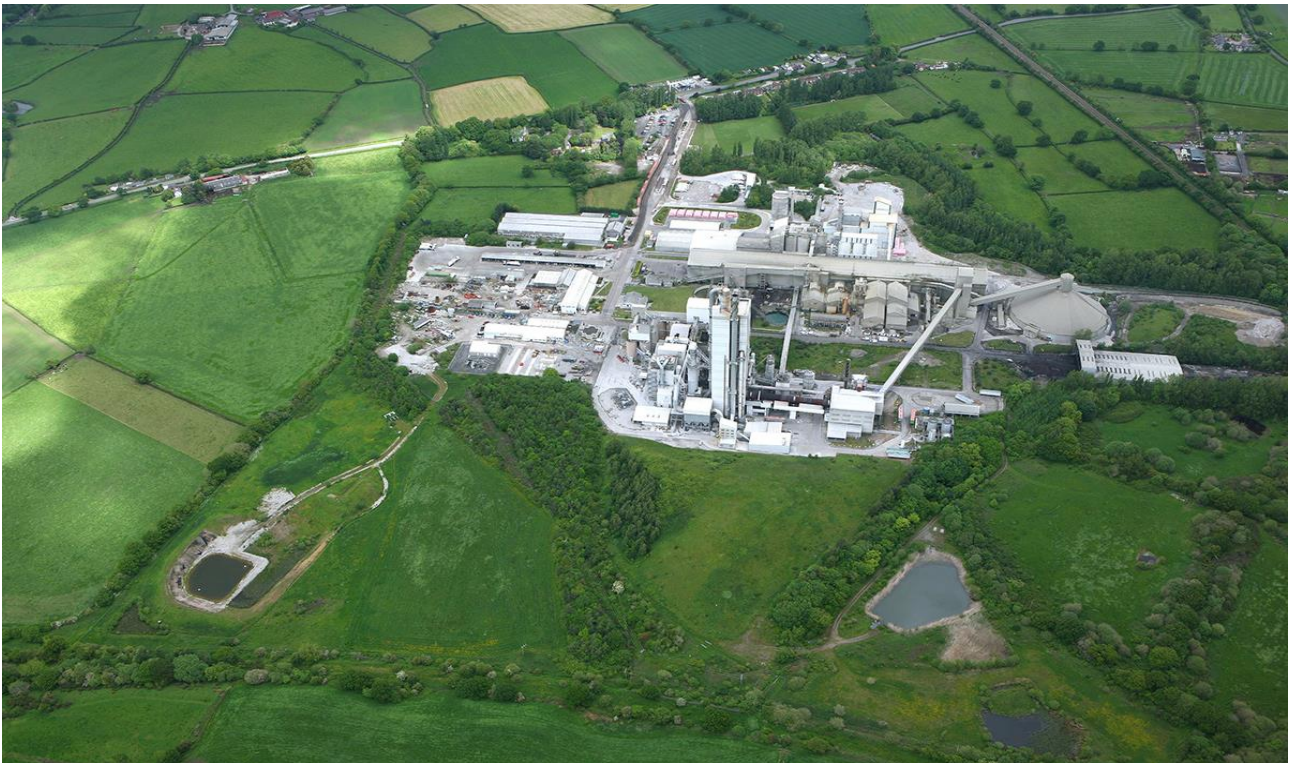


HEIDELBERG MATERIALS

Heidelberg Materials: Padeswood Carbon Capture Plant – FEED Phase

Mechanical equipment specification - Tanks

Document no. Rev 0: 215000-00190-000-ME-SPC-00005



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1. Project Introduction

Heidelberg Materials (HM) has become a partner in the HyNet Northwest consortium, which aims to create the world's first low-carbon industrial cluster in the region of Northwest England. The proposed hydrogen and carbon capture and storage (CCS) industrial cluster will play a critical role in the UK's transition to net zero greenhouse gas emissions and the fight against climate change. As part of 'Making Net Zero Possible', Asset Improvement programme options to decarbonise COMPANY cement plant are being considered. Carbon Capture (CC) is one of the key technologies being developed as a route to decarbonisation. COMPANY cement plant located at Padeswood which currently produces about 110 ton per hour (tph) of clinker, has been selected by DESNZ as a track 1 phase 2 carbon capture project. The PROJECT will enable carbon capture from the existing cement kiln 4 and from a new Combined Heat and Power (CHP) plant designed to provide the heat and electricity required to operate the Carbon Capture and Compression (CCC) plant. Captured CO₂ will be transported by pipeline to the HyNet CO₂ main pipeline at Northop Hall AGI for onward transportation to storage offshore in depleted gas fields operated by Eni UK. The PROJECT will enable the production of net zero cement for use in the UK construction industry.

Ahead of this CONTRACTOR has been engaged by COMPANY to undertake a pre-FEED study for the carbon capture development. The pre-FEED study was completed in March 2023. Based on the pre-FEED study, an amine-based post combustion CO₂ capture technology has been selected as a suitable technology for capturing 95% of the CO₂ emissions from cement plant.

A consortium between Mitsubishi Heavy Industries (MHI) and Worley as the selected FEED contractor for the Heidelberg Material (HM) Padeswood CCS Project shall deliver an overall FEED package utilizing MHI's Carbon capture technology.

The capture plant can be considered a green field development, but some elements of the integration with the cement plant will be considered brown field. Green field elements will be developed by MHI and Worley, while brownfield elements will be developed by both HM and MHI/Worley.

2. Document Purpose

The intent of this document is to provide the technical requirement for design of Tanks for the Heidelberg Materials Padeswood Cement Works CCS Project FEED Project.

3. Abbreviations, Definitions & References

3.1 Abbreviations

Acronym	Definition
A	a
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
B	b
BS EN	British Standard European Norm
C	c
CMTR	Certified Material Test Reports
F	f
FCAW	Flux Core Arc Welding
FEED	Front End Engineering Design
I	i
ITP	Inspection Test Plan
N	n
NDE	Non Destructive Examination
NPS	Nominal Pipe Size
P	p
PER	Pressure Equipment Regulation
PMI	Positive Material Identification
PQR	Procedure Qualification Record
PWHT	Post Weld Heat Treatment
Q	q
QA	Quality Assurance
S	s
SDRL	Supplier Documentation Requirements List
SPIR	Spare Parts Interchangeability Records
SMAW	Shielded Metal Arc Welding
SAW	Submerged Arc Welding
U	u
UT	Ultrasonic Testing
UKCA	UK Conformity Assessment
W	w
WPS	Welding Procedure Specification
WPQ	Welder Performance Qualification

Table 1 - List of Abbreviations

3.2 Definitions

Term	Definition
COMPANY / PURCHASER	Heidelberg Materials
CONTRACTOR	Consortium of Worley Europe Limited and Mitsubishi Heavy Industries Limited (MHI)
LICENSOR	MHI entering a Licensing Agreement with the COMPANY.
PROJECT	Padeswood Carbon Capture Plant.
SUPPLIER/VENDOR	Company / organisation supplying equipment, materials or services.
SUB-SUPPLIER	The organisation selected by the SUPPLIER/VENDOR to supply the part of equipment and services.
WORK	Shall mean all and any of the WORKs and / or services and / or materials required to be provided under the Contract with COMPANY.
shall and must	Indicates mandatory requirements.
Should	Indicates that a provision is not mandatory but recommended as good practice.
May	Used to indicate that optional action is available.
Inspector	The agency appointed by COMPANY or CONTRACTOR to carry out inspection in a SUPPLIER's premises.

