manufacturer shall have the capabilities to perform welding activities including, but not limited, to equipment, personnel, and skills.

##### 1.6 Testing:

The manufacturer shall have the capabilities to perform testing activities including, but not limited to, equipment, personnel, and skills. Testing equipment shall be able to perform pressure and functional tests, production tests and nondestructive testing.

1.7 Coating/Painting:

The manufacturer shall have the capability for coating and painting valves including, but not limited to, equipment, personnel, and skills. Also, the facility shall have a suitable drying area.

2. Required Certifications

The manufacturer shall comply with applicable API certifications or equivalent, as specified in applicable SAMSS.

3. Specifications

The manufacturer shall be able to comply with the applicable Saudi Aramco Material Specifications, including 04-SAMSS-35 and 04-SAMSS-48.

## IV. Coating

### 1. FBE Piping Coating

#### 1.1 Critical Manufacturing Processes

##### 1.1.1 General:

The manufacturer shall have the plant design developed by specialized companies. The manufacturing facility shall have an electronically controlled conveyor to transfer pipes safely during the coating application process. The transferring conveyor wheels should have high abrasion/temperature resistance to prevent pipe contamination. The manufacturing plant shall have adequate lighting and capacity to enable proper inspection.

##### 1.1.2 Surface Preparation:

The manufacturer shall have a control room to monitor the surface preparation process during the manufacturing process. The manufacturer shall have two blasting units connected with a dust collector and recycling system.

##### 1.1.3 Coating Application:

The manufacturer shall have a control room to monitor the coating application process and ensure to have induction heating units that can provide deep heat penetration for external FBE.

Gas burning oven to provide the required heat for internal FBE application.

The manufacturer shall use a thermometer to measure pipe surface temperatures before coating application and shall ensure a FBE loading hopper is connected to a pressurized air source to fluidize the powder and transfer it through hoses to the static spray guns to be applied on the pipe surface.

The manufacturer shall have a quenching station to cool the coated pipes surface to a temperature less than 85°C.

The manufacturer shall ensure the FBE is removed from the cut back at pipe ends.

#### 1.1.4 Inspection:

The manufacturer shall ensure having a dedicated area for surface preparation inspection. The manufacturer shall ensure the final inspection area is equipped with full circle spring electrode for pinhole inspection, DFT gauge, and adhesion tester.

#### 1.1.5 FBE Storage Area

The manufacturer shall ensure FBE is stored in a controlled environment where the FBE storage room is sealed and FBE is stored at a temperature less than 18°C.

#### 1.1.6 Laboratory:

The manufacturer shall ensure the laboratory is equipped with the required equipment to measure differential scanning calorimetry, density, cathodic disbondment, hardness, FBE moisture contents, grit material sieve analysis, FBE porosity, hot water test, FBE particle size, gel time, flexibility, and abrasive salt contamination.

#### 1.1.7 Coated Pipe Storage and Handling

The manufacturer shall ensure having the proper handling equipment and adequate storage yard for coated pipes.

### 1.2 Required Certifications

The manufacturer's technical manager and operation supervisors should be SSPC/NACE certified coating inspector level III and have project management experience. The manufacturer's operator should be SSPC/NACE certified coating inspector level II. Lab technicians within the manufacturing facilities should have proper training to conduct the required testings'.

### 1.3 Specifications

The manufacturer shall comply with international and Saudi Aramco standards, such as SSPC/NACE/CSA/ISO/09-SAMSS-089/91.

## 2. FBE Rebar Coating

### 2.1 Critical Manufacturing Processes

#### 2.1.1 General:

The manufacture shall have the plant design developed by specialized companies. The manufacturing facility shall have an electronically controlled conveyor to transfer rebars safely during the coating application process. The manufacturing plant shall have adequate lighting capacity to enable proper inspection.

#### 2.1.2 Surface Preparation:

The manufacturer shall have a control room to monitor the surface preparation process during surface preparation and coating application processes. The manufacturer shall ensure conducting rebar initial cleaning at a dedicated station by using solvent, water, and wash.

The manufacturer shall have in-line automated blasting facilities with abrasive recycling facilities and an in-line automated air blower station. In the plant, the manufacturer shall ensure having a dedicated area for surface preparation inspection.

#### 2.1.3 Coating application:

The manufacturer is required to have a control room to monitor the coating application processes.

The manufacturer shall have an induction heating units with control panel to provide required heat for FBE curing.

The manufacturer shall use a thermometer to measure pipe surface temperature before coating application.

The manufacturer shall ensure that pre-heating of induction coils is done using control panel for monitoring and controlling.

The FBE loading hopper within the manufacturing plant shall be connected to a pressurized air source to fluidize the powder and transfer it through hoses to the static spray guns to be applied on pipe surfaces.

The manufacturer shall ensure to have a quenching station to cool the coated pipes surface to less than 85°C.

#### 2.1.4 Inspection:

The manufacturer shall ensure having a dedicated area for coating final inspection.

The manufacturer shall ensure the final inspection area is equipped with in-line automated holiday detectors for pinhole inspection, DFT gauge, adhesion tester, grit sieve analysis, and copper, sulfate, chloride, and dust contamination in-line testing.

#### 2.1.5 FBE Coating Storage Area:

The manufacturer shall ensure the FBE storage area is well sealed and FBE is stored at a temperature less than 18°C.

#### 2.1.6 Laboratory:

The manufacturer shall ensure the laboratory is equipped with the required equipment to measure differential scanning calorimetry, density, cathodic disbondment, hardness, FBE moisture contents, FBE particle size, FBE porosity, gel time, flexibility, and abrasive salt contamination.

#### 2.1.7 Storage and handling:

The manufacturer shall ensure having the proper equipment to ensure correct storage and handling. This includes an overhead crane, proper handling equipment, and an adequate storage yard for black (incoming) and coated rebars.

### 2.2 Required Certifications

The manufacturer shall have a technical manager and operation supervisors to SSPC/NACE certified coating inspector level III and should have similar industrial experience.

The manufacturer operators should be SSPC/NACE certified coating inspector level II.

The manufacturer lab technicians should have proper training to conduct the related lab testing.

### 2.3 Specifications

The manufacturer shall comply with international and Saudi Aramco standards such as SSPC, NACE, CSA, ISO, ASTM, and 09-SAMSS-106.

### 3. Liquid Coating

#### 3.1 Critical Manufacturing Facilities and Processes

The manufacturing facilities should be designed, laid out and developed by specialized companies. The space within the plant should be adequate for safe movement of people and materials with proper ventilation and lighting with provision for continuous batch operation.

The manufacturer shall utilize a conveyor system or adequate forklifts for safe transfer of materials during surface preparation, coating application, drying, storage, and shipment/delivery.

##### 3.1.1 Surface Preparation:

The manufacturer shall conduct the surface preparation within an enclosed blasting chamber with dust collector and recycling system.

The manufacturer should have blasting units connected to a dust collector and recycling system.

##### 3.1.2 Coating application:

The manufacturer shall perform adequate coating applications by having proper coating preparation and mixing, airless spray equipment for coating application, coating drying with protection from contaminants, and ventilation system within the plant.

##### 3.1.3 Inspection:

The manufacturer shall ensure to have a dedicated area for surface preparation and coating final inspections.

The manufacturer shall ensure that the dedicated inspection area is equipped with in-line automated hole detectors for pinhole inspection, DFT gauge, adhesion tester, grit sieve analysis, and copper, sulfate, chloride, and dust contamination in-line testing.

##### 3.1.4 Coating Storage area

The manufacturer shall ensure warehouse or material storage rooms have controlled environments with temperature and humidity monitoring and control capabilities.

### 3.1.5 Laboratory:

The manufacturer shall ensure the laboratory is equipped with the required equipment.

### 3.1.6 Storage and Handling:

The manufacturer shall ensure utilizing proper handling equipment and having an adequate storage yard for coated materials.

## 3.2 Required Certifications

The manufacturer shall have the following certified personnel: technical manager and QC supervisor should be SSPC/NACE certified coating inspector level III, and coating inspectors should be SSPC/NACE certified coating inspector level II. Lab technicians should have proper training to conduct the tests.

## 3.3 Specifications

The manufacturer should comply with international and Saudi Aramco standards such as SSPC/NACE/ISO/SAES-H-001/002.

# 4. Cement Internal Lining (Pipes)

## 4.1 Critical Equipment & Manufacturing Processes

### 4.1.1 General:

The lining service provider shall have a minimum of three years of cement lining experience.

Cement mortar compressive strength testing may be outsourced to SA approved testing agencies.

### 4.1.2 Design & Engineering:

Design and drafting activities are not required.

### 4.1.3 Raw Material:

The raw materials cement, sand, water, admixtures, and welded wire reinforcement (for fittings) should conform to the material specifications provided in company material standard specification 01-SAMSS-005.

#### 4.1.4 Cement Lining:

The overhead cranes, fork lifts, and slings should be available for safe handling and storing of materials in the shop.

The shop should be well equipped with machinery and tools for cement lining application.

The internal surface of pipes to be cement lined, shall be cleaned and profiled for a good mechanical bond. Mill scale and debris can be removed using hand tools (ST2) and/or abrasive blasting.

The lining is applied through a centrifugal applicator without any interruption. Telescopic trowels are used to compact the lining as the applicator is retracted at a constant rate from larger spools. Plug trowels are used for smaller pipes. Alternatively pipe may be spun, however, care should be taken to ensure that segregation of cement mortar mix is avoided.

#### 4.1.5 Traceability:

The pipe shall be marked for identification and traceability.

#### 4.1.6 Inspection & Testing:

The inspection tools and equipment like tapes, mallet, Vernier caliper, micrometers, magnifying glass, angle, torch light, and thickness gauge should be available for use.

### 4.2 Required Certifications

The manufacturer shall ensure to have the following certifications:

- Concrete Laboratory Testing Technician - American Concrete Institute
- Blasters and Coaters: Certified by Saudi Aramco approved paint manufacturers.

### 4.3 Specifications

The manufacturer shall comply with the following specifications:

- American Water Works Association AWWA C205.
- 01-SAMSS-005.

## V. Gaskets

### 1. Critical Manufacturing Processes

#### 1.1 Raw Material Handling:

To ensure conformity, the manufacturer shall conduct testing of received material, chemical and mechanical. All sub-manufacturers and outsourced activities shall be approved, controlled and monitored by the manufacturer.

#### 1.2 Cutting:

The manufacturer shall have the capabilities to perform accurate cutting with trained skillful personnel.

#### 1.3 Machining:

The manufacturer shall have machining capabilities including, but not limited to, equipment (such as CNC machines, etc...), personnel and skills.

#### 1.4 Packing:

The manufacturer shall have packing equipment with the capability to perform packaging activities.

#### 1.5 Storing & Delivery:

The manufacturer shall store the final product in a good environment, and shall have a clear preservation plan for delivered products.

### 2. Required Certifications

The manufacturer shall provide processes on all mill certificates, provide evidence of drawings compliance to ASME B16.20 for Metallic, and ASME B16.21 for Non-Metallic.

### 3. Specifications

The manufacturer shall be able to comply with ASME B16.20, ASME B16.21, API or BS or ISO as applicable.

## VI. Static Equipment

### 1. Shell-and-Tube Heat Exchanger

#### 1.1 Critical Manufacturing Processes

##### 1.1.1 Design:

The manufacturer shall have an engineering unit with access to engineering design and qualified engineers, who have experience in thermal and mechanical design of shell and tube heat exchangers as well as supporting manufacturing activities.

##### 1.1.2 Raw Material Handling:

The incoming raw materials shall be inspected for compliance, including review of materials certificates, marking, storage practice/segregation, and traceability. Furthermore, the manufacturer shall ensure proper storage and segregation.

The manufacturer shall procure all components including bare tubes, fittings, pipes, and flanges from Saudi Aramco approved manufacturers.

The manufacturer shall ensure that the plates intended for sour service or cladded plates, shall be procured from Saudi Aramco approved mills.

##### 1.1.3 Rolling:

The manufacturing facility shall have the capability to perform in-house rolling of plates. The manufacturer shall ensure that the rolling machine capacity is adequate for defect-free rolling for the intended thickness of the plates.

