

Gujarat State Petroleum Corporation Ltd.

**FLARE GAS MONETISATION PROJECT
QPS-SE#3**

PIPING DESIGN BASIS

Doc No: GERMI/DB-Piping/GSPCL/06/25-26 R-0

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1. INTRODUCTION

The scope of this document is to provide the Piping design basis for Flare Gas monetization Project QPS – SE #3.

2. SCOPE OF DOCUMENT

This document describes the basis for the overall design such as Fluid services, piping Components, Materials, arrangement of Facilities, Equipment, Piping, Safety, Constructability, Operability, maintainability, Government regulations, Design Codes & Standards, Company Standards & Specifications, etc. for Flare Gas monetization Project QPS – SE #3.

These shall be adhered to by EPCC Contractors or his subcontractors during detail engineering, procurement & construction.

3. DEFINITION

Nomenclature	Description
Company	Gujarat State Petroleum Corporation Ltd.
Engineering Consultant	Gujarat Energy Research and Management Institute
EPCC contractor	
Project	Flare Gas Monetization Project QPS – SE #3

4. ABBREVIATIONS

ABBREVIATIONS	DESCRIPTION
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BS	British Standards
CA	Corrosion Allowance

CS	Carbon Steel
EPC	Engineering Procurement Construction
EPCC	Engineering Procurement Construction and Commissioning
ESD	Emergency Shutdown
FAT	Factory Acceptance Test
FEED	Front End Engineering Design
GSPCL	Gujarat State Petroleum Corporation Ltd.
MSS-SP	Manufacturers Standardization Society of the Valves and Fittings Industry
NACE	National Association of Corrosion Engineers
NDE	Non-Destructive Examination
OISD	Oil Industry Safety Directorate
PTFE	Polytetrafluoroethylene
PSV	Pressure Relief Valve
RFQ	Request for Quotation
RO	Restriction Orifice
SS	Stainless Steel
DSS	Duplex Stainless Steel
TSV	Thermal Relief Valve
FW	Fire Water

Km	Kilometer
M	Meter
Min	Minute
Hr	Hours
N	North
LTCS	Low Temperature Carbon Steel
WN	Weld Neck
RTJ	Ring-Type Joint
RF	Raised Face
ET	Electrical Tracing
EFW	Electric Fusion Welding.
BW	Butt Weld
SW	Socket Weld
HC	Heat Conservation
NPS	Nominal Pipe Size
DN	Diameter Nominal.

5. ORDER OF PRECEDENCE

For the use of Codes and specifications in this project, order of precedence shall be as follows:

- a) Government Regulations and Statutory Requirements
- b) Project specifications and data sheets

- c) Project Design Basis
- d) Indian and International codes and standards
- e) Company Standards/Specifications /drawings

In case of contradiction between the above listed codes & specifications, the more stringent shall govern.

6. REFERENCES

6.1 Codes and Standards (Shall meet latest codes and standard)

STANDARDS	DESCRIPTION
ASME B 31.3	Process Piping
ASME B 36.10M	Welded and Seamless Wrought Steel Pipe
ASME B1.1	Unified Inch Screw Threads (UN and UNR thread form)
ASME B1.20.1	Pipe Threads General Purpose (Inch)
ASME B 36.19M	Stainless steel Pipe
ASME B 16.5	Pipe Flange and Flanged Fittings
ASME B 16.9	Factory - Made Wrought Steel Butt welding Fittings.
ASME B 16.10	Face-to-Face and End-to-End dimensions of Ferrous Valves.
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.20	Metallic Gaskets for Pipe Flange - Ring-Joint, Spiral-Wound, and Jacketed
ASME B16.21	Non-Metallic Gaskets for Pipe Flange
ASME B16.25	Butt welding Ends

ASME B 16.28	Wrought Steel Buttwelding Short Radius Elbow and Returns.
ASME B 16.34	Valves Flanged, Threaded and Welding Ends.
ASME B46.1	Surface Texture (Surface Roughness, Waviness, And Lay)
ASME B18.2.1	Square, Hex, Heavy Hex, And Askew Head Bolts And Heavy Hex, Hex Flange, Lobed Head, And Lag Screws (Inch Series)
ASME B18.2.2	Nuts For General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, And Coupling Nuts (Inch Series)
ASME Sec VIII Div.1	Rules for Construction of Pressure Vessels
ASME Sec V	Nondestructive Examination
ASME Sec IX	Welding Qualifications
ASME Sec II Part-D	Boilers and Pressure Vessel code – Material Properties
ASME B16.48	Line Blanks
ASME B16.36	Orifice Flange
API 5L	Specification for Line Pipe
API 6D	Specification for Pipeline Valves
API 6FA	Specification for Fire Test for Valves
API 594	Check Valves: Flanged, Lug, Wafer, and Butt-welding
API 598	Valve Inspection and Test.
API 600	Bolted Bonnet Steel Gate Valves.

API 602	Steel Gate, Globe and Check Valves for Size DN 100 and Smaller.
API 607	Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats
API-608	Metal Ball Valves—Flanged, Threaded and Welding Ends
MSS-SP-97	Integrally Reinforced Forged Branch Outlet Fittings – Socket Welding, Threaded, and Butt welding Ends
MSS-SP-75	Specification for High-Test Wrought ,Butt-Welding fittings

6.1.1 Local Specific Directives, Acts and regulations.

OISD-STD-118	Layouts for Oil & Gas Installations
OISD-STD-130	Inspection of Piping Systems
OISD-RP-108	Recommended Practice on Oil Storage and Handling

6.2 Project Documents

Doc. No.	Description
Doc No. GERMI/BDP /GSPCL/02/25-26	Feasibility and Basic design Report

7. UNITS OF MEASUREMENT

Refer GSPCL Document GERMI/BDP/GSPCL/02/25-26 for the units of measurement and that shall preferably be used on this PROJECT that will also apply for all data sheets, calculations, and drawings.

