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1. General

1.1 Introduction

The plant is “Designed” to accommodate the “Maximum” conditions.

1.2 Scope

This specification defines the minimum requirements for the design, manufacture, inspection and testing of Flotation Cells in Copper-Moly concentrate plant project. if some item of this specification is not applicable, VENDOR shall specify, a list of any specific exclusion to this specification, otherwise any claims for extras arising out of non-compliance with this specification will not be considered. Compliance by the manufacturer with the provisions of this specification does not relieve him of the responsibility of furnishing Flotation Cells and relevant accessories of proper design, mechanically suited to meet operating guarantees at the specified service conditions. In addition to requirements of this criteria, work shall be done in accordance with recognized and accepted theories, methods, codes, standards and good engineering practice. It should be noted that all Engineering (Detail Design), Procurement and Construction activities must be done by Contractor, based on Project Design Criteria, Specifications and engineering documents approved by Employer.

No deviations or exceptions from this specification shall be permitted without written approval of the Contractor. All activities must be done base on contract documents by contractor and should be submitted to Employer for review and approval. Contractor should be assured about using last revision of all documents.

Supplier shall follow requirements of this specification together with all its due referred approved documents (such as P&ID, data sheets, material requisition, welding procedure specification, surface preparation and painting specification, etc.)

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as well as latest available edition of all specified international codes and standards which most of them are mentioned in following section.

1.3 Regulations

The work shall be done in accordance with the national and local laws and regulations. For subjects not covered by regulations or specifications, the design and construction shall be based on good engineering and working practice and shall be subject to approval by EMPLOYER in written.

The contractor shall inform the EMPLOYER in case of any deviation from the requirements of this specification which is considered necessary, in order to comply with national/local regulations.

1.4 Reference Codes and Standards

The latest revision and edition of the following codes and standards shall constitute minimum requirements of this specification, where applicable. In any case of discrepancy between the codes and standards and specifications, the requirements shall be considered according to EMPLOYER written approval.

ABMA	Anti-Friction Bearing Manufacturers Association
ANSI	American National Standards Institute (For flange connections, couplings, fasteners, etc.)
ASLE	American Society of Lubrication Engineers
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
AGMA	American Gear Manufacturers Association
JIS	Japanese Industrial Standards
ASTM	American Society for Testing and Materials
API 670	Machine Protection System (MPS)

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ISA	Instrument Society of America
ISO	International Organization for Standardization
	Including:
ISO 12944	Paints and varnishes — Corrosion protection of steel structures by protective paint systems
ISO 2768	General tolerances
HI	Hydraulics Institute
MPTA	Mechanical Power Transmission Association
OSHA	US Occupational Safety and Health Administration
SSPC	Steel Structures Painting Council
UBC	Uniform Building Code
IEC60027	Letters, Symbols to be used in Electrical Technology
IEC60072	Rotating Electrical Machines
IEC60050-411	International Electro technical Vocabulary Rotating Machines
IEC60072	Dimensions and Output Rating for Rotating Electrical Machines
IEC60085	Thermal Evaluation and Classification of Electrical Insulation
IEC60445	Identification of Equipment Terminals and of Terminations of System Certain Designated Conductors Including General Rules of an Alphanumeric
IEC60072-1	Frame Size and Dimension
IEC60034-1	Duty & Rating Class
IEC60034-6	Performance

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	Welding — General tolerances for welded
BS EN 13920	constructions — Dimensions for lengths and
	angles — Shape and position
EN 10204	Metallic Products-Types of Inspection Documents
BS 4999	General Requirement for Rotating Electrical
	Machines, Winding Termination
BS 5512	Dynamic Load Ratings and Rating Life of Rolling
	Bearing
BS 6121	Mechanical Cable Glands
NEMA	MG1-1998 Motor and Generators

1.5 Occupational Health and Safety

The Contractor shall adopt safe systems of work which minimise the risk to health and safety. All persons working on the site shall be competent to carry out their tasks and duties safely and in a manner that will not endanger their own health nor the health of others. Persons, when first employed on the site, shall be subject to appropriate pre-employment occupational health checks, instructed on the hazards inherent in the site, precautions to be taken, the form of construction, and emergency procedures and fire safety. Such instructions shall be given whenever there is a material change in the working arrangements. The Contractor shall maintain a record of all persons instructed and each person shall be required to sign such record confirming that instruction has been received. No person shall be permitted on site without being inducted as set out above. The Contractor shall prepare a written statement of Safe Systems of Working which shall be issued to all persons at site.

1.6 Quality Management and Records

- The project shall be administered using an accredited Quality Management System conforming.

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- References to the agreement of materials, workmanship, methods, etc. throughout this Specification shall be interpreted as requiring the agreement of the Employer.
- The Contractor shall maintain all records necessary under this Specification, including quality records as appropriate.
- Copies of all site records shall be available to the Employer.
- The Contractor shall supply the Engineer with all information necessary for the Health and Safety File including as-built drawings and records, maintenance schedules, operation and maintenance manuals, within the time specified in the contract, after substantial completion of the Works. Information shall be provided in the agreed format.

1.7 Measurement Units

SI units shall be applied to the measuring units.

1.8 Language

All drawing design information, Documentation, Operation, and Maintenance Instructions & Correspondence shall be in English.

2. DESIGN DATA

2.1 Working time

The working time is as follows:

Description	Value
Calendar days per year	365
Production days per year	320
Number of shifts per day	3
Working hours per shift	8
Utilization factor	0.85

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2.2 Site condition

For Site Conditions Refer to Document No. 12002-D-PR-DOC-303-GNL-001.