##### 1.1.4 Cutting:

The manufacturer shall perform plate cutting and beveling with proper machine capacity, bevel drawing, bevel appearance, and inspection.

##### 1.1.5 Machining:

The manufacturer shall be capable of conducting machining process in-house and then, related inspection activities shall be carried out to confirm the process is done in accordance with engineering drawings.

1.1.6 Tubesheet Fabrication:

The manufacturer shall perform tubesheet drilling, milling and finishing process, in addition to tube-to-tubesheet expansion.

1.1.7 Welding:

The manufacturer shall have welding machines applicable for seam welds and tube joints (Stick, TIG, etc.). Also, the manufacturer shall have the capability to perform different welding processes by using the correct and qualified welding procedures.

1.1.8 Heat Treatment:

The manufacturer shall ensure heat treatment is conducted with proper procedure, heating temperature control and measurements, and recording chart. The heat treatment may be outsourced.

1.1.9 Pressure Testing:

The manufacturer shall conduct pneumatic/hydro testing within the facility. The hydro testing shall be performed with proper safety measures and by qualified personnel.

1.1.10 Nondestructive Testing:

The manufacturer shall have the capabilities for perform liquid penetrant, magnetic particle, and radiographic testing etc. The manufacturer may subcontract this process to qualified testing companies.

1.1.11 Painting:

The manufacturer shall be capable of preparing and applying coating/painting or alternatively subcontract this process to qualified companies. The coating shall be performed in a controlled environment as required by specifications.

1.2 Required Certifications

The manufacturer shall comply with applicable ASME certification U, U2, R.

1.3 Specifications

The manufacturer shall be able to comply with the applicable ASME code, API-660 specification, and the applicable Saudi Aramco Material Specifications 32-SAMSS-007.

## 2. Air-Cooled Heat Exchanger

### 2.1 Critical Manufacturing Processes

#### 2.1.1 Design:

The manufacturer shall have an engineering unit with access to engineering design with qualified engineers, experienced in thermal and mechanical design of air cooled heat exchanger as well as supporting manufacturing activities.

#### 2.1.2 Raw Material Handling:

The incoming raw materials shall be inspected for compliance including review of materials certificates, marking, storage practice/segregation, and traceability.

Furthermore, the manufacturer shall ensure proper storage and segregation.

The manufacturer shall procure all flanges, fittings, bare tube and piping for use as integral parts of exchanger shall be purchased from Saudi Aramco approved sources.

The manufacturer shall ensure that the plates intended for sour service or cladded plates shall be procured from Saudi Aramco approved mills.

#### 2.1.3 Welding:

The manufacturer shall have welding machines applicable for seam welds and tube joints (Stick, TIG, etc.).Also, the manufacturer shall have the capability to perform different welding processes by using the correct and qualified welding procedures.

#### 2.1.4 Heat Treatment:

The manufacturer shall ensure heat treatment is conducted with proper procedure, heating temperature control and measurements, and recording chart. The heat treatment may be outsourced.

### 2.2 Required Certifications

The manufacturer shall comply with applicable ASME certification U, U2, R.

### 2.3 Specifications

The manufacturer shall be able to comply with the applicable ASME code, API-661 specification and the applicable Saudi Aramco Material Specifications 32-SAMSS-011.

### 3. Scraper Traps

#### 3.1 Critical Manufacturing Processes

##### 3.1.1 Raw Material/Components Handling:

The manufacturer shall procure all components including fittings, pipes, flanges, and structural steel from Saudi Aramco approved manufacturers.

The manufacturer shall ensure that the plates intended for source service or cladded plates, shall be procured from Saudi Aramco approved mills.

##### 3.1.2 Rolling:

The manufacturing facility shall have the capability to perform in-house rolling of plates. The manufacturer shall ensure that the rolling machine capacity is adequate for defect-free rolling for the intended thickness of the plates.

##### 3.1.3 Welding:

The manufacturer shall have the capability to perform different welding processes by using the correct and qualified welding procedures and personnel.

##### 3.1.4 Cutting and Beveling:

The manufacturer shall have the capabilities to perform accurate cutting, beveling, fir-up, and assembly with knowledge and experienced personnel.

##### 3.1.5 Nondestructive Testing:

The manufacturer shall have the capabilities to perform liquid penetrant, magnetic particle, and radiographic testing, etc. The manufacturer may subcontract this process to qualified testing companies.

##### 3.1.6 Post-Weld Heat Treatment:

The manufacturer shall have the capabilities to perform post-weld heat treatment or alternatively, subcontract this process to qualified testing companies.

##### 3.1.7 Coating:

The manufacturer shall be capable of preparing and applying coating, or alternatively, subcontract this process to qualified companies. The coating shall be performed in a controlled environment as required by specifications.

### 3.2 Required Certifications

The manufacturer shall comply with the requirements of ASME SEC VIII D1 section UG-35.

### 3.3 Specifications

The manufacturer shall be able to comply with the applicable Saudi Aramco Material Specifications (SAMSS) including 02-SAMSS-009, and 01-SAMSS-016.

## 4. Pressure Vessels & Tanks

### 4.1 Critical Manufacturing Processes

#### 4.1.1 Raw Material/Components Handling:

The manufacturer shall procure all components including fittings, pipes, flanges, and structural steel from Saudi Aramco approved manufacturers.

The manufacturer shall ensure that the plates intended for sour service or cladded plates shall be procured from Saudi Aramco approved mills.

#### 4.1.2 Rolling:

The manufacturing facility shall have the capability to perform in-house rolling of plates. The manufacturer shall ensure that the rolling machine capacity is adequate for defect-free rolling for the intended thickness of the plates.

#### 4.1.3 Welding:

The manufacturer shall have the capability to perform different welding processes by using the correct and qualified welding procedures and personnel.

#### 4.1.4 Cutting and Beveling:

The manufacturer shall have the capabilities to perform accurate cutting, beveling, fir-up, and assembly with knowledgeable and experienced personnel.

#### 4.1.5 Nondestructive Testing:

The manufacturer shall have the capabilities to perform liquid penetrant, magnetic particle, and radiographic testing, etc. The manufacturer may subcontract this process to qualified testing companies.

#### 4.1.6 Post-Weld Heat Treatment:

The manufacturer shall have the capabilities to perform post-weld heat treatments, or alternatively, subcontract this process to qualified testing companies.

#### 4.1.7 Coating:

The manufacturer shall be capable of preparing and applying coating, or alternatively, subcontract this process to qualified companies. The coating shall be performed in a controlled environment as required by specifications.

### 4.2 Required Certifications

The manufacturer shall have ASME U stamp as a minimum for pressure vessels and U2 for ASME VIII DIV2 vessels.

The manufacturer shall provide the shop layout in order to facilitate sequence of fabrication processes.

### 4.3 Specifications

The manufacturer shall be able to comply with ASME SEC VIII Div1, ASME SEC VIII Div2, and the applicable Saudi Aramco Material Specifications including 32-SAMSS-004, 32-SAMSS-005, 32-SAMSS-006, 32-SAMSS-30, and 01-SAMSS-016.

## 5. Process Heater

### 5.1 Critical Manufacturing Processes

#### 5.1.1 Design:

The manufacturer shall have the capability to perform mechanical design and utilize drawing software.

#### 5.1.2 Raw Material Handling:

The manufacturer shall procure all components including tubes, soot-blowers, and piping material from Saudi Aramco approved manufacturers.

5.1.3 Rolling:

The manufacturing facility shall have the capability to perform in-house rolling. The manufacturer shall ensure that the rolling machine capacity is adequate for defect-free rolling for the intended thickness.

5.1.4 Drilling:

The manufacturer shall have the capability to perform the drilling process per the approved parameters/procedure and by qualified operators.

5.1.5 Welding:

The manufacturer shall have the capability to perform different welding processes by using the correct and qualified welding procedures and personnel. This includes weld and assembly pressure components of fired heaters.

5.1.6 Structural Steel Fabrication:

The manufacturer shall be capable to fabricate the structural steel required as part of fired heaters production processes.

5.1.7 Cutting and Beveling:

The manufacturer shall have the capabilities to perform accurate cutting, beveling, fir-up, and assembly with knowledgeable and experienced personnel.

5.1.8 Nondestructive Testing:

The manufacturer shall have the capabilities for perform liquid penetrant, magnetic particle, radiographic testing, etc. The manufacturer may subcontract this process to qualified testing companies.

5.1.9 Heat Treatment:

The manufacturer shall have the capabilities to perform heat treatment activities with qualified resources.

5.1.10 Assembly:

The manufacturer shall be capable of performing all assembly works of the heaters in-house, utilizing qualified personnel and appropriate machines.

#### 5.1.11 Coating:

The manufacturer shall be capable of preparing and applying coating, or alternatively, subcontract this process to qualified companies. The coating shall be performed in a controlled environment as required by specifications.

### 5.2 Required Certifications

The manufacturer shall have the American Society of Mechanical Engineers ASME certification S and R.

### 5.3 Specifications

The manufacturer shall be able to comply with ASME Section 1, API 560 / 530 and the applicable Saudi Aramco Material Specifications including 32-SAMSS-029.

## 6. Industrial Boilers and HRSG's

### 6.1 Critical Manufacturing Processes

#### 6.1.1 Design:

The manufacturer shall have the capability to perform mechanical design and utilize drawing software.

#### 6.1.2 Components Handling:

The manufacturer shall procure all main components including tubes, soot-blowers, and piping material from Saudi Aramco approved manufacturers.

#### 6.1.3 Rolling:

The manufacturing facility shall have the capability to perform in-house rolling. The manufacturer shall ensure that the rolling machine capacity is adequate for defect-free rolling for the intended thickness.

#### 6.1.4 Drilling:

The manufacturer shall have the capability to perform the drilling process per the approved parameters/procedure and by qualified operators.

6.1.5 Welding:

The manufacturer shall have the capability to perform different welding processes by using the correct and qualified welding procedures and personnel. This includes weld and assembly pressure components of fired heaters.

6.1.6 Cutting and Beveling:

The manufacturer shall have the capabilities to perform accurate cutting, beveling, fir-up, and assembly with knowledgeable and experienced personnel.

6.1.7 Nondestructive Testing:

The manufacturer shall have the capabilities for perform liquid penetrant, magnetic particle, radiographic testing, etc. The manufacture may subcontract this process to qualified testing companies.

6.1.8 Heat Treatment:

The manufacturer shall have the capabilities to perform heat treatment activities with qualified resources.

6.1.9 Pressure Testing:

The manufacturer shall be able to conduct pressure testing, utilizing proper equipment and qualified operators. Testing shall be followed by acceptable dry out to avoid impacting material integrity.

6.1.10 Assembly:

The manufacturer shall be capable of performing all assembly works of the boiler in-house utilizing qualified personnel and appropriate machines.

6.1.11 Coating:

The manufacturer shall be capable of preparing and applying coating, or alternatively, subcontract this process to qualified companies. The coating shall be performed in a controlled environment as required by specifications.

6.2 Required Certifications

The manufacturer shall have the American Society of Mechanical Engineers ASME certification S and R.

### 6.3 Specifications

The manufacturer shall be able to comply with ASME Section 1, the applicable Saudi Aramco Material Specifications including 32-SAMSS-021, 32-SAMSS-035.

## VII. Rotating Equipment

### 1. Packaging

#### 1.1 Critical Manufacturing Processes

The manufacturer shall have full details about packaged equipment, and shall have full details about OEM identity and location. Moreover, any local facility shall be OEM or licensed by a Saudi Aramco approved OEM. Prior providing the manufacturer plant approval for the local facility, the capability of the OEM/licensor shall be surveyed and approved by Saudi Aramco. The manufacturer shall ensure the availability of a Quality Assurance (QA) system to cover all in-house and outsourced manufacturing processes. The engineering control shall be carried out by the manufacturer throughout document and controlled systems/procedures.

The engineering control system/procedure shall cover for example the approval of sub-vendors, flowdown of the received technical requirements, technical issues associated with packaging ...etc. The manufacturer shall ensure the availability of competent and capable engineers to support the packaging activities. Manpower sourcing plan for facility start-up shall be available by the manufacturer for review. All sub-vendors that the packaging facility will be outsourced to, shall be documented in a sub-vendor list.