Table 2 - List of Definitions

4. General

4.1 Scope of Specification

This specification is applicable to atmospheric storage tanks designed to API 650 and required for the Heidelberg Material (HM) Padeswood CCS Project FEED. Together with the tank datasheets and attachments thereto, it outlines the minimum requirements for design, supply, materials, fabrication, manufacture, assembly, construction, erection, surface protection, quality, inspection, testing, preservation, commissioning and documentation for storage tanks for carbon capture on the Heidelberg Material (HM) Padeswood CCS Project FEED.

This specification should be read in conjunction with the requirements detailed in the tank datasheets and the equipment material requisition as well as other equipment specifications applicable to the equipment and referenced by the relevant equipment requisition. Compliance with this project specification does not relieve the SUPPLIER from meeting the requirements of the ultimate user or his nominated representative when stipulated in the Material Requisition.

Storage tanks with internal pressure shall be designed and built to API 620.

In case of any conflict observed between this specification, drawings, datasheets, purchase order, the SUPPLIER shall request written resolution from the CONTRACTOR. Order of precedence as per Section 5.1 is to be followed to resolve the conflict.

4.2 Site Location and Environmental Conditions

A summary of applicable environmental and site conditions is included in the Basic Engineering Design Data document (215000-00190-000-EM-BOD-00002) and shall also be referenced on Equipment Datasheets.

4.3 Unit of Measure

The metric (SI) System shall be used as the units of measurement unless otherwise indicated in the Basic Engineering Design Data document, 215000-00190-000-EM-BOD-00002.

4.4 Language

All Engineering documentation will be in the English language.

5. Applicable Standards and Publications

All work shall comply with the applicable standards and publications listed in this section. If an applicable standard or publication is revised and re-issued during the execution of the Purchase Order / Contract, the Supplier / Contractor shall bring this to the attention of the Purchaser. The Purchaser will determine which revision shall apply.

5.1 Order of Precedence

The requirements of the standards and publications referenced in this specification shall be applied in the following order of precedence:

1. Government acts, regulations and statutory requirements.
2. Purchase Order
3. Project Data Sheets
4. Project Drawings
5. This Specification
6. Principal Specifications and Publications
7. Referenced Codes and Standards

Any conflict between the minimum requirements of the above documents shall be brought to the Purchaser's attention for resolution, prior to award.

An alternate specification or design may only be used when it satisfies the government and statutory requirements and offers a benefit to the project. All such alternatives shall require approval from Purchaser.

5.2 Government Acts, Regulations and Statutory Requirements

It is the responsibility of the Supplier/Contractor to ensure that the equipment, materials and services comply with all applicable government legislation and statutory requirements.

For ease of reference, the principal applicable legislation and statutory requirements include:

Table 3 – UK Regulations

Document Number	Revision or Date	Document Title
Statutory Instrument 2019 No. 696	2019	The Product Safety and Metrology etc. (Amendment etc.) (EU Exit) Regulations 2019
		UKCA Declaration of Conformity
Statutory Instrument 2016 No. 1107	2016	The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016
Statutory Instrument 2016 No. 1105	2016	The Pressure Equipment (Safety) Regulations 2016

5.3 Purchaser Standards and Publications

The equipment, materials and services shall comply with the following list of project specifications:

Table 4 – Project Specifications

Document Number	Revision or Date	Document Title
215000-00190-000-EM-BOD-00001	Note 1	Overall Basis of Design
215000-00190-000-EM-BOD-00002	Note 1	Basic Engineering Design Data
215000-00190-000-ML-SPC-00001	Note 1	Metallurgy specification - Positive Material Identification (PMI)
215000-00190-000-ML-SPC-00002	Note 1	Metallurgy Specification - Welding, PWHT and NDE (plant equipment)
215000-00190-000-ME-SPC-00014	Note 1	Mechanical Specification - Allowable Nozzle Loads
215000-00190-000-ML-SPC-00004	Note 1	Metallurgy Specification - External coating (piping and equipment)
215000-00190-000-ML-SPC-00005	Note 1	Metallurgy Specification - Insulation (Hot and Cold) for piping and equipment
215000-00190-000-ML-SPC-00006	Note 1	Metallurgy Specification - Internal lining for vessels and tanks
215000-00190-000-ME-SPC-00001	Note 1	Mechanical Equipment Specification - Pressure Vessels
215000-00190-000-SR-SPC-00001	Note 1	Active/Passive Fire Protection Specification

Notes:

1. The applicable revision shall be the one quoted on the requisition.

5.4 National, International and Industry Standards

The applicable national, international and industry standards and publications include:

Table 5 – National, International and Industry Standards

Document Number	Revision or Date	Document Title
API 650	Latest	Welded Steel Tanks for Oil Storage
API 620	Latest	Design and Construction of Large, Welded, Low-pressure Storage Tanks
API 2000	Latest	Venting Atmospheric and Low Pressure Storage Tanks

Document Number	Revision or Date	Document Title
ASME Section II	Latest	Boiler and Pressure Vessel Code- Materials
ASME Section V	Latest	Boiler and Pressure Vessel Code- Non Destructive Examination
ASME Section IX	Latest	Boiler and Pressure Vessel Code- Welding and Brazing Qualifications
ASME B16.5	Latest	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24
ASME B16.47	Latest	Large Diameter Steel Flanges: NPS 26 through NPS 60
BS EN 10204 /ISO 10474	Latest	Metallic Products – Types of Inspection Documents / Steel and steel products Inspection documents
BS EN 1991 1-3 + A1	Latest	Eurocode 1 – Actions on structures – Part 1-3: General Actions – Snow loads
BS EN 1991 1-4 + A1 (A1 NA)	Latest	Eurocode 1 – Actions on structures – Part 1-4: General Actions – Wind actions

6. Health, Safety and Environment

6.1 Hazardous Materials

The following materials shall not be used or installed:

- Asbestos in any form.
- PCBs (poly-chlorinated biphenyls).
- Mercury.
- Any paints containing lead or chromates.
- Cadmium Plated Bolts

7. Scope of Supply

7.1 General

The tanks shall be complete including all ancillary equipment/items required to meet the design and process performance conditions for internals (if any) as stated in Equipment Datasheet.