3. Design Requirements

3.1 General

Design and workshop detail drawings of flotation steel tanks shall incorporate bolted connections for all items too large to be transported to site in one piece. Site welding shall be avoided. Approval shall be sought from the EPC Contractor if the Sub-Contractor deems that site welding is required for completion of assembly on site.

As a minimum and unless otherwise stipulated in the project specifications, the requirements set out in the AISC publication: Code of Practice for Steel Buildings and Bridges, 2010 shall apply.

3.2 Standardization

Equipment shall be designed with standard components wherever practicable to:

- Reduce spare parts holding
- Reduce maintenance and operating cost

Wherever possible, all replaceable and consumable materials and components shall be selected from standard supply components locally available in IRAN. The use of any “one off” special designs is subject to approval by the Client.

3.3 Safety

The supplied equipment shall be designed to ensure the safest possible operation and shall be supplied with all safeguards and warning notices required for personnel protection. Safety requirements covered under the referenced International Codes and Standards and local regulations shall be strictly complied with.

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3.4 Non-Permissible Materials

Flammable materials, or materials which themselves are not non-flammable but support combustion shall only be used if alternative non-flammable materials are not readily available or unless operating conditions dictate otherwise. Selection of such materials is subject to approval by the EPC Contractor.

In toxic or flammable or corrosive applications, materials which are not compatible with the process fluids or which do not possess adequate mechanical strength sufficient to resist damage shall not be used.

Materials containing asbestos shall not be used. This requirement is mandatory and no relaxation shall be provided under any circumstances.

3.5 Environment, Sustainability and Community

The design of the plant and equipment shall comply with all local environmental legislation and requirements and reference to ISO 14001 Environmental management systems.

In particular mechanical engineers and designers shall seek to mitigate the following potential environmental hazards in the design phase:

- Uncontrolled spillage or leakage of lubricants and other fluids;
- Excessive noise;
- Excessive spillage of materials e.g., from screens.

The mechanical design of plant and equipment shall consider sustainable operation over the design life of the equipment including:

- Energy efficiency;
- Operations and maintenance requirements and procedures;
- Reliability, availability, maintainability requirements;
- Constructability;
- Standardization of components and minimization of spare parts stock;

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- Availability of replaceable, repairable and consumable components locally;
- Availability of technical support locally within the region.

3.6 Proposals for Change

Proposals for change of materials, sections, designs, details or the manner of performing the work as shown on the drawings or specified shall be submitted to the EPC Contractor and Client for approval. No changes shall commence until both the EPC Contractor and Client provide written approval.

3.7 Materials

3.7.1 General

All materials shall be in accordance with approved drawings.

All material to be used in the work shall be new and in good condition, free from rust and pitting.

The Sub-Contractor shall obtain from the steel supplier test certificates relating to tests performed by the manufacturer for the purpose of establishing compliance with the appropriate material specification as required by the EPC Contractor.

3.7.2 Protection

Prior to and during fabrication, all steel materials shall be protected from the weather.

3.7.3 Welded Splices

Material for structural members shall be supplied in full stock lengths such that splices shall only be used where shown on drawings. Where materials are not

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available in full stock lengths, written approval to splice shall be obtained from the EPC Contractor prior to commencing fabrication.

3.7.4 Bolts and Gaskets

High strength structural hexagonal bolts shall comply with DIN 931 and DIN 933 and DIN 934 for hexagonal nuts as well. Commercial grade bolts and nuts could only be used for hand railing unless noted otherwise. All nuts, bolts and washers shall be galvanized unless noted otherwise.

Gaskets shall be selected in accordance with the suitability of the liquid contained and the prevailing process conditions.

No asbestos type gaskets shall be used.

3.8 Lifting Lugs

Unless noted otherwise, all tanks, surge bins, sumps and shall have four off lifting lugs, positioned such that the tank, surge bin, sump, pontoon or chute is level and orientated correctly for installation when lifted. The requirements for the lifting lugs are as follows:

- Size, shape and material requirements of lifting lugs are to be selected from standard lifting lug detail sheets, available from the EPC Contractor.
- Fabrication and welding of lifting lugs are to comply with this specification.
- All lifting lug welds shall be subject to 100% ultrasonic or radiographic testing and all other requirements of Section 7.2 of this specification shall apply.
- Lifting lugs shall be painted to the specification of the fabrication they are attached to; the final paint coat shall be Safety Yellow.

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Where lifting lugs present obstructions or clashes in the completed structure they shall be removed after installation and the steel surface coating repaired in accordance with the Protective Coatings specification.

3.9 Deliverables

3.9.1 Flotation Cells

- Cell Tanks with Rubber lining
- Mechanism including:
 - Rotor,
 - Stator,
 - Draft Tube,
 - Lower shaft, etc.
- Electrical & Instrumentation including:
 - Motor and Pulley,
 - Level control (External Vertical),
 - Dart valve, 4 sets per row – 2 Dart valve per set
 - Actuator (Pneumatic),
 - Local control panel (PLC) (if any)
 - Level instrument (Ultrasonic with Ball & Target plate), etc.
- Air Flow Control:
 - Transmitter,
 - Control valve,
 - Actuator (Pneumatic or motorized)
 - etc.
- Feed box & Discharge Box & Drop Boxes with Rubber lining
- All Interconnection Launderers
- All Interconnection Piping

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- All Interconnection Electrical Cabling
- Surface Protection
- Maintenance Walkways (Open Mesh Grating)

3.10 Electrical Requirements

The motor should satisfy the requirements according to Technical Specification for MV & LV Motors.