##### 1.1.1 Welding & Heat Treatment:

The manufacturer shall be able to conduct the required welding for in-house manufactured auxiliary systems. Other welding activities including heat treatment, may be outsourced.

##### 1.1.2 Testing:

The manufacturer shall ensure having shall have pneumatic/hydro testing capability of auxiliary components within the facility

##### 1.1.3 Non-Destructive Testing (NDT):

The manufacturer shall have the capabilities to conduct the NDT(s) such as LP, MP, and PMI. However, another NDT can be outsourced such as UT & RT.

#### 1.1.4 Machining:

Machining processes can be outsourced for packaging related machining activities.

#### 1.1.5 Hard Facing/Metal Coating/Painting:

The manufacturer can outsource any of the following activities: hard facing, metal coating, and painting.

#### 1.1.6 Assembly:

The manufacturing/assembly of the packaged equipment shall be performed by a Saudi Aramco approved facility.

### 1.2 Required Certifications

N/A.

### 1.3 Specifications

The manufacturer shall comply with the applicable standard(s) i.e. SAMSS, API, and ASME for the packaged commodity.

## 2. Manufacturing

### 2.1 Critical Manufacturing Processes

The manufacturer shall have full details about packaged equipment, and shall have full details about OEM identity and location. Moreover, any local facility shall be OEM or licensed by a Saudi Aramco approved OEM. Prior, providing the manufacturer plant approval for the local facility, the capability of the OEM/licensor shall be surveyed and approved by Saudi Aramco. The manufacturer shall ensure the availability of a Quality Assurance (QA) system to cover all in-house and outsourced manufacturing processes. The engineering control shall be carried out by the manufacturer throughout document and controlled systems/procedures. The engineering control system/procedure shall cover, for example, the approval of sub-vendors, flowdown of the received technical requirements, technical issues associated with packaging ...etc. The manufacturer shall ensure the availability of competent and capable engineers to support the packaging activities. Manpower sourcing plans for facility start-up shall be available by the manufacturer for review. All sub-vendors that the packaging facility will be outsourced from, shall be documented in a sub-vendor list. The manufacturer shall have the long term storage of the equipment manuals and documentation.

**2.1.1 Design & Engineering:**

The manufacturer shall have an engineering unit with access to engineering design. The engineering unit shall have qualified engineers who have experience in equipment manufacturing.

**2.1.2 Welding & Heat Treatment:**

The manufacturer shall be able to perform and conduct the required casing weld repairs (except for gas turbines), and welding for in-house manufactured auxiliary systems. Other activities can be outsourced including heat treatment, welding of main flanges and casing fabrication.

**2.1.3 Balancing:**

The manufacturer shall be able to perform rotor balancing in the facility.

**2.1.4 Testing:**

The manufacturer shall conduct the mechanical run tests in the facility except for large gas turbines and steam turbines. The performance test is required to be conducted within the facility for pumps and air compressors. For other commodities, testing can be outsourced with local vendor or done in the Saudi Aramco approved manufacturing facility. The manufacturer shall have the capability to perform pneumatic/hydro testing.

**2.1.5 Non-Destructive Testing (NDT):**

The manufacturer shall have the capabilities to conduct the NDT(s) such as LP, MP, and PMI. However, another NDT can be outsourced such as UT & RT.

**2.1.6 Machining:**

Machining processes can be outsourced for packaging related machining activities.

**2.1.7 Hard Facing/Metal Coating/Painting:**

The manufacturer can outsource any of the following activities: hard facing, metal coating, and painting.

**2.1.8 Assembly:**

The manufacturer shall be able to perform assembly for the components in-house except for machines that will require performance testing out of Kingdom.

## 2.2 Required Certifications

N/A.

## 2.3 Specifications

The manufacturer shall comply with the applicable standard(s) i.e. SAMSS, API, and ASME for the manufactured commodity.

# VIII. Steel Structure

## 1. Structural & Miscellaneous Steel

### 1.1 Critical Equipment & Manufacturing Processes

#### 1.1.1 General:

The manufacturer shall ensure that fabricators have a minimum of 3 years of steel fabrication experience.

Member or connection design may be outsourced to a SA approved General Engineering Service (GES+) contractor.

Painting and coating operations (e.g. organic coatings, hot dip galvanized coatings), may be outsourced to SA approved service providers.

Non-destructive examination of welds may be outsourced to SA approved inspection agencies.

#### 1.1.2 Design & Engineering:

The fabricator shall retain an experienced structural engineer (minimum five years), to design or supervise the design of all fabricator designed connections. The licensed design/drafting software should be available for commercial use.

#### 1.1.3 Raw Material:

Raw materials like plates, sections & profiles, and bars shall be procured from local or international mills or distributors that are ISO certified and have well managed

quality control systems. Material grade and specifications shall conform to company standards.

#### 1.1.4 Manufacturing:

The overhead cranes, fork lifts, slings should be available for safe handling and storing of materials in the shop.

The shop should be well equipped with machinery and tools for plate and profile cutting, shearing, punching, drilling, mitering, coping, beveling, and bending such as the following:

- CNC plasma plate processor
- Oxyacetylene torch (thicker materials)
- CNC or manual drilling machine
- CNC beam line (shearing, beveling, coping, punching, drilling, scribing)
- Sawing/cutting machine
- Angle master (angle processor)
- Hydraulic shear and press brakes
- Pipe bender and bending jigs
- Drill bits, blades, diamond tip tools, nozzles, gas cylinders
- Vice and bench grinders, pencil grinders
- Lathe, shaper, milling (for maintenance or minor fabrication works like cutting or threading or boring) is recommended

The fabrication of steel will involve fitting and welding operations, so appropriate welding equipment should be available for applying tack welds (fitting) and production welds (final), such as:

- Welding equipment (transformers/rectifiers).
- SAW tractor (sub-arc welding) or pull-through.
- Baking oven/holding oven/portable quivers for welding consumables.

#### 1.1.5 Traceability:

The members shall be hard punched (stenciled) for identification and erection purposes. Final products shall be traceable to heat numbers or raw material sources.

#### 1.1.6 Welding:

The welding shall involve the following operations:

- Generating Welding Procedure Specifications as per AWS D1.1/D1.3/D1.8

- Assembly fit-up including tack welding
- Production welding by certified welders
- Conduct Visual Inspections and NDT

#### 1.1.7 Coating:

The painting and coating operations shall be conducted as per company standards. It is recommended that the fabricator has an environmentally controlled facility for conducting blasting and coating operations, which allows continuous operations with minimum risk of contamination. The following equipment should be available at the facility to apply coatings:

- Wheelabrator® for blasting or manual blasting pots
- Painting skids
- Airless spray painting gun assembly

Note: Sand is not allowed as an abrasive media.

#### 1.1.8 Inspection & Testing:

The inspection tools and equipment should be available for use such as: tapes, mallet, Vernier caliper, micrometers, magnifying glass, angle, torch light, welding gauge (TWI), hi-low gauge, fillet weld gauge, ammeter, voltmeter, thermometer, temperature indicating crayons, WFT comb gauge, cross hatch profile cutter, limpet gauge, hygrometer, low voltage holiday detector, surface profile needle gauge, rust grade comparators, and electronic dry film thickness gauge. Calibrated non-destructive testing equipment (MT, UT) should be available for use by certified technicians to conduct non-destructive welding examination.

### 1.2 Required Certifications

The manufacturer shall ensure to have the following certifications:

- Facility Certification: AISC (American Institute of Steel Construction) Fabricator certification is recommended but not mandatory.
- Welding Inspectors: Certified to AWS (American Welding Society) Certified Welding Inspector or equivalent.
- Painting Inspectors: Certified to NACE (National Association of Corrosion Engineers) level 2 or equivalent.
- Blasters and Coaters: Certified by Saudi Aramco approved paint manufacturers.
- NDT Inspectors: Certified to ASNT (American Society of Non-Destructive Testing) SNT-Level II.

### 1.3 Specifications

The manufacturer shall comply with the following specifications:

- 12-SAMSS-007
- AISC (American Institute of Steel Construction) 360/341/358
- AWS (American Welding Society) D1.1/D1.3/D1.8

## 2. Pre-Engineered Steel Buildings

### 2.1 Critical Equipment and Manufacturing Processes

#### 2.1.1 General

The manufacturer shall ensure that a fabricator has a minimum of three years of experience in the business of pre-engineered building design and fabrication.

Hot dip galvanized coating may be outsourced to hot dip galvanizing service providers.

Non-destructive examination of welds may be outsourced to SA approved inspection agencies.

#### 2.1.2 Design & Engineering

The fabricator shall retain experienced structural engineers (minimum two years) to design pre-engineered buildings. Design supervisors should have at least five years of design experience. The licensed design/drafting software should be available for commercial use.

#### 2.1.3 Raw Material:

Raw materials like plates, sections & profiles, bars etc. shall be procured from local or international mills or distributors, which are ISO certified and have a well-managed quality control system. Material grade and specifications shall conform to company standards.

#### 2.1.4 Manufacturing:

The overhead cranes, fork lifts, and slings should be available for safe handling and storing of materials in the shop.

The shop should be well equipped with machinery and tools for plate or sheet de-coiling, profile cutting, shearing, punching, drilling, mitering, coping, beveling and bending, such as the following:

- CNC plasma plate processor
- Oxyacetylene torch (thicker materials)
- CNC or manual drilling machine
- CNC beam line (shearing, beveling, coping, punching, drilling, scribing)
- Sawing/cutting machine
- Angle master (angle processor)
- Hydraulic shear and press brakes
- Pipe bender and bending jigs
- Drill bits, blades, diamond tip tools, nozzles, gas cylinders.
- Vice and bench grinders, pencil grinders
- Lathe, shaper, filling (for maintenance or minor fabrication works like cutting or threading or boring) is recommended
- Brace rod threading machine (cut threads/upset threads)

Secondary steel like roof and wall sheeting; cold formed zee and cee sections shall be fabricated on cold form processing lines. Press brake may be used for forming gutters, downspouts, trims, and base & gable angles such as:

- Cold form secondary line (zee and cee)
- Cold form panel line (roof and wall panel)
- Press brake

The fabrication of steel will involve fitting and welding operations. Appropriate welding equipment should be available for applying tack welds (fitting) and production welds (final), such as:

- Welding equipment (transformers/rectifiers)
- SAW tractor (sub-arc welding) or pull-through
- Baking oven/holding oven/portable quivers for welding consumables

#### 2.1.5 Traceability:

The members shall be hard punched (stenciled) for identification and erection purposes. Final products shall be traceable to heat numbers, or raw material sources.

#### 2.1.6 Welding:

The welding shall involve the following operations:

- Generating Welding Procedure Specifications as per AWS D1.1/D1.3/D.18
- Assembly fit-up including tack welding
- Production welding by certified welders
- Conduct visual inspections and NDT

#### 2.1.7 Coating:

The painting and coating operations shall be conducted as per company standards. It is recommended that the fabricator has an environmentally controlled facility for conducting blasting and coating operations, which allows continuous operations with minimum risk of contamination. The following equipment should be available at the facility to apply coatings:

- Wheelabrator® for blasting or manual blasting pots
- Painting skids
- Airless spray painting gun assembly

Note: Sand is not allowed as an abrasive media.

#### 2.1.8 Inspection & Testing:

The inspection tools and equipment should be available for use such as: tapes, mallet, Vernier caliper, micrometers, magnifying glass, angle, torch light, welding gauge (TWI), hi-low gauge, fillet weld gauge, ammeter, voltmeter, thermometer, temperature indicating crayons, WFT comb gauge, cross hatch profile cutter, limpet gauge, hygrometer, low voltage holiday detector, surface profile needle gauge, rust grade comparators, and electronic dry film thickness gauge. Calibrated non-destructive testing equipment (MT, UT) should be available for use by certified technicians to conduct non-destructive welding examination.