Any additional part, equipment, material etc. which are not specifically mentioned in this Specification but are required to make the supplied equipment complete in respect with the intent of this Specification, statutory requirements, applicable codes / standards and for safe and trouble-free operation, shall be deemed to be covered under the scope of the SUPPLIER.

7.2 Extent of Supply

The extent of equipment supply shall consist of tanks complete with all accessories to meet the intended service as stated in the Equipment Datasheets.

The SUPPLIER's scope shall include, but not be limited to, the following:

- Complete detail engineering (Mechanical)
- Shell, bottom plates, annular bottom plates and required attachments
- Roof
- Nozzle connections
- Internal lining (If applicable)
- Gaskets and bolt/nuts for all bolted joints
- Procurement of raw material
- Manufacture and fabrication
- Platforms, Walkways and Stairways
- Insulation & Fireproofing clips (if required)
- Earthing bosses / lugs
- Lifting lugs
- Name plates and brackets
- Surface preparation and Final Painting
- Quality Assurance/Quality Control, Inspection and testing in accordance with approved ITP
- 3rd Party Inspection where required to meet requirements of PER
- Any Structural / Bracing Support as required for temporary support during transportation and lifting for installation.
- Packing suitable for the method of transportation to and storage at site
- All documentation in accordance with the requirements of the Purchase Order
- UKCA marking
- PER certification
- Mechanical Warranty
- Spare parts as per Purchase Order
- Special Tools and tackles as per Purchase Order

7.3 Exclusions

The following items are excluded from the SUPPLIER's scope of supply:

- Civil works and foundation
- Site preparation
- Off loading
- Site storage
- Unpacking
- For field erected tanks:
 - Supply and installation of tank mounted instrumentation and control (I&C) and electrical scope of work.
 - Supply of fluid required for hydrostatic testing, flushing, and cleaning and the disposal of the hydrotest fluid after hydrotest is completed.

8. Technical Requirements

8.1 General

8.1.1 Design Life

The tank shall be designed to support the plant for its design life of 25 years.

8.1.2 Design Code

The Storage tanks shall be designed, constructed and inspected in accordance with API 650 for this specifications and other applicable Project Standards and Specifications as referenced in section 5.4 of this specification.

All components of the Tanks shall be designed for the expected mechanical design conditions including Wind, Snow and any other load specified in the Equipment Datasheet, in accordance with this Specification and referenced design Codes.

8.2 Design Requirement

8.2.1 General

The SUPPLIER shall be entirely responsible for the complete design, process guarantee (for internals if any), mechanical guarantee, materials, fabrication, inspection, testing, surface preparation, internal coating, painting, documentation and preparation of shipment of storage tanks in accordance with the requirements of this specification, datasheet and all referenced documents in Section 5 of this specification.

The SUPPLIER shall also be fully responsible for the selection and quality of all material inclusive of all consumables, welding, testing, protection devices, machinery, tools, labor, and all necessary materials and services required to complete the supply of equipment whether or not they are specified in the specification and attachments.

The SUPPLIER shall be fully responsible for the coordination with all his SUB-SUPPLIERS for materials and services provided by them. The SUPPLIER shall be solely responsible to COMPANY/CONTRACTOR for compliance with the specified requirements. This includes expediting and assurance that all applicable specifications referenced on tank datasheets, project specifications and material requisitions are supplied to SUB-SUPPLIER. The SUB-SUPPLIER list and their experience summary shall be provided to the COMPANY/CONTRACTOR for review and approval.

SUPPLIERS shall be responsible for obtaining all design and manufacturing approvals, permits, licenses, certificates and other documentation as required by statutory authorities and / or regulatory bodies.

Stainless steel tanks shall be designed and constructed in accordance with Appendix S of API 650.

All tanks shall be provided with venting system. The sizing of vents shall be carried out in accordance with API 2000.

Design of internals (if any specified on tank datasheet) shall ensure that it meets the process and service requirement. All internals shall be fabricated in sections to pass through the manhole.

Tank gauges, stilling wells and related fittings, internal pipes, pressure / vacuum vents, sampling connection / support pads, earthing connections, cathodic protection attachment, heating coils, agitators, insulation support rings / cleats, piping and platform support pads / cleats etc. as specified in tank datasheets shall be installed in accordance with applicable datasheets, project specifications and standards.

Heating coil pipes (if specified) shall be of seamless quality with schedule 80 as a minimum and connected by butt welded joints. Heating coil supports shall not be welded to tank bottom; however, they shall be rigidly supported.

Lap-welded joints shall be lapped at least five times the nominal thickness of the thinner plate joined. However, with double-welded lap joints, the lap shall not exceed 50 mm, and with single-welded lap joints, the lap shall not be less than 25 mm.

Top angles shall be attached to the shell by butt welds with complete penetration and complete fusion. The outstanding leg of the top angle shall not extend inside the tank shell.

All permanent attachments to the tank shall be completely fillet welded all around. Pad plates shall be used for all supports welded to shell and bottom plates. They shall be of the same quality and grade as the plates to which they are attached. Sharp corners are to be rounded to minimum 6 mm radius unless otherwise specified.

Details of each weld and its corresponding welding procedure specifications (WPS) shall be shown on the drawings.

Tanks with internal/external floating roofs shall be flush stacked on the inside. Tanks without floating roofs may be centerline stacked, or flush stacked on the inside or outside as specified on the storage tank datasheet.

Continuous welds shall be used for all horizontal top-side joints and for all vertical joints. Horizontal bottom-side joints shall be seal-welded.

Dead storage volume below which a tank cannot be unloaded under normal operating conditions shall be set at the practical minimum. For a pumped tank, the design operating capacity shall be the total tank volume less the sum of the free board allowance and the dead storage allowance.

It is to be ensured that enough space is available to accommodate the long length bolts used to install flushed type instruments.

8.2.2 Design Pressure

Tanks shall be designed for specified internal pressure considering the static head as per the datasheet.

Design liquid level shall be considered as specified in the storage tank datasheet.

8.2.3 Design Temperature

Maximum design temperature shall be specified on equipment datasheets.

8.2.4 Design Metal Temperature

Design metal temperature shall be specified on equipment datasheets.

The SUPPLIER shall determine the impact test requirement according to Code rules. The design metal temperature shall be indicated in the equipment datasheet, tank drawings and nameplate.

8.2.5 Corrosion Allowance

Corrosion allowance specified on the storage tank datasheet shall be added for carbon steel internal surfaces of shell courses, annular plates, bottom plates, nozzles and manholes, roof, and structural members.