The Local Control Board (LCB) should satisfy the requirements according to Technical Specification Local Control Board.

3.11 Instrument & Control Specification

The instruments required for the Flotation Cells should be engineered, designed and tested according to international Standards and subject to engineer review and approval.

A Level instrument device for level Control shall be considered. Instrumentation and control of this package shall follow the requirements of Project instrument design criteria and package control system specification attached to the inquiry documents.

The control system shall be capable of communication with the plant DCS (Distributed Control System) through serial and hardwire links. The signal list will be finalized in the package I/O list. Preferred serial link is Profinet, however, it will be finalized in the pertinent documents.

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3.12 Component Assemblies

3.12.1 Component Marking

All Parts which are supplied to site in sub-assemblies shall be marked with a die stamp mark in accordance with the shop drawings and marking plans as applicable, at an appropriate stage prior to application of the surface protective coating.

In addition to the stamped marking, each sub-assembly shall be stencil marked with a permanent ink marker that is compatible with the surface protective coating after the final coat of paint has dried.

3.12.2 Bolting

All bolts and threads for equipment (not piping) shall conform to ANSI/ASME B18.2.3.1M-1996 (metric) with mating nuts and washers, unless stated otherwise.

Tapered washers shall be used with tapered sections.

Two full threads shall protrude through a nut when the nut has been tightened to recommended torque. In the case of the use of locknuts sufficient thread shall be available to allow two full threads to protrude after both nuts tightened.

All bolts less than 12mm size or bolts of any size which are used to attach removable access covers, shall be grade 316 stainless steel. Bolts less than 12mm are not preferred.

When bolting onto parallel surfaces, all nuts shall be fitted with plain parallel washers except where the machinery is subject to vibration or movement. Then spring washers, nylon insert locknuts or tack welding shall be used as indicated by the design. Where nut adjustment is required, castellated nuts with split pins shall be used. For thread diameters of 8mm and smaller, the use of tab washers shall be permitted.

Bolts shall be installed in conformance with the following assembly requirements:

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- All bolt heads and nuts shall make contact, bearing on parallel plane surfaces perpendicular to the bolt axis;
- A tapered washer shall be correctly positioned under the bolt head or the nut whenever the surfaces contacted are not parallel and perpendicular to the bolt axis. It shall be used against the sloping surface;
- A flat washer or a tapered washer shall be used under the bolt head or nut, whichever is to be rotated during tightening operations;
- Washers shall be of adequate size and thickness to prevent their distortion, for any reason, during tightening;
- After assembly and proper part-turn tightening procedure, bolts shall project through nuts for a minimum distance of two full threads;

Plate liners, unless otherwise specified, shall be fitted with nib-headed countersunk bolts and spring washers shall be used under the nuts.

3.12.3 Flange and Cover Bolting

All bolts and gaskets shall be as specified on the detail design drawings. Where rubber linings are used, they shall not act as the gasket i.e. gaskets should be provided.

Bolts shall be tightened in a sequence and in a manner suited to a gasketed joint. Care shall be taken to tighten all bolts to AISC-360-16 or the manufacturer's recommendations.

Where joints must be bolted up for hydrostatic testing, the gasket used shall not be of a softer type than specified for service. The gasket used for hydrostatic testing shall be discarded.

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3.12.4 Labelling

Equipment Numbering - All equipment issued with an equipment number (as specified on the equipment data sheet) shall be provided with a 316L stainless steel equipment number plate of minimum dimensions 100 x 50mm x 2mm thick. Number plates shall be neatly hard stamped or engraved with the equipment number and equipment name with letters not less than 12mm high in English. Equipment number plates shall be permanently and securely attached to the equipment, in a prominent location, by means of stainless-steel screws or rivets.

Equipment Nameplates - All pieces of proprietary equipment shall be provided with a corrosion resistant metal equipment manufacturer's nameplate. Nameplates shall be neatly hard stamped with the equipment make, model, serial numbers and date of manufacture with letters not less than 12mm high in English. Equipment nameplates shall be permanently and securely attached to the equipment by means of stainless-steel screws or rivets.

Where components must be separated for shipment, each separable component shall be provided with a clearly stamped stainless steel temporary name tag securely attached to each such component.

4. Fabrication / Manufacture

4.1 General

All fabrication and manufacturing shall comply with the following criteria:

- The fabrication and assembly of rougher cells tanks shall be in accordance with this Specification and AISC-360-16 as applicable.
- Fabrication of all structural steel frames or sub-assemblies shall comply in with AISC-360-16 Specification for Structural Steel Buildings

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- Fabrication shall only commence after written approval of the workshop drawings, welding procedures and site erection procedures has been obtained from the EPC Contractor.
- The Sub-Contractor shall be responsible for verifying all dimensions and ensuring their accuracy.
- Discrepancies shall be reported immediately to the EPC Contractor and an instruction obtained before continuing.
- Steel tanks with overall dimensions greater than allowable transportation limits shall be fabricated in a manner such that they can be bolted together on site. Assemblies which are to be transported to site in the 'knocked down' condition shall be trial erected in the workshop prior to transport to site.
- Steel tanks, with overall dimensions within allowable local transportation shall be fully assembled in the workshop.
- All components must be welded to the tanks, prior to undertaking post weld heat treatment (if required).
- To avoid any deformation of equipment during transportation, necessary provisions shall be made by Vendor.