### 2.2 Required Certifications

The manufacturer shall ensure to have the following certifications:

- Facility Certification: IAS (International Accreditation Services) AC472 certification is recommended but not mandatory.
- Welding Inspectors: Certified to AWS (American Welding Society) Certified Welding Inspector or equivalent.
- Painting Inspectors: Certified to NACE International (National Association of Corrosion Engineers) level 2 or equivalent.
- Blasters and Coaters: Certified by Saudi Aramco approved paint manufacturers.

- NDT Inspectors: Certified to American Society of Non-Destructive Testing Level II.

## 2.3 Specifications

The manufacturer shall comply with the following specifications:

- 12-SAMSS-014
- Metal Building Manufacturer Association MBMA 2012
- AISC (American Institute of Steel Construction) 360
- AWS (American Welding Society) D1.1/D1.3/D1.8

## 3. Space Frame

### 3.1 Critical Equipment & Manufacturing Processes

#### 3.1.1 General:

The manufacturer shall ensure that fabricators have a minimum of three years of spaceframe design and fabrication experience.

Member or connection design may be outsourced to SA approved General Engineering Service (GES+) contractors.

Painting and coating operations (e.g. organic coatings, hot dip galvanized coatings) may be outsourced to SA approved service providers.

Non-destructive examination of welds may be outsourced to SA approved inspection agencies.

#### 3.1.2 Design & Engineering:

The fabricator shall retain an experienced structural engineer (minimum two years) for design of space frame members and connections. Design supervisor shall have a minimum five years of design experience. The licensed or proprietary design/drafting software should be available for commercial use. Proprietary software shall be validated using acceptable engineering or testing methods.

#### 3.1.3 Raw Material:

Raw materials like plates, sections & profiles, and bars shall be procured from local or international mills or distributors that are ISO certified and have well managed quality control systems. Material grade and specifications shall conform to company standards.

### 3.1.4 Manufacturing:

The material handling equipment should be available in the shop.

The shop should be well equipped with machinery and tools for plate and profile cutting, shearing, punching, sleeve machining, node drilling and tapping, such as the following:

- CNC plasma plate processor
- Oxyacetylene torch (thicker materials)
- CNC or manual drilling machine for node drilling and tapping
- CNC beam line (shearing, beveling, coping, punching, drilling, scribing)
- Sawing/cutting machine
- Hydraulic shear and press brakes
- Pipe bender and bending jigs
- Drill bits, blades, diamond tip tools, nozzles, gas cylinders
- Vice and bench grinders, pencil grinders
- Lathe, shaper, milling m/c is required for node facetting and planning

The fabrication of space frame member will involve fitting and welding operations. Appropriate welding equipment should be available for applying tack welds (fitting) and production (final) welds, such as:

- Welding equipment (transformers/rectifiers)
- SAW tractor (sub-arc welding) or pull-through
- Baking oven/holding oven/portable quivers for welding consumables

### 3.1.5 Traceability:

The materials shall be hard punched (stenciled) for identification and erection purposes. Final products shall be traceable to heat numbers or raw material sources.

### 3.1.6 Welding:

The welding shall involve the following operations:

- Generating Welding Procedure Specifications as per AWS D1.1
- Assembly fit-up including tack welding
- Production welding by certified welders
- Conduct visual inspections and NDT

### 3.1.7 Coating:

The painting and coating operations shall be conducted as per company standards. It is recommended that the fabricator has an environmentally controlled facility for conducting blasting and coating operations, which allows continuous operations with minimum risk of contamination. The following equipment should be available at the facility to apply coatings:

- Wheelabrator® for blasting or manual blasting pots
- Painting skids
- Airless spray painting gun assembly

Note: Sand is not allowed as an abrasive media.

### 3.1.8 Inspection & Testing:

The inspection tools and equipment should be available for use such as: tapes, mallet, Vernier caliper, micrometers, magnifying glass, angle, torch light, welding gauge (TWI), hi-low gauge, fillet weld gauge, ammeter, voltmeter, thermometer, temperature indicating crayons, WFT comb gauge, cross hatch profile cutter, limpet gauge, hygrometer, low voltage holiday detector, surface profile needle gauge, rust grade comparators, and electronic dry film thickness gauge. Calibrated non-destructive testing equipment (MT, UT) should be available for use by certified technicians to conduct non-destructive welding examination.

## 3.2 Required Certifications

The manufacturer shall ensure to have the following certifications:

- Welding Inspectors: Certified to AWS (American Welding Society) Certified Welding Inspector or equivalent.
- Painting Inspectors: Certified to NACE (National Association of Corrosion Engineers) level 2 or equivalent.
- Blasters and Coaters: Certified by Saudi Aramco approved paint manufacturers.
- NDT Inspectors: Certified to ASNT (American Society of Non-Destructive Testing) SNT-Level II.

## 3.3 Specifications

The manufacturer shall comply with the following specifications:

- 12-SAMSS-007
- AISC (American Institute of Steel Construction) 360
- AWS (American Welding Society) D1.1

## 4. Portable Steel Buildings

### 4.1 Critical Equipment & Manufacturing Processes

#### 4.1.1 General:

The manufacturer shall ensure that fabricators have a minimum of three years of portable steel building design and fabrication experience.

Non-destructive examination of welds may be outsourced to SA approved inspection agencies.

#### 4.1.2 Design & Engineering:

The manufacturer shall retain experienced structural/mechanical/electrical engineers (minimum two years). Design supervisors should have at least five years of design experience. Licensed design/drafting software should be available for commercial use.

#### 4.1.3 Raw Material:

Raw materials like plates, sections and profiles, and bars shall be procured from local or international mills or distributors that are ISO certified and have a well-managed quality control system. Material grade and specifications shall conform to company standards. Only SASO or UL marked Electro-mechanical and plumbing materials shall be procured.

#### 4.1.4 Manufacturing:

The overhead cranes, fork lifts, and slings should be available for safe handling and storing of materials in the shop.

The shop should be well equipped with machinery and tools for plate or sheet de-coiling, profile cutting, shearing, punching, drilling, mitering, coping, beveling and bending, such as the following:

- Oxyacetylene torch
- CNC or manual drilling machine
- Sawing/cutting machine
- Hydraulic shear and press brakes
- Hack saw blades, screw guns
- Pipe bender and bending jigs
- Drill bits, blades, diamond tip tools, nozzles, gas cylinders
- Vice and bench grinders, pencil grinders

Secondary steel like roof and wall sheeting; cold formed cee sections (stud and runner) shall be fabricated on cold form processing lines. Press brake may be used for forming gutters, downspouts, trims, and base and gable angles such as:

- Cold form secondary line (c-studs and runner)
- Cold form panel line (roof and wall panel)
- Press brake

The Fabrication of steel will involve fitting and welding operations. Appropriate welding equipment should be available for applying tack welds (fitting) and production (final) welds, such as:

- Welding equipment (transformers/rectifiers)
- SAW tractor (sub-arc welding) or pull-through
- Baking oven/holding oven/portable quivers for welding consumables

#### 4.1.5 Traceability:

The materials shall be hard punched (stenciled) for identification. Final products shall be traceable to heat numbers or raw material sources.

#### 4.1.6 Welding:

The welding involves the following operations:

- Generating Welding Procedure Specifications as per AWS D1.1/D1.3/D1.8
- Assembly fit-up including tack welding
- Production welding by certified welders
- Conduct Visual Inspections and NDT

#### 4.1.7 Coating:

The painting and coating operations shall be conducted as per company standards. It is recommended that the fabricator has an environmentally controlled facility for conducting blasting and coating operations, which allows continuous operations with minimum risk of contamination. The following equipment should be available at the facility to apply coatings:

- Wheelabrator® for blasting or manual blasting pots
- Painting skids
- Airless spray painting gun assembly

Note: Sand is not allowed as an abrasive media.

#### 4.1.8 Inspection & Testing:

The inspection tools and equipment should be available for use such as: tapes, mallet, Vernier caliper, micrometers, magnifying glass, angle, torch light, welding gauge (TWI), hi-low gauge, fillet weld gauge, ammeter, voltmeter, thermometer, temperature indicating crayons, WFT comb gauge, cross hatch profile cutter, limpet gauge, hygrometer, low voltage holiday detector, surface profile needle gauge, rust grade comparators, and electronic dry film thickness gauge. Calibrated non-destructive testing equipment (MT, UT) should be available for use by certified technicians to conduct non-destructive welding examination.

#### 4.2 Required Certifications

The manufacturer shall ensure to have the following certifications:

- Facility Certification: IAS (International Accreditation Services) AC472 certification is recommended but not mandatory.
- Welding Inspectors: Certified to AWS (American Welding Society) Certified Welding Inspector or equivalent.
- Painting Inspectors: Certified to NACE International (National Association of Corrosion Engineers) level 2 or equivalent.
- Blasters and Coaters: Certified by Saudi Aramco approved paint manufacturers.
- NDT Inspectors: Certified Level II ASNT.

#### 4.3 Specifications

The manufacturer shall comply with the following specifications:

- SAES-M-100
- SAES-S-060
- SAES-K-100
- 12-SAMSS-007; 12-SAMSS-014
- Saudi Aramco Safety Management Guide 07-005
- AISC (American Institute of Steel Construction) 360
- AWS (American Welding Society) D1.1 /D1.3

## 5. Tower; Communication or Transmission

### 5.1 Critical Equipment & Manufacturing Processes

#### 5.1.1 General:

The manufacturer shall ensure that fabricators have a minimum of three years of tower design and fabrication experience.

Painting and coating operations (e.g. organic coatings, hot dip galvanized coatings) may be outsourced to SA approved service providers.

Non-destructive examination of welds may be outsourced to SA approved inspection agencies.

Full scale load testing of transmission towers may be outsourced.

#### 5.1.2 Design & Engineering:

The fabricator shall retain an experienced structural engineer (minimum five years) to design or supervise the design of all fabricator designed connections. The licensed design/drafting software should be available for commercial use.

#### 5.1.3 Raw Material:

Raw materials like plates, angles, channels etc. shall be procured from local or international mills or distributors that are ISO certified and have well managed quality control system. Material grade & specifications shall confirm to company standards.

#### 5.1.4 Manufacturing:

The overhead cranes, fork lifts, and slings should be available for safe handling and storing of materials in the shop.

The shop should be well equipped with machinery and tools for angle processing, shearing, punching, drilling, mitering, coping, beveling and bending such as the following:

- CNC plasma plate processor
- Oxyacetylene torch (thicker materials)
- CNC or manual drilling machine
- Sawing/cutting machine
- Angle master (angle processor)

- Hydraulic shear and press brakes
- Drill bits, blades, diamond tip tools, nozzles, gas cylinders
- Vice and bench grinders, pencil grinders
- Induction heating or furnace for hot bending works
- Bending dies

The fabrication of steel will involve fitting, welding, and bending operations. Appropriate welding equipment should be available for applying tack welds (fitting) and production welds (final), such as:

- Welding equipment (transformers/rectifiers)
- Baking oven/holding oven/portable quivers for welding consumables
- Induction heaters or furnace
- Bending dies

#### 5.1.5 Traceability:

The members shall be hard punched (stenciled) for identification and erection purposes. Final products shall be traceable to heat numbers or raw material sources.

#### 5.1.6 Welding:

The welding shall involve the following operations:

- Generating Welding Procedure Specifications as per AWS D1.1/D1.3/D1.8
- Assembly fit-up including tack welding
- Production welding by certified welders
- Conduct visual inspections and NDT

#### 5.1.7 Coating:

The painting and coating operations shall be conducted as per company standards. It is recommended that the fabricator has an environmentally controlled facility for conducting blasting and coating operations, which allows continuous operations with minimum risk of contamination. The following equipment should be available at the facility to apply coatings:

- Wheelabrator® for blasting or manual blasting pots
- Painting skids
- Airless spray painting gun assembly

Note: Sand is not allowed as an abrasive media.

### 5.1.8 Inspection & Testing:

The inspection tools and equipment should be available for use such as: tapes, mallet, Vernier caliper, micrometers, magnifying glass, angle, torch light, welding gauge (TWI), hi-low gauge, fillet weld gauge, ammeter, voltmeter, thermometer, temperature indicating crayons, WFT comb gauge, cross hatch profile cutter, limpet gauge, hygrometer, low voltage holiday detector, surface profile needle gauge, rust grade comparators, and electronic dry film thickness gauge. Calibrated non-destructive testing equipment (MT, UT) should be available for use by certified technicians to conduct non-destructive welding examination. The transmission towers and gantries are fully scale load tested for design validation and design improvement.