Internal lining shall apply when specified on the tank datasheet. Internal lining shall comply with Metallurgy Specification - Internal lining for vessels and tanks, 215000-00190-000-ML-SPC-00006.

8.2.6 Shell

Shell minimum plate thicknesses shall be in accordance with the design requirements of API 650. The tank corrosion allowance specified in the storage tank datasheet shall be added to the calculated minimum plate thickness.

Nominal tank diameter shall be the inside diameter of the tank.

Tank shell courses shall be aligned in such a manner that inside diameter of all shell courses is same.

All carbon steel internal piping shall be of schedule STD wall thickness (excluding corrosion allowance) or higher, unless otherwise specified.

8.2.7 Connections & Nozzles

Nozzles shall be minimum 2" size. Number, size and type of nozzles and manholes shall be as specified in the storage tank datasheet.

Nozzle projections shall be in accordance with API 650 Table 5.6a & 5.6b. Projections shall be adequately increased to include insulation thickness, if applicable.

All nozzle connections shall be flanged type. Unless approved by COMPANY/CONTRACTOR, threaded /screwed connections shall not be permitted. When approved by COMPANY/CONTRACTOR or specified on the tank datasheet, threaded and socket welded connections shall be in accordance with ASME B16.11.

All nozzles shall be set-in design and shall be flushed with inside of the tank.

Bolt holes shall straddle the vertical centerline for shell nozzle, and the tank radial line for roof nozzle, unless otherwise specified.

Flanges NPS 24 and smaller shall be as per ASME B16.5, Flanges NPS 26 and above shall be in accordance with ASME B16.47 series A.

Manholes shall be circular cross section of 600 mm inside diameter, unless otherwise specified in datasheet.

Davit or hinge shall be provided for manhole covers for which weight exceeds 25 kg. Each manhole cover shall be provided with two handles.

Manholes / nozzles fabricated from plate shall have the same quality and grade as the plate to which they are attached. Reinforcing pads shall have the same quality and grade as the plate to which they are attached.

Pipes (internal as well as external) attached to nozzle shall be properly supported to minimize the load on the nozzle.

Shell nozzles of size 3" and above shall be provided with a reinforcing pad. Nozzle reinforcement shall be in accordance with API 650 Table 5.6a & 5.6b.

Cleanout door arrangement, if specified in storage tank datasheet shall be provided as per API 650.

Reinforcing pads and all other external attachment pads shall have rounded corners of minimum 50 mm radius.

All pads those covers shell seams shall be provided with a 6 mm telltale hole. Pad telltale holes shall be filled with grease after the leak test.

8.2.8 Roof

8.2.8.1 General

Type of roof (fixed cone or dome, external floating) for tanks shall be provided as specified in the respective storage tank datasheet.

Roof plates to shell junction of hydrocarbon storage tanks shall not be designed as having a frangible joint. Tanks shall be provided with connections adequate for emergency venting capacity.

Roof plates shall be continuously fillet welded to the curb angle but not attached to the roof supporting structure.

If underside of roof is to be coated, butt welded roof joints shall be used and all inside of joints such as roof to shell junction, roof plate to roof structure shall be seal welded to seal the crevices. In this case, roof design with external roof structure should be considered to minimize seal welding at site.

8.2.8.2 Supported Cone Roof

Welded joints shall be used for all structural attachments in the roof supporting system other than rafter clips for the outer row to the tank shell joint and column-base clip guide to the tank bottom joint.

8.2.8.3 Self-Supported Cone Roof

The roof lap joints shall be continuously welded on both sides.

Welded joints shall be used for all structural attachments in the roof supporting system.

8.2.8.4 Self-Supported Dome Roof

All dome roof storage tanks shall be self-supported type roof arrangement, unless otherwise specified in the tank datasheet.

8.2.8.5 External Floating Roof

Floating roof types shall be single or double deck as specified in the datasheet.

All external floating roofs shall be designed and constructed in accordance with Appendix C of API 650.

Unless specified otherwise, all decks shall be of the contact type design.

The floating roof shall be designed and constructed so that the roof travels between maximum and minimum design liquid levels without any damage to roof parts, internals and its appurtenances.

Double deck floating roofs shall have sufficient buoyancy to remain afloat on a liquid and have a strong structure designed to resist permanent distortions under uniform design load and wind load.

The design of secondary seals that permit the inspection of primary seals without removal of the secondary seals.

Emergency drains provided for double deck floating roofs shall be pipes, open ended on top and bottom, discharging 300 mm below the bottom of the roof. Pipes shall be adequately braced.

8.2.9 Bottom Plates

Tank bottoms slope including apex detail shall as specified in respective storage tank datasheet. Slope shall meet minimum requirement as per API 650 and shall be towards the drain sump.

Bottom plates, when lap welded, shall be welded with the lap towards the direction of the sump. At least two weld passes shall be used for lap welds.

8.2.10 Annular Bottom Plates

Annular plates shall be of the same material as the lowest (bottom) shell course material and butt welded.

8.2.11 Bottom Connection

Dimensions for draw-off sump shall be as per API 650, quantity for draw-off sump shall be as per tank datasheet, if required.

Internal piping shall be provided by the SUPPLIER for Draw-off sump.

8.2.12 Platforms, Walkways, and Stairways

All tanks shall be provided with platforms, ladders, walkways and staircases as necessary for access, operation and maintenance. Special attention shall be given to Instrumentation and ensure there is open space available for easy removal of instruments for maintenance.

Platform shall be provided for level gauge, sample hatch and instrumentation nozzles with access walkway to this platform from the top landing platform. Proper access shall be provided to manholes, vents and foam pourer nozzles, as applicable. Access walkway with handrails on either side to roof center shall be stairway (shall not be on anti-slippery pads or angle sections welded to roof plates). There shall be platform with handrails at roof center.

Spiral stairway shall be installed for storage tank with height more than 5 meters, and ladders for smaller tanks, unless otherwise specified in tank datasheet. Landing platforms shall be provided at approx. every 5 meter rise of the stairway.

All spiral stairways on tanks shall be of double stringer type. Ladders shall be caged type. Where the height between platforms does not permit access to a full cage, partial caging with side entry shall be provided.

Floating roof tanks shall be provided with a Gauger platform at top of stairway to access the gauge well and rolling ladder. Rolling ladder arrangement shall be designed to resist permanent distortions under strong wind conditions.

Toe plates of handrail posts shall extend continuously around the edges of all platforms, landings, walkways and openings except at stair and ladder landings.

Unless specified otherwise, all components of platforms, walkways, stairways and handrails for carbon steel tanks shall be hot dipped galvanized. Galvanized steel shall not be used on stainless steel tanks.