4.2 Fabrication Schedule

The Sub-Contractor shall submit a detailed fabrication schedule to the EPC Contractor two (2) weeks prior to fabrication commencing. Progress shall be updated on the schedule once a week. This time schedule is agreed upon between Sub-Contractor and EPC Contractor and it shall be prepared in a way that the approved time schedule between Client and EPC Contractor is complied with.

4.3 Tolerances and Templates

All layouts, tolerances and templates shall comply with the following parameters:

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- Tolerances and dimensions of cut plates shall be suited to the needs of the welding preparation and procedures and of the completed tank tolerances as set out in the drawings.
- The maximum out of plumb of the tank or surge bin, measured over the height of the shell, shall not exceed 1/400 of the shell height.
- The mean outside diameter of a cylindrical tank shall, at any cross section by circumference measurement, shall not differ from the nominal outside diameter by more than 8mm or 0.1% of the nominal diameter, whichever is the greater.
- Where curvature does not appear to be suitably maintained across a vertical joint in a cone or cylinder, due to weld distortion, incorrect curving of the plate(s) or poor fit- up alignment a check shall be made by template. The template shall be 900mm long, cut to the theoretical curvature and it shall show a maximum 'daylight' due to peaking or flattening of 6mm.
- All tanks with overflows fitted, must be checked to ensure even flow over the perimeter when the tanks have been installed (levelled and aligned).
- The Sub-Contractors QA procedures shall also verify that all mating components shall meet or exceed the stipulated manufacturing tolerances on the workshop drawings.

4.4 Plate Rolling and Pressing

The following parameters shall be observed for plate rolling:

- Plates for cylindrical or conical components shall be rolled or pressed to suit the required curvature and to suit the assembly and welding procedures.
- The methods used to correct bent or distorted material or members and to camber, curve, bend or set member and plate to specify shape shall not alter

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the properties of the material. Whenever possible straightening and bending shall be done by mechanical means and without heating.

- Straightening and bending of steel of higher strength than grade 350 by the application of heat shall not be permitted.

4.5 Bolt Holes

All bolt holes shall be drilled, punched or machine cut subject to limitations on surface finish. No holes can be produced by laser, plasma-jet or oxy-fuel cutting. All holes shall have cut-edge roughness less than 12 µm. Gas burning of holes is not permitted in any case. Punching of full size holes shall not be permitted in materials thicker than 16mm, unless otherwise approved in writing by the EPC Contractor. Punching of holes 3mm undersize and then reaming shall be permitted in material of any thickness. The region around punched full size holes shall be flat prior to assembly. Dressing around such holes by approved means shall be permitted.

Unless otherwise shown on the drawings, the clearance provided in holes for structural bolts shall not be greater than what is permitted by relevant DIN standard or the following (whichever is smaller):

- 2mm for structural bolts not exceeding 25mm diameter,
- 3mm for structural bolts exceeding 25mm diameter.

Unless otherwise shown on the drawings, the clearance provided in holes for Holding down (HD) bolts shall not be greater than:

- 3mm for HD bolts not exceeding 25mm diameter,
- 6mm for HD bolts exceeding 25mm diameter.

Oversize and slotted holes for high strength bolts shall be permitted in accordance with AISC-360-16. Slotted holes for mild steel bolts shall be of dimensions shown on the drawings. Pitch and edge distances, whether maximum or minimum shall conform to the requirements outlined in AISC-360-16.

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The holes and surface around holes shall be smooth and free of burrs, fins and other defects that may prevent solid seating of contact surfaces.

4.6 Joints

4.6.1 Preparation, Location and Cutting

Workshop drawings shall show the location and details of all strake joints. If the joint locations are shown on the design drawings, these locations shall be adopted for fabrication. Cut edges of pieces shall be free of gouges, burrs and other defects that would adversely affect the joint. Any such like defects shall be removed prior to assembly and welding of parts. The quality of workmanship resulting from shearing and cropping, in particular the extent of distortion of the cut edge, shall be subject to the approval of the EPC Contractor. Re-entrant corners shall be shaped notch-free to a radius of at least 1.6mm unless otherwise shown on the drawings.

4.6.2 Splices

Splices shall be located as shown on the drawing. If the Sub-Contractor considers additional splices necessary or desirable, a proposal for such splices shall be submitted in writing for approval of both the EPC Contractor and Client prior to fabrication commencing. Splices shall be made with pre-qualified full strength butt welds to AWS- D1.1. Splices shall comply with tolerances as specified in AISC-360-16.

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4.7 Component Fit Up

4.7.1 Flat Bottoms

Plates shall be assembled and tacked to provide the prescribed fit-up for welding. Flat bottoms, when composed of more than one plate, shall be laid out, tacked and welded in a sequence that minimizes distortion and provides as nearly as possible a flat surface.

4.7.2 Shells, Cones and Roofs

Plates shall be assembled and tacked to provide the prescribed fit-up for welding. Tank strake plates shall be correctly aligned using shims and wedges. The maximum wedge spacing shall be 450mm.

Misalignment in vertical butt-welded joints shall not exceed 10% of the plate thickness or 1.6mm whichever is the larger.

Misalignment in horizontal butt-welded joints shall not exceed;

- 1.6mm in 900mm for plates greater than 8mm nominal thickness.
- 0.8mm in 900mm for plates 8mm or less nominal thickness.

The curvature of the plates shall be maintained across the welded joints with no undue peaks or flats.