## 5.2 Required Certifications

The manufacturer shall ensure to have the following certifications:

- Welding Inspectors: Certified to AWS (American Welding Society) Certified Welding Inspector or equivalent.
- Painting Inspectors: Certified to NACE (National Association of Corrosion Engineers) level 2 or equivalent.
- Blasters and Coaters: Certified by Saudi Aramco approved paint manufacturers.
- NDT Inspectors: Certified to ASNT (American Society of Non-Destructive Testing) SNT-Level II.

## 5.3 Specifications

The manufacturer shall comply with the following specifications:

- 12-SAMSS-007; SAES-T-744
- Telecommunication Industry Association TIA-222-G
- AISC (American Institute of Steel Construction) 360
- AWS (American Welding Society) D1.1

## IX. Heating, Ventilation and Air Conditioning (HVAC)

### 1. Critical Manufacturing Processes

#### 5.3.1 Design:

The manufacturer shall have in-house developed or available industry wide accepted software for HVAC component(s) design and selection.

#### 5.3.2 Nondestructive Testing:

The manufacturer shall have the capabilities to conduct the Magnetic Particle Testing (MT) and Liquid Penetrant Testing (PT).

#### 5.3.3 Sheet Metal Fabrication:

The manufacturer shall perform sheet metal fabrication meeting the requirements; turret punch presses, laser cutting systems, blanking automation, press brakes, bending automation, and general fabrication (fiber laser welder, tool grinder, spot welder)

#### 5.3.4 Condenser and Evaporator Coil Production:

The manufacturer have the capability to perform the following:

- CNC punching head: shall be equipped with punching, forming, notching, shearing, louvering, cutting modes
- CNC press brakes: for bending intricate profiles
- CNC shearing: for precise cutting in Mass production

#### 5.3.5 Pretreatment of Sheet Metal Components:

The manufacturer shall have the capability to remove dirt, oil, grease and other foreign materials.

The manufacturing facility shall be equipped with an after fabrication hot dip galvanizing process, consisting of a soil and grease removal tank, pickling tank, fluxing tank, galvanizing tank, and finishing.

#### 5.3.6 Coating/Painting:

The manufacturer shall perform the powder coating/painting in-house using booth and oven and minimum.

### 5.3.7 Assembly:

The main assembly line of the manufacturing facility shall consist of different stations such as:

- Compressor, condenser and evaporator mounting on equipment chassis
- Refrigerant piping brazing
- Leak testing
- Evacuation and vacuum, refrigerant charging
- Fan motor assembly
- Performance testing
- Cleaning and packing
- Warehouse facility for storing and dispatching

### 5.3.8 Testing:

The manufacturing facility shall hold Third Party Certification, meeting the requirements of AHRI and AMCA, to determine the performance rating of the HVAC equipment manufactured.

## 2. Required Certifications

The manufacturer shall comply with AHRI and AMCA requirements and hold products UL certificates.

## 3. Specifications

HVAC equipment shall be designed, fabricated, manufactured and tested as per the requirements of American Society of Heating Refrigeration and Air-conditioning Engineers (ASHRAE), Sheet Metal and Air Conditioning Contractors National Association (SMACNA), National Fire Protection Association (NFPA), American Heating and Refrigeration Institute (AHRI), and Air Movement Control Association (AMCA).

## X. Electrical Equipment

### 1. Transformers

#### 1.1 Critical Manufacturing Processes

##### 1.1.1 Raw Material/Component Handling:

The manufacturer shall ensure all components and raw material specifically and insulation material are stored in a controlled environment to avoid any potential deterioration. The insulation material integrity shall be assured through proper selection and qualification of raw material vendors.

##### 1.1.2 Core Cutting:

The manufacturer may sub-contract the core cutting, provided imposing adequate measures to ensure quality of work and integrity of material.

##### 1.1.3 Lamination:

The manufacturer shall be capable of conducting stack lamination in-house.

##### 1.1.4 Winding:

The manufacturer may sub-contract the conductor winding process, provided imposing sufficient control to ensure no compromise on product quality.

##### 1.1.5 Tank Fabrication:

The manufacturer may sub-contract tank and radiator fabrications, provided imposing adequate control measures to ensure tank and radiator integrity.

##### 1.1.6 Drying:

The manufacturer shall own in-house drying oven(s) to perform all drying activities.

##### 1.1.7 Painting and Packing:

The manufacturer may sub-contract the painting process, provided that the painting application is performed and inspected by qualified applicators and painting inspectors respectively.

The manufacturer shall apply appropriate dust protection to avoid any ingress.

#### 1.1.8 Testing:

The manufacturer shall be able to conduct the required testing (e.g. type /design test, routine test, testing and methods) as per the applicable standards.

#### 1.2 Required Certifications

The manufacture shall maintain valid design/special test records as per 14-SAMSS-531, 14-SAMSS-533, 14-SAMSS-534 or 14-SAMSS-536, as applicable.

The manufacturer shall provide line by line compliance matrix with the applicable SAMSS, along with compliance letter.

The manufacturer shall share local and global reference lists, technical catalogues, and manuals.

#### 1.3 Specifications

The manufacturer shall be able to comply with the applicable Saudi Aramco Material Specifications (SAMSS) including 14-SAMSS-531, 14-SAMSS-533, 14-SAMSS-534 or, 14-SAMSS-536 as applicable.

## 2. Power Cable

#### 17.1 Critical Manufacturing Processes

##### 2.1.1 Raw Material:

The manufacturer shall ensure that the insulation material (e.g. XLPE, EPR, PILCA, etc.) is sourced from a vendor proven with highest quality products.

##### 2.1.2 Manufacturing:

The manufacturer shall ensure its capability for cables production flow such as copper milling, import large diameter strands, source of XLPE and type, lead extrusion, type of armored, and stranding.

The manufacturer shall specify the highest KV ratings its production line is capable to manufacture.

The manufacturer shall specify the method used in the extrusion process such as Catenary Continuous Vulcanization (CCV) or Vertical Continuous Vulcanization (VCV).

The manufacture shall equip its facility with all required machines to support the extrusion machine including online x-ray insulation thickness read outs.

The manufacturer's production line shall include horizontal or vertical catenary lines to control cable temperature after extrusion.

The manufacturer shall possess galvanized steel or aluminum armoring machines as part of the armoring process.

#### 2.1.3 Testing:

The manufacturer shall declare capability level to conduct all applicable testing, such as highest AC testing, impulse testing, partial discharge testing, conductor resistance testing, XLPE elongation testing, water tightness testing, online production jacket testing, and conductor elongation testing.

### 2.2 Required Certifications

The manufacturer shall maintain valid design/special test records and all type tests records, as per applicable standards.

The manufacturer shall provide line by line compliance matrix with the applicable SAMSS along with compliance letter.

The manufacturer shall specify system/procedures of engineering controls (the approval of sub-vendors, flow down of the received technical requirements, technical issues associated with packaging, etc.). This has to be provided along with years of experience in manufacturing power cable and experience list.

The manufacturer shall provide a list of the equipment/materials manufactured in its facility, and a list of equipment/material contracted/sub-supplied.

### 2.3 Specifications

The manufacturer shall be able to comply with IEC, AEIC, ICEA, SEC11-TMSS-02 and/or ASTM specifications, and the applicable Saudi Aramco Material Standards/Specifications. Including, 15-SAMSS-502, 15-SAMSS-503, 15-SAMSS-504, and SAEP-P-104 as applicable.

### 3. Switchgears, Control Gear, and Panels

#### 3.1 Critical Manufacturing Processes

##### 3.1.1 Components Handling:

The manufacturer shall ensure all components are handled per the Original Components Manufacturer (OCM) guidelines.

The manufacturer shall source the circuit breakers and relays from the Saudi Aramco Acceptable Protective Devices List, as applicable.

The manufacturer shall guarantee quality and continual supply of spare parts.

##### 3.1.2 Manufacturing:

The manufacturer may sub-contract bus fabrication provided imposing adequate control measures to ensure bus integrity.

The manufacturer may sub-contract enclosure fabrication provided imposing adequate control measures to ensure enclosure integrity. The manufacturer is responsible to ensure that the enclosures are certified as required by the applicable specifications.

The manufacturer shall be able to assemble the complete equipment lineup along with wiring of control and power circuits.

##### 3.1.3 Testing:

The manufacturer shall be able to conduct required testing (e.g. type /design test, routine test, testing and methods), as per the applicable standards.

#### 3.2 Required Certifications

The manufacturer shall maintain valid design/special test records as per 16-SAMSS-502, 16-SAMSS-503, 16-SAMSS-504, 16-SAMSS-506, 16-SAMSS-507, 16-SAMSS-510, 16-SAMSS-513, 16-SAMSS-518, and 16-SAMSS-519, as applicable

The manufacturer shall provide line by line compliance matrix with the applicable SAMSS, along with compliance letter.

The manufacturer shall hold an Alliance Agreement with an internationally recognized manufacturer.

The manufacturer shall share local and global reference lists, technical catalogues, and manuals.

### 3.3 Specifications

The manufacturer shall be able to comply with the applicable Saudi Aramco Material Specifications (SAMSS) including 16-SAMSS-502, 16-SAMSS-503, 16-SAMSS-504, 16-SAMSS-506, 16-SAMSS-507, 16-SAMSS-510, 16-SAMSS-513, 16-SAMSS-518, and 16-SAMSS-519, as applicable.

## 4. Adjustable Frequency Drives

### 4.1 Critical Manufacturing Processes

#### 4.1.1 Components Handling:

The manufacturer shall ensure all components are tested at the source as per the applicable specifications prior to use in equipment productions.

The manufacturer shall guarantee quality and a continual supply of spare parts.

The manufacturer shall list all sub-equipment/materials manufactured in facility, and list of all sub-equipment contracted/sub-supplied.

#### 4.1.2 Manufacturing:

The manufacturer shall ensure its capability to supply the required range of production of AFD output kVA, and AFD kW.

#### 4.1.3 Testing:

The manufacturer shall be able meet the minimum testing capability; full load at rated output test, back to back, no load testing, 50 and 60 Hz test, temperature type tests, efficiency tests, sound pressure level tests, performance tests, and overload capability/current limit.

The manufacturer shall be able to conduct required testing (e.g. type /design test, routine test, testing and methods), as per the applicable standards.

### 4.2 Required Certifications

The manufacturer shall maintain valid design/special test records as per 16-SAMSS-517.

The manufacturer shall provide line by line compliance matrix with the applicable SAMSS along with compliance letter.

#### 4.3 Specifications

The manufacturer shall be able to comply with Saudi Aramco Material Specifications (SAMSS), including 16-SAMSS-517, as applicable.

### 5. Motors & Turbine Generators

#### 5.1 Critical Manufacturing Processes

##### 5.1.1 Components Handling:

The manufacturer shall ensure all components are tested at the source as per the applicable specifications, prior to use in equipment production.

The manufacturer shall specify the sources of all components, including the bearings.

The manufacturer shall guarantee quality and continual supply of spare parts.

The manufacturer shall list all sub-equipment/materials manufactured in facility and a list of all sub-equipment contracted/sub-supplied.

##### 5.1.2 Manufacturing:

The manufacturer may sub-contract the fabrication of frames, excitors, coils, rotors, and core cores punched/lasered, provided imposing adequate control to ensure work quality and components integrity.

##### 5.1.3 Testing:

The manufacturer shall be able to conduct required testing (e.g. type/design test, routine test, testing and methods) as per the applicable standards.

#### 5.2 Required Certifications

The manufacturer shall maintain valid design/special test records as per 17-SAMSS-502, 17-SAMSS-503, 17-SAMSS-510, and 17-SAMSS-520, as applicable.

The manufacturer shall provide an experience list; mentioning the location, enclosure, watts, voltage level, speed (RPM), frequency, and date.

The manufacturer shall provide a line by line compliance matrix with the applicable SAMSS, along with compliance letter.