8.2.13 Cathodic Protection

Where indicated on the tank datasheet provision shall be made for the installation of internal sacrificial or impressed current cathodic protection system.

SUPPLIER design (where applicable) shall accommodate the installation of an under-tank cathodic protection system. Provision shall be made for enhanced safety D.C. negative connection points and installation of at least four conduits through the tank ring beam (at the cardinal points) for the routing of cable.

8.2.14 Foundation

Tank foundation shall be suitable with respect to level, drainage and other factors affecting the SUPPLIER's work. SUPPLIER shall provide loads and other engineering data to allow CIVIL CONTRACTOR to design and construct the foundations in accordance with SUPPLIER's design.

Unless otherwise specified in tank datasheet, Tanks in service other than water shall be designed to include a sub-grade protection membrane with facility for leak detection and collection in accordance with Annexure-I, API 650. The design of membrane shall include facility for leak testing of the membrane to demonstrate its effectiveness. The sub-grade protection membrane

shall be compatible with externally applied impressed current protection system, where specified.

Unstable tanks shall be provided with anchor bolts and concrete foundation rings. Uplift is caused by the internal vapor pressure acting against the underside of the roof, in conjunction with wind load. A stability calculation shall be made to determine the size, number and PCD of anchor bolts required. When required, the number of anchor bolts for vertical tanks shall be in multiples of four. Also, calculate loads (Shear force and Moments) for foundation design for empty, operating and hydro-test conditions in corroded and un-corroded state.

8.3 Design Loads and Design Criteria

8.3.1 General

Design loads shall be as described in the applicable Code and include the following:

- Dead Load
- Design Pressure
- Hydrostatic test Loads
- Live Load
- Wind Load
- Seismic Load
- Snow Load
- External Nozzle Loads

8.3.2 Dead Loads

It includes the weight of the tank or tank component, including any corrosion allowance unless otherwise noted.

8.3.3 Design Pressure

It includes internal and external design pressures as specified on equipment datasheet.

8.3.4 Hydrostatic Test Load

The load due to filling the tank with water to the design liquid level.

8.3.5 Live Load

For fixed roof tanks, the minimum roof live load of 1 kPa shall be considered on roof projected area for roof design in addition to external pressure specified in the storage tank datasheet.

For floating roof tanks, the minimum roof live load of 1.2 kPa shall be considered on roof projected area for roof design.

Localized loads resulting from items such as ladders, stairs, platforms, etc. shall be considered in design.

8.3.6 Wind Loads

Wind loads shall be calculated in accordance with Basic Engineering Design Data, 215000-00190-000-EM-BOD-00002.

BS EN 1991 1-4 + A1 (A1 NA) shall be used for calculating wind pressure and apply a basic wind speed of 16 m/s (52.49ft/s).

8.3.7 Seismic Loads

Seismic loads are not applicable. The site is not located in earthquake zone.

8.3.8 Snow Loads

Snow loads, if specified in the Equipment Datasheet, shall be calculated in accordance with Basic Engineering Design Data, 215000-00190-000-EM-BOD-00002.

Snow load assessment shall follow the principles and guidance of BS EN 1991-1-3:2003 + A1:2015 "Eurocode 1: Actions on structures – Part 1-3: General actions – Snow loads" and its corresponding National Annex NA to BS EN 1991-1-3.

8.3.9 Nozzle Loads

Local load analysis shall be carried out for nozzles located on tank shell per Mechanical Specification - Allowable Nozzle Loads, 215000-00190-000-ME-SPC-00014 and API 650.

Piping loads shall not be transferred on to nozzles located on tank roof. Piping supports, if any on tank roof shall be suitably located on the roof structure. Piping shall not be supported from tank roof plate.

8.3.10 Combination of Loads

Load combinations shall be as per API 650 clause 5.2.2.

8.4 External Attachments

8.4.1 General

All attachments welded to any component of pressure boundary shall be of the same material P number as the pressure boundary component.

8.4.2 Earthing Lugs

Number of earthing connections shall be as per the tank datasheets. Minimum two numbers earthing connections shall be provided for the tanks at diametrically opposite sides.

8.4.3 Insulation support rings and clips

When hot or cold insulation, including personnel and fire protection is specified for tank, insulation support rings and clips shall be provided.

8.4.4 Lifting Lugs for Equipment's

Lifting lugs shall be provided for all shop fabricated tanks. Holes shall not be cut in tank plates for erection purposes.

8.4.5 Fireproofing clips (If applicable)

Tanks shall be provided with suitable fireproofing clips.

8.5 Materials

8.5.1 General

Materials of construction and corrosion allowance shall be as specified in the datasheet. Use of alternate materials per API 650 Table 5.2a or 5.2b is subject to prior, written approval by COMPANY/CONTRACTOR.

Materials other than those specified may be proposed as an alternate when accompanied by their advantages and/or cost savings. Proposed alternative materials are to be approved by the CONTRACTOR.

Materials shall be in accordance with the latest edition of the ASME/BPVC Section II.

All materials shall be new, unused and free of defects. Material certification shall be submitted for CONTRACTOR's review and approval.

Materials shall be suitable for the minimum design temperature stated on the datasheet. If required, Impact testing shall be carried out in accordance with the Code.

Materials for special services (hydrogen, caustic, and amine services) shall comply Appendix D of Pressure Vessel Specification, 215000-00190-000-ME-SPC-0001 as applicable.

The SUPPLIER shall make necessary provision for the installation of cathodic anodes inside the tank and externally in the foundation as required. The SUPPLIER is responsible to design a system to protect the tank.

Positive material identification (PMI) procedures shall be performed on all alloy materials in the pressure retaining envelope, and welded attachments.

8.5.2 Material testing, Certification and Marking

All pressure retaining components, directly welded attachments to equipment (lifting lugs, lifting beams etc.) shall be provided with Certified Material Test Reports (CMTR) / Certificates per BS EN 10204:2004 Type 3.1.

For all other non-pressure parts, material certificates type 2.2 shall be provided.

Stamping of materials shall be carried out with low stress stamps.

8.6 Fabrication

8.6.1 General

All work of fabricating tanks shall be done in accordance with API 650 and with the permissible alternatives specified in this specification.

SUPPLIER may start fabrication only after receiving the written approval from COMPANY/CONTRACTOR on the SUPPLIER's detailed fabrication drawings, design calculations, welding procedures, and fabrication and erection procedure.

If tank is internally coated, the top curb angle shall be attached to shell by a full penetration butt weld. The outstanding leg of the top curb angle shall extend outside the tank unless otherwise specified on datasheets.

All materials shall be supplied in prefabricated condition to minimize the site work.

All internal surfaces and welding shall be free of sharp corners and porosity for tanks which are internally coated.