Welding of the butt joints within a shell cover or roof shall be completed before making cut-outs for nozzles and inspection openings and before attaching rings, cleats and other attachments.

4.7.3 Shell Penetrations

Except for lined tanks, all nozzle connections in the tank or surge bin wall shall protrude approximately 19mm inside the tank, unless shown otherwise on the drawings. Lined tanks shall have no nozzle protrusions inside the tank. Nozzle to

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shell corners shall be ground to 6mm radius for rubber lining purposes. The edge at the inside diameter of flush trimmed openings, including manholes, shall be rounded to a minimum radius of 1.6mm.

4.8 Welding

4.8.1 General

All welding shall be carried out by electric arc processes and shall be by one of the following processes:

- Manual metal arc (MMAW)
- Gas Metal-arc (GMAW)
- Flux-cored-arc (FCAW)
- Submerged-arc (SAW)

All welding materials, workmanship, inspection and testing shall conform to AWS-D1.1, AISC-360-16 and specification. Welding safety shall comply with ANSI Z49.1. All welding shall be carried by qualified personnel in accordance with qualified weld procedures set out for the work. The Sub-Contractor shall ensure that the parameters set out in the procedure are adhered to at all times.

Welding shall not be carried out in conditions where the works are exposed to inclement weather such as high wind or rainfall. In such conditions, adequate protection shall be provided to protect and shield the operator, machine and the work.

Where preheating or temperature monitoring of the weld is required, it shall be carried out in accordance with AWS-D1.1. A digital temperature gauge or temperature crayons shall be used to monitor the temperature of the steel during the preheating.

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Where weld details are not shown on the drawing, then the Sub-Contractor shall request this information from the EPC Contractor prior to proceeding with the work.

Butt welds shall be full penetration welds unless shown otherwise on the drawings. Seal welds shall be 6mm continuous fillet welds, unless noted otherwise on the drawings.

After welding, all sharp edges, burrs, spatter, etc. shall be removed from the steel and the welds by suitable means.

The edges of all stiffeners and attachments, such as brackets and clips, shall be completely seal welded to prevent corrosion between attachments and the base material.

4.8.2 Weld Category, Plant, Equipment and Welding Consumables

All welds, plant equipment and welding consumables shall comply with the following criteria:

- All welds shall be in accordance AWS-D1.1 unless otherwise stated on the drawings.
- Welding plant and equipment shall be adequately sized for the work and in good working order. It shall be operated in accordance with the manufacturer's instructions.
- Electrodes and other welding consumables shall be stored and used as recommended by the manufacturer.
- Coated electrodes for manual arc welding and fluxes for automatic and semi- automatic welding that have been wet or dampened shall not be used whether they have been re-dried or not.
- The electrodes used for welding shall be clean and free from rust, oil, grease or any other deleterious substance.

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4.8.3 Welding Procedures and Welder Qualifications

All welding procedures shall be conducted in accordance with AWS-D1.1. All welding procedures and welding procedure qualifications such as AWS-D1.1 Annex N shall be submitted to the EPC Contractor for review. Welding shall not proceed without written acceptance of such procedures.

All welders used on the works shall hold a current Certificate of Competency for each weld procedure they are to execute. All tests and test records for qualification of welders and welding procedures shall be carried out by registered AWI Certified Welding Inspectors.

The EPC Contractor may at any time request to inspect the Certificate of Competency for any welder and/or to witness the welding of a test piece by the welder. Should a welder's certificate not be available, the EPC Contractor may require welder testing to be performed, such a test shall be at the Sub-Contractors cost.

4.8.4 Welding Supervisors

All welding shall be carried out under the supervision of personnel who have had suitable training and experience in the fabrication of welded structures and who satisfy the Welding Supervisor requirements of American Welding Society.

4.8.5 Weld Map and Workmanship

A weld map of the assembly showing the location of all welds, the welding sequence, the weld procedure and the identity of the welder shall be provided. The work shall be planned in a manner to limit overhead welding.

For general workmanship, welds in any one stroke, all longitudinal (vertical) welds shall be completed before welding, or extensive tacking of the circumferential (horizontal) welds.

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When site welding is to be employed, the Sub-Contractor shall plan the assembly of steelwork in sections to permit a maximum amount of welding to be completed on the ground.

4.8.6 Steel Preparation

4.8.6.1. Edge Preparation

Steel edges prepared for welding shall comply with AWS-D1.1. Edges shall be prepared whenever practicable by cold saw, laser, plasma arc or machine gas cutting. Surfaces and edges to be welded shall be smooth, uniform, and free from fins, tears, cracks and other discontinuities. Surfaces to be welded and surfaces adjacent to the weld shall also be free from loose/thick scale, slag, ground moisture, grease, rust and any foreign material. Special edge preparation will apply to elements which receive special coating systems such as rubber linings; refer to the plate work drawings and specifications for linings to identify appropriate edge preparation.

4.8.6.2. Steel Fit-up

Plates, steel sections shall be prepared in accordance with the relevant qualified welding procedure. Plates joined by fillet welds shall have separation distances no greater than 1.6mm. Where plate deformities do not allow for the above dimensions to be achieved, a

procedure rectifying the problem shall be submitted to the EPC Contractor for approval. Plates joined by butt welds shall be aligned carefully such that the misalignment does not exceed 1.6mm for any case.

To ensure correct fit up, plates or sections shall be held in the correct position by tack welds, bolts, clamps, shims, wedges, guys, struts or other suitable device until the welding is complete.