### 5.3 Specifications

The manufacturer shall be able to comply with IEC, IEEE, API, or NEMA and Saudi Aramco Material Specifications (SAMSS) including 17-SAMSS-502, 17-SAMSS-503, 17-SAMSS-510, and 17-SAMSS-520, as applicable.

## 6. Diesel Generators

### 6.1 Critical Manufacturing Processes

#### 6.1.1 Components Handling:

The manufacturer shall ensure all components are tested at the source as per the applicable specifications prior to use in equipment production.

The manufacturer shall specify the sources of all components including the molded case circuit breakers.

The manufacturer shall guarantee quality and continual supply of spare parts.

The manufacturer shall list all the sub-equipment/materials manufactured in facility, and a list of all sub-equipment contracted/sub-supplied.

#### 6.1.2 Manufacturing:

The manufacturer may sub-contract the fabrication of the generator, diesel engine, base plate, and governor/control, provided imposing adequate control to ensure work quality and components integrity.

#### 6.1.3 Testing:

The manufacturer shall be able to conduct required testing (e.g. type/design test, routine test, testing and methods), as per the applicable standards.

### 6.2 Required Certifications

The manufacturer shall maintain valid design/special test records as per 17-SAMSS-518, as applicable.

The manufacturer shall provide an experience list, mentioning the location, enclosure, watts, voltage level, speed (RPM), frequency, and date.

The manufacturer shall provide a line by line compliance matrix with the applicable SAMSS along with compliance letter.

### 6.3 Specifications

The manufacturer shall be able to comply with the requirements of Saudi Aramco Material Specifications (SAMSS), including 17-SAMSS-518.

## 7. UPS & DC Systems

### 7.1 Critical Manufacturing Processes

#### 7.1.1 Components Handling:

The manufacturer shall ensure all components are tested at the source as per the applicable specifications prior to use in equipment production.

The manufacturer shall guarantee quality and continual supply of spare parts.

The manufacturer shall list all sub-equipment/materials manufactured in facility and a list of all sub-equipment contracted/sub-supplied.

#### 7.1.2 Manufacturing:

The manufacturer shall ensure its capability to supply a required range of production of UPS output kVA, rectifier/battery charger kW, and battery, as well as the number of phases (one or three).

#### 7.1.3 Testing:

The manufacturer shall be able meet the minimum testing capability; full load at rated output test, both 50 and 60 Hz test, specify kW limitations, efficiency tests, acoustical noise level tests, input feedback THDI test, and overload capability/current limit.

The manufacturer shall be able to conduct required testing (e.g. type /design test, routine test, testing and methods), as per the applicable standards.

## 7.2 Required Certifications

The manufacturer shall maintain valid design/special test records as per 17-SAMSS-511, 17-SAMSS-514, or 17-SAMSS-516, as applicable.

The manufacturer shall provide a line by line compliance matrix with the applicable SAMSS along with compliance letter.

## 7.3 Specifications

The manufacturer shall be able to comply with Saudi Aramco Material Specifications (SAMSS) including 17-SAMSS-511, 17-SAMSS-514, or 17-SAMSS-516, as applicable.

## XI. Instrumentation, Process and Control Equipment

### 1. Instrumentation

#### 1.1 Critical Manufacturing Processes

##### 1.1.1 General:

This section covers the requirement of flow instruments, pressure instruments, level instruments, temperature instruments, analytical instruments, safety relief valves, instrument valves, rupture discs, flame instruments, programmable logic controllers, monitoring systems, shutdown systems, control valves, actuators, recorders, controllers, instrument/control panels, cabinets, relays, Foundation Fieldbus instruments, wiring, tubing , and instruments fittings.

##### 1.1.2 Components Handling:

The manufacturer shall demonstrate capabilities of proper material selection to suit the service conditions.

The manufacturing facility shall be furnished with a climate controlled place for storage of sensitive components.

The capability of the OEM/licensor shall be surveyed and approved by Saudi Aramco prior to approving the local facility requesting the approval.

##### 1.1.3 Manufacturing:

The manufacturer shall be capable to meet all manufacturing and assembly requirements stipulated in the respective specifications mentioned in "Specifications" part of this document.

##### 1.1.4 Testing:

The manufacturer shall be fully capable of performing all related tests for the specific commodity in-house.

The manufacturer shall maintain at minimum, the necessary equipment to functionally test the instruments.

The manufacturer shall maintain at minimum, the necessary equipment for final inspection and testing after assembly.

The manufacturer shall maintain at minimum, a list of certified equipment necessary for the type of instruments intended for process measurement and control applications.

The manufacturer shall have an engineering unit with access to engineering design and with qualified engineers who have experience in the commodity manufacturing.

The manufacturer shall have engineers who are capable of supporting manufacturing activities.

## 1.2 Required Certifications

The manufacturer shall hold commodity specific certifications such as ASME Stamps for pressure relief devices, etc.

The facility shall have their own system/procedures of engineering controls such as the approval of sub-vendors, flowdown of the received technical requirements, technical issues associated with manufacturing, etc.

The facility shall have the long term storage of the equipment manuals and documentation.

The manufacturer shall have a list of all sub-vendors that the manufacturing facility will be outsourcing from.

The manufacturer shall provide a compliance letter with the applicable Saudi Aramco Material Specifications and Inspection Forms.

## 1.3 Specifications

The manufacturer shall be able to comply with API, ASME, ISO and the applicable Saudi Aramco Material Standards/Specifications including SAES-J-003 , SAES-J-200, SAES-J-400, SAES-J-502, SAES-J-605, SAES-J-904,34-SAMSS-010,34-SAMSS-117,34-SAMSS-118, 34-SAMSS-318,34-SAMSS-319, ,34-SAMSS-511,34-SAMSS-512,34-SAMSS-514,34-SAMSS-515, ,34-SAMSS-517, ,34-SAMSS-611,34-SAMSS-612,34-SAMSS-617,34-SAMSS-619,34-SAMSS-625,34-SAMSS-634,34-SAMSS-624,34-SAMSS-711,34-SAMSS-716,34-SAMSS-717,34-SAMSS-718,34-SAMSS-815,34-SAMSS-820,34-SAMSS-821,34-SAMSS-830, ,34-SAMSS-913.

## 2. Flare Equipment

### 2.1 Critical Manufacturing Processes

#### 2.1.1 Components Handling:

The manufacturer shall ensure that the flare stacks, flare tips, dry gas seals, liquid-seals, and flare knockout drums are designed, fabricated, tested, and inspected in accordance with the applicable specifications. These components shall be purchased from Saudi Aramco approved manufacturers.

The manufacturer shall establish a process for handling and protection of both inlet and product materials.

#### 2.1.2 Welding & NDT:

The manufacturer shall perform the welding using the correct and qualified welding procedures, parameters and essential variables control. Welding procedures and qualifications/certifications shall be certified by third party entities.

The manufacturer shall be capable to avail that radiographic and dye penetrant testing on the auxiliary piping and flare tip barrels welds.

#### 2.1.3 Fabrication:

The manufacturer shall provide a breakdown of fabricated materials versus contracted/sub-supplied.

The manufacturer shall ensure that all fabrication activities for the components and the fare system are supervised and certified by qualified personnel. Fabrication include the flare stacks, tips, steam piping, knockout & liquid seals drum, refectionary installation and positive material identification, as applicable.

#### 2.1.4 Testing:

The manufacturer shall be able to conduct required testing (e.g. type/design test, routine test, testing and methods) as per the applicable standards.

### 2.2 Required Certifications

The manufacturer shall ensure appropriate certification are required for the main equipment and the associated component (e.g. ASME certifications)

The manufacturer shall maintain valid design/special test records as per the applicable international standards and Saudi Aramco Material System Specification (SAMSS).

The manufacturer shall provide technical documents related to the basic design of the plant, technical data/specifications for each equipment.

The manufacturer shall furnish a performance guarantee. The length is based on purchase order, along with a Compliance Certificate upon official release of the flare system.

The manufacturer shall share local and global reference lists, technical catalogues, and manuals.

Manufacturer capability to execute complete or partial projects and number of flare commodities, or will be approved for.

### 2.3 Specifications

The manufacturer shall be able to comply with the applicable international standards (e.g. ASME) and Saudi Aramco Material Specifications (SAMSS) including 32-SAMSS-022, and 32-SAMSS-004.

## 3. Trays and Packing

### 3.1 Critical Manufacturing Processes

#### 3.1.1 Raw Material Handling:

The manufacturer shall ensure all tray hardware is manufactured of the same basic material type as tray deck plates, except for trays with carbon steel deck plates, which shall have 410 stainless steel hardware.

#### 3.1.2 Fabrication:

The manufacturer shall ensure that the surface of fabricated parts shall be free from scale, dents and defects. Burrs shall be removed from all perforated areas and edges of tray sections. Burrs on sheared edges are acceptable.

The manufacturer shall ensure the trays and packing meet acceptable properties; packing material porosity and pore distribution, trays and packing surface area, trays and packing crush strength and attrition resistance/endurance, packing density, trays and packing pressure drop, trays material.

The manufacturer shall perform proper mechanical sizing to ensure adequate height/spacing of trays for human inspection, number of passing, weir length, beams, and valves / caps.

### 3.1.3 Testing:

The manufacturer shall be able to conduct required testing (e.g. type /design test, routine test, performance testing, etc.) as per the applicable standards.

### 3.1.4 Installation:

The manufacturer shall establish and implement a process installing and disassembling of the trays and packing panels in line with the applicable standards.

### 3.1.5 Marking and Shipping:

Each tray or packing material part segment shall be piece marked, using metal stencil, with part number in the part-list as shown on the tray/packing manufacturer's drawings.

Tray hardware shall be packaged separately from the main tray segments and marked with adequate identification.

The manufacturer shall implement a process to ensure proper packing for carbon and alloy steel material. For example, carbon steel trays and component shall be protected with a removable rust inhibitor, and the stainless steel components shall be protected from salt water and spray when shipped by ocean freight.

## 3.2 Required Certifications

The manufacturer shall maintain valid design/special test records as per 32-SAMSS-020, 32-SAMSS-004, as applicable.

The manufacturer shall be able to perform evaluation and optimization of plant process' using simulation and calculation software. (Revamp of plant throughput and operation mode).

The manufacturer shall furnish technical documents related to authorized products, technical documents related to the basic design of the plant, technical data/specifications for each product, product data sheet, and material safety data sheet.

The manufacturer shall be capable of performing these production services; purchase order processing, project management, engineering and design, design certification, procurement, assembly, testing, training, and field support.

The manufacturer shall provide a written guarantee for the length of the warranty period specified in the purchase order or contract documents that the trays or packing shall perform under continuous operation at design conditions specified on the data sheets.

The manufacturer should perform R&DC for product improvement and troubleshooting or association with international R&DC's or universities.

The manufacturer shall hold an Alliance Agreement with internationally recognized manufacturers.

The manufacturer shall share local and global reference lists, technical catalogues, and manuals.

### 3.3 Specifications

The manufacturer shall be able to comply with the applicable international standards and Saudi Aramco Material Specifications (SAMSS) including 32-SAMSS-020, 32-SAMSS-004.

## 4. Process Automation Systems

### 4.1 Critical Manufacturing Processes

#### 4.1.1 Design Process:

The manufacturer shall ensure that development of engineering design drawings are in Saudi Aramco format and other Non-Material Requirements (NMRs) for systems.

#### 4.1.2 Components Handling:

The manufacturer shall ensure that the components are stored as per the guidelines of the original components manufacturer.

The manufacturer shall have adequate facilities and space for receiving and storing system components.

#### 4.1.3 Assembly and Integration:

The manufacturer shall have adequate space to assemble system components into cabinets or, have identified an approved In-Kingdom manufacturer to perform the assembly work.

The manufacturer shall perform assembly and integration of system components, power supply wiring, and networking equipment into cabinets. Alternatively, a formal agreement with one of the approved third party cabinet integrators to perform cabinet assembly and testing.

The manufacturer shall be able to develop and configure application software.

The manufacturer shall be capable of providing the following services to support approval of products;

- Provide product release notes and detailed explanation of new features and product enhancements.
- Engineering / product expertise resources and test equipment to support product evaluation testing.