Nozzle neck shall be constructed from seamless pipe. If nozzle neck is constructed from rolled plate, the longitudinal weld shall be 100% radiographed.

Reinforcing pads shall be provided on the bottom of contact with floating roof support legs / fixed roof support columns / tank roof drain supports. Reinforcing pads shall be welded to bottom by continuous seam welding.

If a prefabricated assembly is to be stress relieved as per Code requirement, the whole assembly shall be stress relieved in a furnace. Where PWHT is required, all applicable inspection requirements shall be applied before and reassessed after completion of PWHT.

The tank shell shall be carefully checked for uneven settlement and any misalignment of the top of the shell shall be corrected before the roof members are positioned.

8.6.2 Welding Requirement

8.6.2.1 General

All welding, qualification of welding procedures, and qualification of welders and welding operators shall be performed in accordance with the ASME Section IX and Specification for Welding, PWHT and NDE of Plant Equipment 215000-00190-000-ML-SPC-00002 as restricted herein.

The SUPPLIER shall be responsible for the following, with referenced documents made available for use by welders or welding operators and for reference by CONTRACTOR:

- Selecting and preparing the WPS for each type of joint, material, and thickness with weld map.
- Preparing and providing a procedure qualification record PQR documenting proof of weldability of the variables described in the WPS.
- Preparing and providing a welder performance qualification WPQ documenting proof of the welder's ability to deposit sound weld metal within the range of WPS parameters being used.
- Submitting weld procedures to CONTRACTOR for acceptance prior to beginning fabrication of the tank.

Peening of welds is prohibited.

Weld repair procedure, if any, shall be submitted to COMPANY/CONTRACTOR for written approval with details provided for the extent of repairs.

8.6.2.2 Welding Procedure Specifications (WPS)

The WPS shall clearly identify the essential variables, materials, specifications, and consumables by name and specification, as well as the standard ASME Code requirements.

The application for each WPS shall be shown on a separate weld map or welding and testing plan, which shall clearly indicate the WPS for each main type of joint and for attachments.

8.6.2.3 Welding Procedure Qualification (PQR)

The WPS shall be qualified for all welding to be used for fabrication of the tank, including repair welding to the requirement of ASME Section IX.

When Charpy V-notch impact tests are required, the size of consumable and heat inputs used shall be considered supplementary essential variables.

Welding procedures shall be qualified with PWHT as applicable for each tank.

When Charpy impact test is required on the base material, the weld procedure qualification shall meet impact test requirement for the welds and HAZ (heat affected zone).

8.6.2.4 Welding Process

Acceptable methods of welding shall be shielded metal arc welding (SMAW), submerged arc welding (SAW), gas metal arc welding (GMAW), GTAW (gas Tungsten arc welding), and flux-core arc welding-gas shielded (FCAW-G) processes.

Other welding processes may be used only with COMPANY/CONTARCTOR's written acceptance.

The interrupted-arc (short-circuit transfer) GMAW process may be used only for the following applications:

- Root passes on circumferential, longitudinal, or nozzle-to-shell welds if back-gouged and back-welded.
- Root passes on circumferential piping welds for fabricated nozzles or internal piping.

Joints welded from two sides shall be ground, back-chipped, or back-gouged to sound metal before continuing welding on the back side of the joint.

Before welding or hot cutting, weld surfaces and heat-affected zones (HAZs) shall be clean and free of lead, sulfur, dirt, grease, and any other deleterious material.

8.6.2.5 Weld Map

A weld map that indicates each weld and the weld procedure to be used shall be submitted for approval at the same time as the weld procedure.

8.6.2.6 Welding Consumables

A welding material handling procedure shall be submitted for approval. As a minimum, procedure shall define storage, issuance and recycling.

Selection of consumable shall be the responsibility of the SUPPLIER to meet the specified requirements of strength, toughness.

8.7 Heat Treatment

All parts hot formed from carbon steel shall be normalized after forming unless it can be demonstrated to the satisfaction of the COMPANY/CONTRACTOR that those parts were formed within the normalizing temperature range. The upper limit of the temperature range, whether for normalizing or forming, shall not exceed 960°C.

Tanks shall be post weld heat treated as follows:

- Where required by the design Code.
 - When specified on the Equipment Datasheet due to Special service
- No welding or thermal cutting is permitted on stress relieved tank after completion of final PWHT. SUPPLIER shall submit procedures for all heat treatment operations for COMPANY/CONTRACTOR's approval prior to work commencing. PWHT shall meet or exceed minimum requirements specified in design Code.

Heat treatment procedures shall give details of heating rate and temperature control method. All machined faces shall be suitably protected during post weld heat treatment.

8.8 Tolerances

Tank dimensional tolerances shall be as specified in API 650, paragraph 7.5 In addition, the tank nozzles shall be installed within the following tolerances:

Projection from the inside of the tank to the face of flange ± 3 mm.

Elevation or orientation ± 6 mm.

Flange tilt in any plane $\pm 1/2$ degree but not to exceed 5.0 mm.

For hillside nozzles, from face of flange to centreline of tank and from centreline of tank to centreline of nozzle ± 6 mm.

Flange bolt hole orientation ± 1.5 mm.

8.9 Surface preparation and Painting

All surfaces of completed tank shall be cleaned to remove loose scale, rust, grease, dirt, weld spatter, hydro-test water and other foreign matter. Internal surfaces are to be cleaned of foreign materials and thoroughly dried.

The type of coating and painting systems to be applied shall be as specified on the Equipment datasheet.

SUPPLIER shall submit detailed surface preparation, coating and painting procedure for CONTRACTOR approval.

All external surface preparation, painting and protective coatings shall be in accordance with Project Specification for External Coating 215000-00190-000-ML-SPC-00004.

External surface preparation, priming and painting shall only be carried out after hydro test and all other tests have been satisfactorily completed.

Surfaces to be coated shall be cleaned and prepared prior to its coating in accordance with the applicable coating and painting systems.

Gasket contact surfaces shall be properly protected from blasting and shall not be coated or painted.

8.10 Insulation and Fireproofing

External insulation/personnel protection, if required, shall be in accordance with Specification for Insulation (Hot and Cold), 215000-00190-000-ML-SPC-00005.

The insulation supports shall be located so as to allow the removal of insulation cladding, and not adversely affect adjacent insulation from the removal, in locations where access ports are located.

Surfaces shall be appropriately cleaned before installation of insulation/ personnel protection.

Fire proofing requirements if indicated in the datasheet shall be in accordance with Active/Passive Fire Protection Specification, 215000-00190-000-SR-SPC-00001.

8.11 Equipment Nameplates

Each completed tank shall be provided with SS 304 name plate in accordance with the requirements of API 650 Section 10 & PER.

Name plates to be in English. Name plates shall be shared digitally and be legible.