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4.8.7 Weld Termination

Welds shall be terminated at the end of a joint in a manner that will ensure sound welds. Whenever necessary, this shall be done by use of extension bars and runoff tabs. In open structures, extension bars and runoff tabs shall be removed. In clad structures, they need not be removed unless they are likely to impede subsequent fabrication, handling and erection, or where likely to be injurious to personnel, or as directed otherwise by the EPC Contractor.

4.8.8 Distortion and Shrinkage

Before welding commences, the Sub-Contractor shall establish a welding sequence for assemblies, which, in conjunction with the joint welding procedures and overall fabrication method, will produce assemblies meeting the requirements specified herein. The procedure and sequence shall be such as to minimize distortion and shrinkage.

In so far as practicable, all welds shall be made in a sequence that will balance the applied heat of welding while the welding progresses.

4.8.9 Weld Repairs

Weld repairs shall be subject to the inspection and testing requirements specified for the original weld. Welds shall be repaired, where required, in accordance with the following:

- Removal of weld metal or portions of the base metal may be by machining, grinding, chipping or air carbon arc gouging. Flame gouging is not permitted. Removal shall be undertaken in such a manner that the remaining weld metal or base metal is not nicked or undercut.
- Unacceptable portions of the weld shall be removed without substantial removal of the base metal.

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- Additional weld metal to compensate for any deficiency in the size of the weld shall be deposited using an electrode smaller than that used for making the original weld and not more than 4mm diameter. The surfaces shall be cleaned thoroughly before welding.
- Excess weld metal of overlap or excessive convexity shall be removed.
- For excessive concavity of weld or crater, undersize welds and undercutting, additional weld metal shall be deposited after cleaning the surfaces.
- For excessive weld porosity, excessive slag inclusions, incomplete penetration and incomplete fusion, unacceptable portions shall be removed and the area re-welded.
- For cracks in weld or base metal, the extent of the crack shall be ascertained by use of magnetic particle inspection, dye penetration inspection, or other equally positive means approved by the EPC Contractor. The crack and sound metal 50mm beyond each end of the crack shall be removed and the area re-welded.

4.8.10 Post Weld Heat Treatment (PWHT)

Where PWHT is called up on drawings, the Sub-Contractor shall submit details of the proposed procedure, equipment, monitoring and control systems, for review by both the EPC Contractor and Client prior to commencing treatment. The post weld heat treatment shall be in accordance with AWS-D1.1.

5. Maintenance

The Flotation cells will be designed in order to minimize maintenance and make unavoidable maintenance safe, quick and easy.

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In order to minimize the frequency of maintenance, the temporary table of inspection and maintenance of Flotation cells components, contained in the offer documentation, must be drawn up in terms of previous engineering experience and subsequent improvements.

Every component must be easy to handle and equipped with hooks to allow them to be properly balanced when lifted.

Components which need frequent maintenance must be easily accessible and they must not need special tools.

6. Inspection and Testing

6.1 General

6.1.1 Inspection & Test Plan

The Sub-Contractor shall provide an inspection and test plan for review and approval by the EPC Contractor prior to commencing fabrication.

6.1.2 Cleaning

Prior to inspection and testing, all tanks shall be thoroughly cleaned of all dirt, weld spatter, loose scale, oil, paint and all other foreign matter. Carbon steel tanks that are to be rubber lined shall have the welds radius ground smooth before applying the rubber, and before testing. Weld finish required for other lining materials to be as noted on the drawings.

6.1.3 Workshop Access

Provision shall be made for access for weld inspection by the EPC Contractor or their nominated representative. The Sub-Contractor shall, at the EPC Contractor's

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request, provide reasonable access to the workshops where fabrication is being undertaken.

6.2 Weld Inspection

6.2.1 General

Weld inspection shall comply with the requirements of API 650 or AWS-D1.1, as specified in this specification and shall be completed by AWI Certified Welding Inspectors. If required by the EPC Contractor, additional inspection and testing shall be performed at the locations nominated on the drawings. Testing of welds shall be carried out progressively as work is completed. All test reports and certificates shall be submitted to both the EPC Contractor and Client for review/approval.

Unless noted otherwise, the minimum extent of welding inspection shall be as follows:

- All welds shall be subject to 100% visual scanning and examination
- All welds shall be subject to Dimensional Test (DT)
- All Fillet welds and Partial Penetration Butt Welds shall be subject to 10% Magnetic Particle Inspection,
- Full Penetration Butt Welds shall be subject to 10% Ultrasonic Testing or Radiographic Testing.

6.2.2 ITP Forms

The inspection & test plan (ITP) forms cover the minimum verification, checks and test required to comply with codes, specification and / or contractual requirements.

The following tests should be performed by the supplier:

- Visual Inspection
- Dimensional Inspection

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- Mechanical Running Test
- No load running test
- Motor temperature rise test
- Routine Tests for operation box as per IEC Standard
- Noise level Test
- Vibration Measurement Test
- Assembly Inspection performed at shop
- Marking Inspection for Packing
- Final Inspection prior to Packing
- Packing Inspection

6.2.3 Weld Inspection and Testing

6.2.3.1. Visual Examination

100% Visual examination is required for all welding. Visual Examination shall be in accordance with the requirements of AWS-D1.1. If the weld fails the visual acceptance criteria given in AWS-D1.1, the weld shall be rejected and no further NDT is prescribed until the visual condition of the weld is rectified.