#### 4.1.4 Factory Acceptance Testing (FAT):

The manufacturer shall conduct FAT testing using approved procedure, qualified personnel, and adequate & certified test equipment.

The manufacturer shall have adequate space for preparing and storing cabinets for shipment to site after completion of successful FAT.

The manufacturing facility shall be furnished with UPS of conditioned power capable of meeting manufacturer installation requirements.

The manufacturing facility shall be furnished with a grounding system capable of meeting manufacturer installation requirements.

The manufacturing facility shall be furnished with adequate climate control capable of meeting manufacturer installation requirements.

The manufacturer shall be able to provide access to Saudi Aramco computer network for project team.

The manufacturer shall have adequate engineering staff to execute all PAS project activities such as:

- Qualified hardware design, network design, software engineering, graphics development, system test, project documentation development, project document control, material handling, and inspection personnel.
- Competent engineering manager capable of providing project oversite and assure engineering quality.
- Clear statement on use of subcontractors, outsourcing or back office for performing engineering tests.
- Competent engineers to lead engineering work and participate in design reviews, Preliminary Design Review (PDR) and Critical Design Review (CDR) meetings.
- Qualified and trained technicians for cabinet assembly and test.
- Certified safety engineers for ESD system work.

The manufacturing facility shall have sufficient manpower with the minimum level of experience and qualification in the various processes (design, assembly, integration, application software development, testing, inspection, support, and services, as applicable). The manpower categories include technical staff, quality staff, inspection, engineers, technicians and management. The number depends on the size of the facility, production capacity, etc.

#### 4.2 Required Certifications

The manufacturer shall provide compliance letter with the applicable Saudi Aramco Material Specifications.

The manufacturer shall share local and global reference list (including installation in Kingdom and GCC), technical catalogues, and manuals.

#### 4.3 Specifications

The manufacturer shall be able to comply with Saudi Aramco Material Specifications (SAMSS) including 23-SAMSS-010, 23-SAMSS-020, 34-SAMSS-623, 34-SAMSS-624, 34-SAMSS-621, 34-SAMSS-622, 23-SAMSS-030, 23-SAMSS-050, and Saudi Aramco Engineering Standard SAES-Z-003.

### 5. Custody Measurement Systems

#### 5.1 Critical Manufacturing Processes

##### 5.1.1 Integration/Assembly

The system integrator shall be able to do the following in-house as a minimum:

###### 5.1.1.1 General:

- Conduct engineering design of measurement systems.
- Design, build, test and troubleshoot metering control system. This shall not be sub-contracted.

###### 5.1.1.2 System integration:

- Assemble and integrate the measurement system. If components of the system integration are subcontracted, they must be approved according to Saudi Aramco applicable standards.

5.1.1.3 Welding:

- Maintain procedures related to welding of pipe components and structures.

5.1.1.4 System Testing:

- Conduct full system testing and inspection as per the applicable standards.
- For liquid applications, conduct a water injection test for automatic sampling systems.
- For liquid applications, conduct a wet factory acceptance test.
- For gas applications, conduct dry factory acceptance test.
- For gas applications, facilitate dry and wet calibration of ultrasonic flow meters.
- For proving systems, provide 3rd party certification of prover calibrated volume.
- Own sufficient shaded space to stage integrated FAT of metering systems.

5.1.1.5 Sub-Contracted Activities:

- Sub-contracting is limited to services and/or fabrication of unfinished subcomponents such as cutting, bending, painting, welding and non-destructive tests).
- Sub-contracting is limited Saudi Aramco qualified manufacturers only.

5.1.2 System Components:

The component manufacturer shall be able to do the following in-house as a minimum:

General:

- Final assembly, inspection and testing of component (i.e. flow meter, sampling system, etc). If components of the system integration are subcontracted, they must be approved according to Saudi Aramco applicable standards

Calibration:

- For flow meters, certification of meter accuracy classification.

### 5.1.3 System Service

The service provider shall maintain procedures for the type of services intended for custody measurement applications.

The system integrator shall maintain at minimum, the necessary equipment to functionally test the system at full capacity (dry and wet).

The component manufacturer shall maintain at minimum the necessary equipment for final inspection and testing after assembly.

The service provider shall maintain at minimum, a list of certified equipment necessary for the type of service intended for custody measurement applications.

The manufacturer shall establish site technical support division (located in Kingdom).

The manufacturing facility shall have sufficient manpower with the minimum level of experience and qualification in the various processes (manufacturing, assembly, integration, testing, inspection, support, services, as applicable). The manpower categories include technical staff, quality staff, inspection, engineers, operators, and technicians. The number depends on the size of the facility, production capacity, etc.

## 5.2 Required Certifications

The manufacturer shall obtain and maintain required certification from the following certification bodies depending on applicability and as defined by Custody Measurement relevant Saudi Aramco standards and material specification documents:

- American Petroleum Institute (API)
- American Society for Testing Materials (ASTM)
- International Standards Organization (ISO)
- International Electro technical Commission (IEC)
- International Organization of Legal Metrology (OIML)

## 5.3 Specifications

The manufacturer shall be able to comply with the applicable Saudi Aramco Material Specifications including 34-SAMSS-112, 34-SAMSS-114, 34-SAMSS-117, 34-SAMSS-118, 34-SAMSS-119, 34-SAMSS-120, 34-SAMSS-180, 34-SAMSS-121, 34-SAMSS-122, 34-SAMSS-321, 34-SAMSS-511, 34-SAMSS-517, 34-SAMSS-525, 34-SAMSS-841, 34-SAMSS-846, 34-SAMSS-847, 34-SAMSS-151, 34-SAMSS-167, 34-SAMSS-851, SAES-Y-100, SAES-Y-101, SAES-Y-501, SAES-Y-103, SAES-Y-301.

## 6. High Integrity Protection Systems (HIPS)

### 6.1 Critical Manufacturing Processes

#### 6.1.1 General:

The manufacturer shall establish in-house processes to execute the procurement and project management activities.

#### 6.1.2 Components Handling:

The manufacturer shall procure all components from Saudi Aramco approved sources and impose all applicable inspection and testing requirements.

The manufacturer shall have adequate facility and covered space for receiving and storing system components.

#### 6.1.3 Manufacturing/Integration:

The manufacturer/system integrator shall be capable to perform full system design and integration in-house.

The manufacturer shall have adequate space to assemble components into systems.

#### 6.1.4 Subcontracted Activities:

The manufacturer is allowed to subcontract system SIL assessments and certification provided it is performed by a safety instrumented engineer with a valid certification from an internationally recognized notified body such as TUV, Lloyd's or Exida.

#### 6.1.5 Testing:

The manufacturer shall have the capabilities to perform the Factory Acceptable Test (FAT) and inspection in-house unless Saudi Aramco approves an alternative FAT facility.

The manufacturer shall provide detailed testing procedures, and detailed IOM with trouble shooting procedures for the whole system.

#### 6.1.6 Packing and Shipping:

The manufacturer shall have adequate space for system pack, packing and covered storage prior shipment.

The manufacturer ensures the HIPS equipment is packed and protected against mechanical and corrosive damage. A non-toxic vapor phase corrosion inhibitor shall be applied to the internal surfaces of the assembled HIPS equipment.

The manufacturer shall have adequate and certified (calibrated) test equipment to perform FAT on the systems (functional and pressure tests), meeting the inspection requirements as indicated in the corresponding specifications.

The manufacturer shall have adequate staff/manpower to execute all project activities:

- Competent engineering manager, project manager and quality manager, capable of providing project oversite and assure quality and performances.
- Competent engineers to lead engineering work and address technical issues and/or discrepancies in the shop during assembly, FAT and in the field.
- Competent personnel for procurement, project documentation development, documentation control and inspection.
- Competent technicians for system assembly and testing.
- Competent manpower in packaging systems for shipment.
- Establish site technical support division (located in Kingdom).

#### 6.2 Required Certifications

The manufacturer should hold valid quality system/program certification such as ISO 9001 or API Q1.

The manufacturer shall provide training in Kingdom, at the facility and at site and provide field support in Kingdom.

#### 6.3 Specifications

The manufacturer shall be able to comply with the applicable Saudi Aramco Material Specifications including, 34-SAMSS-626, 34-SAMSS-627, 34-SAMSS-628, and 34-SAMSS-629.

## XII. Others

### 1. Crane

(Structural Fabrication works. See Electrical/Mechanical commodities for electro-mechanical components)

#### 1.1 Critical Equipment & Manufacturing Processes

##### 1.1.1 General:

The manufacturer shall ensure that fabricators have a minimum of three years of crane system and fabrication experience.

Member or connection design may be outsourced to SA approved General Engineering Service (GES+) contractors.

Painting and coating operations (e.g. organic coatings, hot dip galvanized coatings) may be outsourced to SA approved service providers.

Non-destructive examination of welds may be outsourced to SA approved inspection agencies.

##### 1.1.2 Design & Engineering:

The fabricator shall retain an experienced structural, mechanical, and electrical engineer (minimum five years) to design or supervise the crane systems. The licensed design/drafting software should be available for commercial use.

##### 1.1.3 Raw Material:

Raw materials like plates, sections and profiles, and bars shall be procured from local or international mills or distributors that are ISO certified and have well managed quality control system. Material grade and specifications shall confirm to company standards. Local manufacturers may fetch crane system electro-mechanical parts from the parent company, or joint-venture companies operating in other parts of the world.

##### 1.1.4 Manufacturing:

The overhead cranes, fork lifts, and slings should be available for safe handling and storing of materials in the shop.

The shop should be well equipped with machinery and tools for plate and profile cutting, shearing, punching, drilling, mitering, coping, beveling and bending such as the following:

- CNC Plasma Plate processor
- Oxyacetylene torch (thicker materials)
- CNC or manual drilling machine
- CNC beam line (shearing, beveling, coping, punching, drilling, scribing)
- Sawing/cutting machine
- Hydraulic shear and press brakes
- Pipe bender and bending jigs
- Drill bits, blades, diamond tip tools, nozzles, gas cylinders
- Vice & bench grinders, pencil grinders
- Lathe, shaper, milling

The fabrication of steel will involve fitting and welding operations. Appropriate welding equipment should be available for applying tack welds (fitting) and production welds (final), such as:

- Welding equipment (transformers/rectifiers)
- SAW tractor (sub-arc welding) or pull-through
- Baking oven/holding oven/portable quivers for welding consumables

#### 1.1.5 Traceability:

The members shall be hard punched (stenciled) for identification and erection purposes. Final products shall be traceable to heat numbers or raw material sources.

#### 1.1.6 Welding:

The welding shall involve the following operations:

- Generating Welding Procedure Specifications as per AWS D1.1/D1.3/D1.8
- Assembly fit-up including tack welding
- Production welding by certified welders
- Conduct Visual Inspections and NDT

#### 1.1.7 Coating:

The painting and coating operations shall be conducted as per company standards. It is recommended that the fabricator has an environmentally controlled facility for conducting blasting and coating operations, which allows continuous

operations with minimum risk of contamination. The following equipment should be available at the facility to apply coatings:

- Wheelabrator® for blasting or manual blasting pots
- Painting skids
- Airless spray painting gun assembly

Note: Sand is not allowed as an abrasive media.

#### 1.1.8 Inspection & Testing:

The inspection tools and equipment should be available for use such as: tapes, mallet, Vernier caliper, micrometers, magnifying glass, angle, torch light, welding gauge (TWI), hi-low gauge, fillet weld gauge, ammeter, voltmeter, thermometer, temperature indicating crayons, WFT comb gauge, cross hatch profile cutter, limpet gauge, hygrometer, low voltage holiday detector, surface profile needle gauge, rust grade comparators, and electronic dry film thickness gauge. Calibrated non-destructive testing equipment (MT, UT) should be available for use by certified technicians to conduct non-destructive welding examination.

#### 1.2 Required Certifications

The manufacturer shall ensure to have the following certifications:

- Facility Certification: API 2C Monogram/certification is required for offshore pedestal cranes.
- Welding Inspectors: Certified to AWS (American Welding Society) Certified Welding Inspector or equivalent.
- Painting Inspectors: Certified to NACE (National Association of Corrosion Engineers) level 2 or equivalent.
- Blasters and Coaters: Certified by Saudi Aramco approved paint manufacturers.
- NDT Inspectors: Certified to ASNT (American Society of Non-Destructive Testing) SNT-Level II.