The nameplate shall be attached to the tank shell adjacent to a manhole or to a manhole reinforcing plate immediately above a manhole. A nameplate that is placed directly on the shell plate or reinforcing plate shall be attached by continuous welding or brazing all around the nameplate. A nameplate that is riveted or otherwise permanently attached to an auxiliary plate of ferrous material shall be attached to the tank shell plate or reinforcing plate by continuous welding.

8.12 Erection

The foundation for receiving the tank bottom shall be suitable for the type of bottom specified. The SUPPLIER shall be responsible for proving all technical loads for designing the foundation and shall also inspect and takeover the foundation prior to start of tank erection.

All tank components to be marked for erection in accordance with "List of Identification Marks" to be prepared by SUPPLIER.

Holes shall not be cut into the shell for erection purposes.

Plate misalignment shall not be corrected by grinding off plate thickness to reduce offset.

Prior to field erection, shop fabricated components to be stored at site, in a manner to prevent physical damage. Bottom and roof plates should be properly supported during transportation, shipping, and storage at construction site in order to retain flatness / fabricated shape of the fabricated plate items.

9. Quality Inspection, Testing and Certification

9.1 Quality Assurance

The SUPPLIER shall have an accredited quality system in place that is in accordance or exceeds the requirements as per relevant sections of International Standard Organization (ISO) 9001 or equivalent.

The SUPPLIER shall submit an Inspection Test Plan (ITP) for COMPANY/CONTRACTOR approval prior to procurement of any materials. The ITP shall list and detail all quality related activities, reference standards, acceptance criteria, and responsible personnel assigned by the Supplier to carry-out the activities.

9.2 Inspection and Tests

Inspection and testing requirements shall be in accordance with the respective storage tank specification/ datasheet, applicable project documents, API 650, other applicable codes / standards (specified in section 5 of this Specification) and also in accordance with SUPPLIER's standard inspection and testing requirements.

SUPPLIER shall identify all tests that will be carried out on the storage tank at his works and at project construction site in the preliminary Inspection and Test Plan (ITP) to be submitted with the bid and which will be later revised and submitted as a contract Inspection and Test Plan for review and approval by COMPANY / CONTRACTOR. The COMPANY / CONTRACTOR or its authorized representative, shall be permitted at all times free access to all areas of SUPPLIER's workshop that concern the fabrication and testing of the storage tank.

All items shall be inspected and certified by a Third Party Inspection Agency / Authorities, if appointed by the COMPANY / CONTRACTOR.

A detailed test procedure of shop tests and field tests shall be submitted at least 10 weeks in advance of any testing and shall be approved by the COMPANY / CONTRACTOR. SUPPLIER shall provide weekly reports during procurement and fabrication phases indicating progress status.

9.3 Non-Destructive Examination Methods

All non-destructive examination (NDE) shall be in accordance with the requirements of API 650.

The NDE procedures shall be submitted for COMPANY/CONTRACTOR review. All SUPPLIER's and personnel performing NDE must be qualified and certified in accordance to specified standards and regulations.

The SUPPLIER shall ensure the welders and NDT operators are suitably qualified.

Calibration certificates for test & NDE equipment shall be available for inspection at all times.

The complete length of all welds on lifting attachments shall be examined by NDE for surface flaws.

Wherever heat treatment is applicable, non-destructive testing shall be carried out before and after completion of heat treatment.

All NDE methods shall cover the whole wall thickness. SUPPLIER shall submit the NDE procedures for COMPANY / CONTRACTOR'S review.

9.3.1 Radiographic Testing

Radiography examination shall be in fully accordance with paragraph 8.1 of API 650.

Radiography shall be conducted promptly as tank erection progresses so that it may be used for quality control, rather than as a basis for acceptance after all welding has been completed. Purchaser to give approval in all cases.

9.3.2 Magnetic Particle Testing

Magnetic particle testing shall be in accordance with the requirements of paragraph 8.2 of API 650.

9.3.3 Ultrasonic Testing

Ultrasonic examination shall be made in accordance with paragraph 8.3 of API 650 and ASME V.

9.3.4 Liquid Penetrant Testing

Examination shall be made in accordance with paragraph 8.4 of API 650 and ASME V.

At least the following welds shall be 100 % liquid penetrant examined:

- Attachment welds, to the equipment tank shell and/or roof, subject to loads (supports for attached piping, lugs, platform & caged ladder supports, etc...).
- The supports / clips for the internals (pontoon, etc...).

9.3.5 Visual Examination

All welds shall be subjected to 100% visual examination in accordance with paragraph 8.5 of API 650 and this specification.

Appearance and dimensional check of the complete equipment needs to be done by Supplier.

Supplier to issue a dimensional check report, which shall be used during final inspection by Purchaser's designated inspector and Contractor.

9.3.6 Vacuum Testing

Vacuum box testing of all bottom plates shall be in accordance with paragraph 8.6 of API 650. Vacuum box testing shall be performed prior and after hydrostatic testing.

A report of the test including a statement addressing temperature and light intensity shall be completed and submitted to the Purchaser and shall be part of final data book.

9.3.7 Impact Testing

Impact test requirement for all carbon and low-alloy steel materials shall be in accordance with the requirements of section 4 of API 650 unless otherwise specified on the Equipment Datasheet.

Impact tests shall be done at a temperature not higher than the minimum design metal temperature for the Tank.

All impact test results shall be reported in the material SUPPLIER's certified test reports. Percent shear shall be reported for information only.

9.3.8 Positive Material Identification

Tank parts fabricated from alloy and SS material shall be subject to Positive Material Identification (PMI). SUPPLIER shall recommend the extent of PMI and submit procedure for PMI for COMPANY/CONTRACTOR review and approval.

The results of acceptable PMI tests shall be recorded and included in the final Manufacturing Record Book.

9.4 Hydraulic Testing

Tanks shall be hydrostatically tested per API 650 or API 620 as applicable.

Prior to the hydrotest, the inside of the tank shall be cleaned by sweeping, vacuuming or other methods so that the tank will be "broom clean" and free of all trash, dirt, welding rod stubs and other construction debris.

The Tank SUPPLIER shall be responsible for conducting the tank hydrostatic test. Any limitations on filling rates or stage filling requirements for foundation consolidation will be specified by the COMPANY.

The hydrotest shall be conducted with all accessories, weld on attachments and appurtenances installed.

Tanks constructed of austenitic stainless steel or austenitic stainless clad material shall be hydrotested with potable water only, with maximum chloride content of 50 ppm; no salt, brackish, or raw river water shall be used. Parts of a tank that cannot be completely drained shall be flushed with boiler condensate or demineralised water having a maximum chloride content of 50 ppm.

For shop-built tanks the SUPPLIER is responsible for the supply of the test water.