6.2.3.2. Magnetic Particle Examination

Magnetic particle examination shall be performed in accordance with ASTM E709 and the requirements of ASTM E1444. The weld must meet the acceptance criteria given in AWS-D1.1.

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6.2.3.3. Ultrasonic Examination

Ultrasonic examination shall be performed in accordance with ASTM E273 or equivalent and the requirements of AWS-D1.1. The weld must meet the acceptance criteria given in AWS-D1.1.

6.2.3.4. Radiographic Examination

Radiographic examination shall be performed in accordance with ASTM E1416 and the requirements of ASTM E1742. The weld must meet the acceptance criteria given in AWS-D1.1.

6.2.4 Weld Defects

All welds that do not comply with Section 7.2.3 shall be classed as defects. Weld defects must be repaired in accordance with Section 6.8.9 and retested to the same level as that originally specified. All costs associated with the repair and retesting of weld defects shall be borne by the Sub-Contractor.

6.2.5 Non-Destructive Testing Results

Copies of all testing records and results must be made available to the EPC Contractor and Client immediately such reports become available. On completion of the contract, copies of all testing records and results must be submitted to the EPC Contractor and Client.

6.3 Hydrostatic Testing

6.3.1 Hydrostatic Testing

Tanks shall be hydrostatically tested for leakage. The hydrostatic testing shall be undertaken prior to the application of protective coatings or wear lining materials.

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The hydrostatic testing shall not start until completion of non-destructive testing, stress relieving and surface preparation of the weld seams.

After satisfactory completion of non-destructive testing, each tank shall be filled with water to within 75 mm from the tank top and held for at least 6 hours. The EPC Contractor may elect to inspect the tank for water leaks.

If leaks are found, the water level shall be dropped below the level of the leak and such leaks shall be repaired in accordance with section 6.8.9 of this specification. After the repairs have been satisfactorily completed, the tank shall be re-tested. This process shall continue until all leaks have been eliminated. Clean water shall be used for hydrostatic tank testing. Required water for hydrostatic test shall be supplied by the Constructor at his own cost.

6.3.2 Removal of Test Water

Roofed tanks shall be fitted with a vent pipe or have a suitable roof opening provided before the test water is released. The top manhole shall be opened prior to emptying the tank.

After satisfactory completion of hydrostatic testing, the test water shall be completely removed from the tank. The tank should be dried with clean rags after the test water is removed.

6.3.3 Test Certificate

Immediately after the satisfactory completion of the hydrostatic test, the Sub-Contractor shall deliver to the EPC Contractor a certificate indicating that the tank has passed the test. The certificate shall show the tank number, the average temperature of the test water, indicate the date and time the test was carried out and be signed by the Sub- Contractor.

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7. Surface Preparation

Surface protection of tanks, surge bins and sumps shall not proceed until all inspection and testing requirements detailed in this specification are completed satisfactorily. Internal surface areas of tanks that contain slurries and are subject to excessive abrasion shall be lined with rubber or alternate wear lining material as noted on the drawings. All areas not lined with a wear resistant lining shall be painted. Exposed machined surfaces shall be coated with a suitable rust inhibitor.

All lined surfaces shall be painted as per project document Protective Coating Systems except in cases where lining must be attached to mating surfaces with adhesive (e.g., Ceramic tile lining).

7.1 Painting

Painting of all equipment According to specification for painting Doc No. 12002-D-PI-SPC-303-GNL-004.

7.2 Rubber Lining

7.2.1 General

Rubber lining shall be applied in full accordance with BS 6374-Part 5 to all components as shown in the drawings.

7.2.2 Material

Rubber linings shall be of high impact and impinging abrasion resistant natural rubber with the following properties unless noted otherwise on the drawings:

Thickness: Minimum 6mm
Tensile: 22 MPa
Elongation: 600%

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Hardness: 60±5 Shore "A"

Rubber lining adhesive shall be as recommended by both the lining manufacturer and the adhesive manufacturer and subject to the approval of the EPC Contractor.

7.2.3 Surface Preparation

All surfaces to which the rubber lining is applied shall be free of traces of grit, grease, oil, loose rust, mill scale, surface contaminants or corrosion of any kind. The surfaces to be lined shall be solvent cleaned and White Metal blast cleaned in accordance with document Specification for Painting 12002-D-PI-SPC-303-GNL-004 "Protective Coating Systems". A surface profile of 0.05 – 0.075 mm is required.

The steel surface to be rubber lined shall not be coated with any primer prior to application of liner; if the area has been primed it is to be blasted back to bare metal prior to installation of the rubber lining.

7.2.4 Adhesive Application

Mixing and application shall be in strict accordance with the manufacturers recommended procedures.

Using only undamaged containers mix and thoroughly agitate with a power-driven mixer for minimum of 5 minutes. Apply each coat by brush or roller to all areas, frequently hand stirring the container to maintain contents in suspension. All adhesives shall be kept out of direct sunlight at all times before and after application. The steel substrate temperature during the adhesive application shall be maintained between 15°C and 32°C. The temperature of the substrate shall be maintained at least 3°C above the dew point. Adhesive application shall stop if humidity increases such that surface condensation may occur.

A separate test plate shall be prepared for an adhesion test to ASTM D-429.

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7.2.5 Rubber Lining Application

The Contractor shall submit detail drawings to the EPC Contractor for written approval prior to the application, showing the manner of jointing linings and execution of lining at corners, around penetrations, in bores of nozzles and on nozzle flanges.