#### 1.3 Specifications

The manufacturer shall comply with the following specifications:

- SAES-M-001; 12-SAMSS-007
- American Petroleum Institute API 2C
- Crane Manufacturer Association of America CMAA 70 & 74
- American Petroleum Institute API 9A
- AISC (American Institute of Steel Construction) 360
- AWS (American Welding Society) D1.1

## 2. Slings and Rope Attachments (Synthetic, Wire, Chain)

### 2.1 Critical Equipment & Manufacturing Processes

#### 2.1.1 General:

The manufacturer shall have a minimum of three years of sling manufacturing experience.

#### 2.1.2 Design & Engineering:

The fabricator shall retain experienced structural and mechanical engineers (minimum five 5 years) to design or supervise the design and prepare fabrication drawings using industry recognized software. The licensed design/drafting software should be available for commercial use.

#### 2.1.3 Raw Material:

Raw materials like wire, rope and chain shall be procured from Saudi Aramco approved sources. Synthetic webbing material shall be procured from reputed ISO manufacturers. Accessories like ferrules, thimbles, links, shackles etc. shall be procured from Saudi Aramco approved sources. Material grade & specifications shall confirm to company and/or international standards.

#### 2.1.4 Manufacturing:

The sling manufacturing processes will involve wire rope cutting, chain cutting and heated knife cutting of synthetic webbing materials. Bench cutters or hydraulic shear/press brake should be available for shearing of wire rope/chains.

The fabricators should have good experience and skill in creating the Flemish eye (wire rope sling).

The manufacturer shall retain skilled tradesmen (tailors) for webbing sling soft eye formation (synthetic sling).

The hydraulic press (multiple – various capacity up to 500T) should be available in the shop for ferrule swaging operations (wire rope sling).

The manufacturer shall have vice & bench grinders, pencil grinders.

#### 2.1.5 Traceability:

The slings shall be labelled for identification. Final assemblies shall be traceable to raw materials.

### 2.1.6 Inspection & Testing:

Inspection tools and equipment like tapes, mallet, Vernier caliper, micrometers, and magnifying glass should be available in the shop. Proof load and break load testing stations (min. 100T capacity) should be available in the facility to carry out pull tests.

### 2.2 Required Certifications

The manufacturer shall ensure to have the following certifications:

- Facility Certification: LEEA (Lifting Equipment Engineers Association) membership or equivalent.

### 2.3 Specifications

The manufacturer shall comply with the following specifications:

- API (American Petroleum Institute) 9A
- ASME (American Society of Mechanical Engineers) B30.9
- Saudi Aramco Construction Safety Manual.

## 3. Wire Rope

### 3.1.1 General:

The manufacturer shall ensure that fabricators have a minimum of three years of wire rope manufacturing experience.

### 3.1.2 Design & Engineering:

The manufacturer shall retain experienced structural and mechanical engineers (minimum five years) to custom design special wire rope. Design works are not required for standard rope constructions and sizes listed in industry standards.

### 3.1.3 Raw Material:

The wire (bright steel or hot dip galvanized), shall be procured from ISO certified manufacturers with a sound QMS. Material grade and specifications shall conform to company and/or international standards.

### 3.1.4 Manufacturing:

Wire rope manufacturing process includes - wire unwinding & drawing, wire welding (resistance flash-butt weld), wire stranding & rope formation, rope closing & termination (fused or socketed). Aforementioned processes are conducted on continuous drawing and stranding lines. Wire rope cutting and labelling operations may be performed offline.

### 3.1.5 Traceability:

Wire ropes shall be labelled for identification. Final assemblies shall be traceable to raw materials.

### 3.1.6 Inspection & Testing:

Inspection tools and equipment like tapes, mallet, Vernier caliper, micrometers, and magnifying glass should be available in the shop. Proof load and break load testing stations (min. 100T capacity) should be available in the facility to carry out pull tests and torsional capacity tests.

## 3.2 Required Certifications

The manufacturer shall ensure to have the following certifications:

- Facility Certification: API 9A or equivalent.

## 3.3 Specifications

The manufacturer shall comply with the following specifications:

- API (American Petroleum Institute) 9A
- ASME (American Society of Mechanical Engineers) B30.9
- Saudi Aramco Construction Safety Manual.

## 4. Fire Rated Doors (Steel)

### 4.1 Critical Equipment & Manufacturing Processes

#### 4.1.1 General:

The manufacturer shall ensure that fabricators have a minimum of three years steel fire door fabrication experience.

The De-coiling operations may be outsourced.

#### 4.1.2 Design & Engineering:

The fabricator shall retain experienced structural and mechanical designers. The licensed design/drafting software should be available for commercial use.

#### 4.1.3 Raw Material:

Raw materials like plates, coils, sections & profiles, bars etc. shall be procured from local or international mills or distributors that are ISO certified and have well managed quality control system. Material grade and specifications shall conform to company standards.

#### 4.1.4 Manufacturing:

The overhead cranes, fork lifts, and slings should be available for safe handling and storing of materials in the shop.

The shop should be well equipped with machinery and tools for plate/coil and profile cutting, shearing, punching, drilling, mitering, coping, beveling and bending. De-coiling and slitting of thin coils (1.2mm/1.5mm/2.0mm) is among the first operations. Manufacturer may procure de-coiled sheet steel or outsource de-coiling and slitting operations.

Press brakes (Manual or CNC) should be available for cold bending and C/Hat section formation (cold bending).

Fire door core are typically filled with insulation. Impregnating foam insulation or laying out batt/honey-comb insulation shall be done in the premises.

Fire doors shall be constructed as per tested and labelled assembly. Any doors that are oversized (size of door larger than the tested assembly) cannot be labelled.

Tack welding and production welding shall be conducted as per Welding Procedure Specifications generated according to American Welding Society - AWS D1.3.

Finished and inspected doors shall be painted (spray or powder coating).

#### 4.1.5 Traceability:

The members shall be hard punched (stenciled) for identification and erection purposes. Final products shall be lot traceable to raw material test certificates.

#### 4.1.6 Welding:

The welding shall involve the following operations:

- Generating Welding Procedure Specifications as per AWS D1.1 or D1.3 as applicable
- Assembly fit-up including tack welding
- Production welding by certified welders
- Conduct visual Inspections

#### 4.1.7 Coating:

The painting and coating operations shall be conducted as per company standards. It is recommended that the fabricator has an environmentally controlled facility for conducting blasting and coating operations, which allows continuous operations with minimum risk of contamination. The following equipment should be available at the facility to apply coatings:

- Profiling and chemical cleaning
- Powder or organic coating lines
- Furnace (powder coating lines)

Note: Sand is not allowed as an abrasive media.

#### 4.1.8 Door Labelling:

The door labels shall be affixed to both door frame and leaf. Fire door labels shall be controlled, and records shall be maintained.

#### 4.1.9 Inspection & Testing:

The inspection tools and equipment like tapes, mallet, Vernier caliper, micrometers, magnifying glass, angle, torch light, welding gauge (TWI), Hi-Low gauge, fillet weld gauge, ammeter, voltmeter, thermometer, temperature indicating

crayons, WFT comb gauge, cross hatch profile cutter, limpet gauge, hygrometer, low voltage holiday detector, surface profile needle gauge, rust grade comparators, electronic dry film thickness gauge should be available for use.

#### 4.2 Required Certifications

The manufacturer shall ensure to have the following certifications:

- Product Certification: Door assemblies are fire tested and certified by either UL, FM, Intertek or Thomas Bell Wright Institute (TBWIC Dubai).
- Welding Inspectors: Certified to AWS (American Welding Society) Certified Welding Inspector or equivalent.
- Painting Inspectors: Certified to NACE (National Association of Corrosion Engineers) level 2 or equivalent.
- Blasters and Coaters: Certified by Saudi Aramco approved paint manufacturers.

#### 4.3 Specifications

The manufacturer shall comply with the following specifications:

- 12-SAMSS-007
- International Building Code (IBC)
- AISC (American Institute of Steel Construction) 360
- AWS (American Welding Society) D1.1/D1.3
- 12-SAMSS-014; Steel Door Institute
- National Fire Protection Agency NFPA80 and NFPA 101
- Underwriter Laboratories UL 10C

### 5. Fire Rated Doors (Wood)

#### 5.1 Critical Equipment & Manufacturing Processes

##### 5.1.1 General:

The manufacturer shall ensure that fabricators have a minimum of three years of wood fire door fabrication experience.

##### 5.1.2 Design & Engineering:

The fabricator shall retain an experienced structural/mechanical designer. The licensed design/drafting software should be available for commercial use.

#### 5.1.3 Raw Material:

Kiln dried hardwood like oak, birch, teak and softwood like pine; MDF (medium density fiberboard; plywood, veneer shall be procured from ISO certified companies. Wired glass (listed) and door accessories (listed) shall be procured from UL listed sources.

#### 5.1.4 Manufacturing:

The overhead cranes, fork lifts, and slings should be available for safe handling and storing of materials in the shop.

The shop should be well equipped with CNC machinery, auto planar, shaper, auto edge bander, auto slicer, saw, automatic door mortizer, CNC boring, lathe, drills, grinding, gluing, and hydraulic press machines.

Fire door core may be procured from listed sources (e.g. Halspan tested to UL10C).

Fire doors shall be constructed as per tested and labelled assembly. Any doors that are oversized (size of door larger than the tested assembly), cannot be labelled.

Finished and inspected doors shall be spray painted.

#### 5.1.5 Traceability:

A traceability system shall be implemented through documentation procedures. Fire door core and accessories shall be traceable to labelled door assembly.

#### 5.1.6 Coating:

Varnishing, staining or painting operations shall be conducted as per company standards. It is recommended that the fabricator has an environmentally controlled facility for conducting blasting and coating operations, which allows continuous operations with minimum risk of contamination. The following equipment should be available at the facility to apply coatings:

- Profiling and chemical cleaning
- Spray painting stations

Note: Sand is not allowed as an abrasive media.

#### 5.1.7 Door Labelling:

The door labels shall be affixed to both door frame and leaf. The fire door label shall be controlled and records shall be maintained.

#### 5.1.8 Inspection & Testing:

The inspection tools and equipment like tapes, mallet, Vernier caliper, micrometers, magnifying glass, angle, and torch light should be available for use.

### 5.2 Required Certifications

The manufacturer shall ensure to have the following certifications:

- Product Certification: Door assemblies are fire tested and certified by either UL, FM, Intertek or Thomas Bell Wright Institute (TBWIC Dubai).

### 33.3 Specifications

The manufacturer shall comply with the following specifications:

- International Building Code (IBC)
- National Fire Protection Agency NFPA80 and NFPA 101
- Underwriter Laboratories UL 10C

## 6. Single-Mode and Multi-Mode Outside-Plant Fiber Optic Cables

### 6.1 Critical Manufacturing Processes

#### 6.1.1 General:

The manufacturer shall be able to design, engineer, manufacture, inspect and test the performance of single-mode and multi-mode outside-plant fiber optic cables as per 18-SAMSS-625 requirements.

#### 6.1.2 Manufacturing and Testing:

The manufacturer shall provide Saudi Aramco with the results of qualification or type tests confirming that the cable has passed successfully these tests.

The manufacturer shall conduct routine tests on all production cable lengths to demonstrate their integrity.

The manufacturer shall demonstrate manpower capabilities, engineering, technicians, and staff certifications

The manufacturer should perform R&DC for product improvement, testing, and troubleshooting.

The manufacturer shall be associated with internationally recognized 3rd party labs.

## 6.2 Required Certifications

The manufacturer shall have 3rd party certification for qualification or type tests result.

The manufacturer shall have 3rd party certification for the fiber optic strands and origin.

The manufacturer shall provide reference list for the major projects and customers, including Saudi Arabia.

## 6.3 Specifications

The manufacturer shall be able to comply with the applicable Saudi Aramco Material Specifications including, 18-SAMSS-006 and 18-SAMSS-625.