After completion of the hydrotest, the Tank SUPPLIER shall drain the tank and open the tank for inspection. Final cleaning of the tank will be by the SUPPLIER.

All weld attachments provided with tell-tale holes shall be tested prior to hydrotest. Reinforcing pads and similar attachments shall be tested at pressure of 103 kPa with air. Test holes to be left open, after the test.

The SUPPLIER shall submit all test procedures (shop and field testing) for COMPANY/CONTRACTOR's approval, not later than 8 weeks before the scheduled testing.

Where the product stored has a specified gravity greater than 1.0. special attention should be given to the method of testing to ensure that the tank walls are sufficiently overloaded above

the normal operating load. The SUPPLIER's test procedure shall be subject to approval by the COMPANY.

The equipment shall be cleaned and thoroughly dried after pressure test.

Mechanical stability shall be ensured during hydrostatic LOAD.

9.5 Manufacturing Repair

Repair welding of defects in material shall be performed using a qualified repair procedure, after approval by COMPANY/CONTRACTOR. All repairs shall be fully recorded. Qualification of repair weld procedures shall be required by the COMPANY/CONTRACTOR.

SUPPLIER shall carry out repair of all weld joints that fail to pass NDE requirements.

No repairs shall be carried out after hydro testing. Repairs required if any, shall be performed only after obtaining written approval from COMPANY/CONTRACTOR.

9.6 Registration, Certification and Regulatory Approval

Any additional design review or inspection required by a third party (hired supplier for drawing review and physical inspection) for proper approval prior to equipment start up required by local/state governments will be the responsibility of the equipment supplier. Requirements shall be stated in the requisition and associated documentation.

10. Operability and Maintenance Requirements

SUPPLIER shall provide full details for maintaining the equipment as specified in the Supplier Documentation Requirements List (SDRL) as part of the Requisition.

The tank shall be designed so that all maintenance can be carried out with the minimum special facilities/tools.

11. Preservation, Packing and Shipping

11.1 General

The SUPPLIER shall be responsible for preparation for shipment including packing, protection, preservation, labelling and marking of all shop fabricated items.

After inspection and testing, all equipment shall be thoroughly cleaned, dried and touched up with paint if necessary.

Packing protection and marking shall be provided and be suitable for transportation and short-term storage outdoors.

The transportation constraint for this project is an envelop size 18m(L) x 5m (W) x 3.8m (H). Hence same shall be accounted to define overall size of equipment single piece. Envelop constraint shall be further verified by the EPC CONTRACTOR with outcome report received for the "Scope of Work for Logistics Study" from 3rd Party Logistics Specialist during FEED Phase. The envelop size constraint as per Logistics Study Report (prepared by Logistics Specialist) will have precedence over the limit specified here in.

Suitable protection of the equipment shall be provided for transportation, shipment and storage at construction site.

It shall be the SUPPLIER's responsibility to ensure that the equipment is adequately braced and blocked for transportation to ensure that damage is not caused during loading, transportation or unloading. The CONTRACTOR does not bear any responsibility for materials before delivery in accordance with the contract terms.

All lifting equipment/devices shall be proof load tested. Proof load tests shall be witnessed by COMPANY/CONTRACTOR's representative and shall be certificated as proof of test. Copies of lifting certificates shall be supplied with the packages on delivery and shall accompany the package until final installation

11.2 Packing

The component shall be securely packed for shipment from SUPPLIER'S location to the actual component destination. All packing shall be suitable for sea transport and shall be per export packing requirements.

The loose supplied components shall be adequately packed to withstand at least 12 months storage at project site prior to installation.

Spare Parts (start up, commissioning and operating spares) shall be packed separately and clearly marked "Spare Parts" for "Start-up, Commissioning and Operating".

11.3 Preservation

All tanks shall be thoroughly cleaned internally and packaged free of loose foreign materials. The SUPPLIER shall replace all parts which have defects due to loose debris left from fabrication / shop tests at his own cost.

SUPPLIER shall provide a detailed preservation specification for the tanks for sea transportation and long duration storage (at least 6 months) at Project Site.

All openings shall be covered or capped to protect the inside surface from dust, rust and moisture during transportation and storage.

11.4 Identification and Marking

The SUPPLIER shall attach a packing list, in a waterproof enclosure, to the outside of the package. In addition to any specific requirements identified via the documentation referenced within the requisition, the packing list shall clearly show as a minimum:

- CONTRACTOR's Name;
- Address;
- Project Name;
- Name and Address of SUPPLIER;
- CONTRACTOR's Purchase Order Number;
- Purchase Order Item Number;
- Partial or complete delivery for each Order Number;
- Description of Contents;
- Number of Packages.

Tanks shall be clearly identified by painting or stenciling on the Purchase Order number, equipment item number, etc., according to the CONTRACTOR's instructions. Additional indications such as north/east/west/south along with center of gravity shall be clearly marked.

Orientation shall be marked on the surface of the tank at 0°, 90°, 180°, and 270° respectively, with white paint.

12. Spare Parts and Special Tools

12.1 Spare parts

All spare parts furnished by SUPPLIER shall be wrapped and packaged to preserve original as-new condition under normal conditions of storage anticipated at the project site. The same parts shall be tagged by stainless steel tags and coded so that later identification as to their intended equipment usage will be facilitated. All items supplied shall be packaged separately and clearly marked as "Spare parts" and shipped with the Tank.

12.2 Special Tools

All special tools required as per requisition shall be provided by the SUPPLIER.

13. Technical Documentation

13.1 General

The tank documentation both quantity and format shall be provided in accordance with COMPANY/CONTRACTOR's requirements as defined in the Purchase Order/Requisition.

Documentation to be submitted after order shall be in accordance with the agreed Purchase Order requirements and the Supplier Data Requirements List (SDRL) which will be attached with the Requisition.

All documents to be prepared by the SUPPLIER shall be checked and signed by a competent representative of the SUPPLIER for compliance with codes and specifications before the documents are submitted to the CONTRACTOR.

13.2 Test Certificate and Documentation

Certificates of each mechanical test shall be furnished, including pressure test certificates.

The SUPPLIER shall supply test documentation covering all the tests, which are performed during the implementation stages, installation and commissioning phase. The SUPPLIER shall supply all relevant test and calibration certificated applicable for equipment.

13.3 Material Certificates

Material certificates shall be furnished for all components as detailed in Section 8.5.2 of this specification.

Components shall be fully traceable back to the certificate. Full traceability of pressure retaining welds and critical structural steel welds (i.e. Lifting lugs) is required. The traceable data shall include NDE reports, welding procedure and welder number.

13.4 Instruction Manuals and Data Report

SUPPLIER shall provide complete Installation Instructions, Operating and Maintenance Manuals, Manufacturer Data Book.