Rubber lining shall not be carried out when:

- Relative humidity is above 85%.
- Ambient temperature is less than 3oC above dew point.
- When metal or rubber temperature is above or below the recommended values of the primer/adhesive manufacturers.
- When rubber sheet stock is less than the minimum substrate allowable temperature. A single layer lining shall be used unless otherwise specified in the drawings
- Install rubber sheet and completely roll out and bond to the metal surface without tensioning or bridging and insure not to entrap air. If strings are used for venting, ends will be trimmed so as not to extend onto flange faces.
- All edges and seams shall be laid straight. Joints and seams shall be staggered to avoid more than 2 thicknesses of rubber at any point. The order of preference for type of joints as shown on BS 6374, Part 5, and Figure 7 shall be:
 - Overlap scarf joints
 - Straight scarf joints
 - Strapped joint
 - Butt joint with approved filler/sealant (i.e., polyurethane).

Butt seams may be used only where lapped seams are impractical. Overlapping edges shall be skived and turned down so as to give a smooth, neat appearance with no exposed tie gum and with the exposed edge of the upper lap facing

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downstream of the flow direction indicated on the drawings. The number of seams shall be kept to a minimum, consistent with good workmanship. The bond between adjacent sheets of overlap shall be such that separation cannot occur. The rubber lining shall extend out on all flanges, manholes, and nozzles. Circumferential joints in nozzles shall be located so as not to restrict the opening.

Equipment specifying double linings shall be lined such that smooth surface is accomplished for the outer lining. Seams of the underlying lining shall be butt joints and shall not be within six (6) inches of the lapped seams of the overlay lining. Internal flanges shall be completely lined, including the bolt holes. Flanges of spigots and nozzles that are rubber lined shall have the rubber lining cover the full face of the flange.

7.2.6 Cure of Lining

Vulcanization of the lining shall be carried out by one of the following methods:

- Autoclave vulcanization
- Using equipment as its own autoclave
- Steam or hot air vulcanization at ambient pressure
- Hot water vulcanization
- Self-vulcanization at ambient temperature

The method employed shall depend on application requirements as outlined on the drawings, size of equipment and manufacturers recommendations for the rubber stock to be used.

The cure times shall be in accordance with the manufacturer's recommendation. Temperature and pressure shall be monitored throughout the entire cure cycle. Cured linings shall attain hardness values recommended by the manufacturer.

Uniform temperatures shall be maintained during the curing process, and the lining or covering shall be protected against excessive heat losses to ensure uniform

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vulcanizing conditions. Vessels should be taped or otherwise insulated from the detrimental effects of in-clement weather and temperatures below 15°C.

Contractor may use a multi-point recorder to measure temperatures required on the “Record of Temperature during Cure” log sheet. These readings are to be recorded hourly, every shift during temperature warm-up and throughout the entire cure cycle. “No Welding or Cutting” stickers shall be adhered to the outside of all tanks, surge bins and sumps with wear resistant lining.

7.2.7 Inspection after Cure

All joint and seam areas shall be visually inspected.

The adhesion test plate that the Contractor has previously lined and cured shall be tested in accordance with ASTM D-429. The rubber shall be adhered to the steel so that tests will show strength of adhesion that is specified for each lining.

A Durometer (Shore “A”) hardness survey shall be made of the cured lining. A sufficient number of readings shall be taken at all elevations to assure all areas of the lining are properly cured.

7.2.8 Continuity (Spark) Testing

Continuity testing of lined items shall be carried out using high frequency AC equipment in accordance with NACE RP0188. The spark testing shall cover the entire area of rubber lined items.

Spark testing shall be witnessed by the EPC Contractor and will be a hold point in the Contractor’s ITP. The following information shall be included for each test and submitted to the EPC Contractor for written approval prior to the commencement of continuity testing;

- Calibration intervals.
- Spark length.

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- Maximum recommended voltages for rubbers tested.
- Electrode shape.

7.2.9 Repairs after Cure

Patching of rubber lining is not permitted unless authorized specifically by the EPC Contractor or his representative. The extent of all repairs shall be clearly defined by the Contractor after completion of the Cure Inspections. Any repairs to damaged lining shall be detailed in a written procedure and approved by the EPC Contractor.

8. Packaging Transport and Storage

Requirements for packaging, transport and storage shall be provided prior to tender.

8.1 Release for Shipment

Successful completion of inspection, testing and packaging constitute part of the release for shipment. The Sub-Contractor shall ensure that he receives the EPC Contractors written approval to ship the equipment to the Contract specified location. Release for shipment does not relieve the Sub-Contractor of responsibility for meeting performance requirements, any warranties or other requirements under this specification.

9. Quality System

The Sub-Contractor shall maintain an effective quality management system so as to ensure and demonstrate that goods and services conform to the specified requirements. The quality management system shall be documented and be at least equivalent to the requirements of ISO 9001. The Sub-Contractor shall, in addition,

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ensure that all sub- Contractors maintain equivalent systems commensurate with their particular scope of supply.

Further details on inspection, testing procedures and quality control will be provided for tender.

10. Guarantee

- The VENDOR shall guarantee the Package for the duty, emissions, noise levels and utility consumption as specified on Equipment Data Sheets, and for safe and reliable operation.
- The VENDOR shall guarantee the suitability of the materials of construction for the duties required, even if the CONSULTANT has specified the type and grade of material to be used.
- The VENDOR shall guarantee all equipment and components against design fault, defective or improper materials, poor workmanship and failure during normal usage.
- The Guarantee period is according to main contract.