8. BASIS OF DESIGN

8.1 Design Criteria

All Design shall be carried out in accordance with ASME B31.3 in conjunction with Scope of services, PMS, VMS developed based on P&ID, Line List, Material selected, Safety features, Good Engineering Practice, Codes & Standards to be followed, COMPANY Specifications to be used, Pipe Routing, Instrument Hook-Up, Equipment Design Requirements, Etc. Piping systems shall be Carbon steel or Stainless steel as indicated in the P & ID's and line list. Piping system MOC shall be in line with material selection diagrams

Minimum pipe size running on a pipe rack shall be 2". Line size 1 1/2" and below shall be increased to 2" while on the pipe rack.

Pipe size NPS 1 1/4", 2 1/2", 3 1/2", and other odd sizes indicated as NPS 5" and NPS 7" etc., shall not be used except where required for connections to Mechanical Equipment of Standard design or where specific velocities must be maintained, If used for equipment, counter Flange shall be in equipment Vendor's scope.

8.2 Minimum Design Consideration

The minimum design parameters to be considered for design of the piping systems (Pipes, fittings, valves, accessories, Flange, gaskets, fasteners, Pipe Supports, Insulation, etc.) for a minimum Plant Life Span of 20 Years shall be based on the Internal Loads to Piping System due to the fluid services - Design Pressure & Temperature, Corrosion Allowances, External Loads (various stresses, etc.) due to the selection of Pipe Support Span, Pipe wall Thickness & Pressure Class ratings for fittings, Etc., weight of the Piping system components & others, Pipe Support Type provided which is governed by the Piping Design Code ASME B31.3 and other relevant codes & standards.

8.3 Piping Classes

The design Pressure and Temperature considered shall be as per the Basic design Package. In situations where different design conditions exist in one piping system, different piping classes maybe used. Also, considering the life of the plant as 20 years, all calculation to be done accordingly.

8.4 Materials

Basic material selection of particular line depending on its service, temperature and corrosivity shall be as spelt out in process package. Detailed material specification shall follow the requirements stated herewith, except wherever specified as per Licensor's Requirement. Piping material shall be as per ASTM, API and other International Standards as applicable. Dimensional standards and tolerance, in general, shall be as per relevant Code. All pipes, fittings, Flange etc. shall be in line with requirements of relevant international and other company specifications.

Wall thickness shall be as specified in the Piping material specification and shall be developed during the detail engineering, and shall be considered as a minimum requirement for piping. For wetted part material requirement of all inline Instrument valves and inline flow meters, refer to Instrumentation design basis.

8.5 Piping and fittings

a) Wall Thickness

- Pipe material and wall thickness shall be as per Piping Material specification
- Pipe wall Thickness and Branch Reinforcement shall be calculated as per ASME B31.3. Proper corrosion allowance and mill tolerance shall be considered while selecting nominal thickness.
- For carbon steel and low alloy steel pipes minimum pipe thickness shall be as follows:
 - S160' up to DN 20
 - 'XS (S80)' for DN 25 to DN 50
 - 'STD' for DN 80 & above
- For stainless steel minimum pipe thickness shall be as follows:
 - '80S' up to DN 20
 - '40S' for DN 25 to DN 50,
 - '10S' for DN 80 & above
- The philosophy of minimum thickness/schedule is applicable for both seamless and welded pipes.
- All pipes (seamless & welded) shall have uniform negative wall thickness tolerance of 12.5% for wall thickness calculations purpose.
- Maximum 10% of corrosion allowance may be reduced in special cases, to optimize the pipe schedules.
- In general, the pressure-temperature combination to calculate wall thickness shall be as follows:

Material	Class	Size	Design
C.S. (A106-GR.B, API-5L GR.B, A672)	150	All size	Class condition
	300	All sizes	Class condition
SS (A312 TP304, 304L 321,347) OR (A358), 316L,	150	All sizes	Class condition
	300	All sizes	Class condition

b) Pipe size

Pipe sizes shall normally be DN 15, 20, 25, 40, 50, 80, 100, 150, 200

c) Pipe Type

Material	Size	Type
CS, LTCS, AS (Process & non process lines)	Up to 14"	Seamless
	16" and Above	EFW.
SS (Process & non process lines)	up to 8"	Seamless
	10" and Above	EFW.
	10" and Above	EFW.

d) Fittings

- Type of fittings shall be equivalent to pipe type.
- Thickness of fittings at ends to match pipe thickness for BW fittings.
- Long radius elbows (R=1.5D) shall be used for changes in direction of piping. Short radius elbows (R=1D) shall be used only where there is a space constraint.
- Butt Welded Pipe Fittings (Elbows, TEEs, Reducers, and Caps) for sizes NPS 2" & above shall be as per ASME B16.9.
- Forged steel SW and threaded fitting shall be in accordance with ASME B16.11, unless otherwise specified.
- SW fittings shall be 3000#, 6000# and 9000# depending on the pipe thicknesses S80, S160 and above S160 respectively.
- Upto 600# all branch connections shall be as follows, unless specifically mentioned otherwise in PMS:
 - 2" and above Tees / weldolet
 - upto 1.1/2"NB Sockolet/Tee
- The thickness to be used for the Reducing Fittings [Reducing Tee, Reducers (Conc. / Ecc.)] shall match the wall thickness being used for the connected pipe wall thicknesses.
- Seamless or Welded construction of fittings shall match the MOC of Pipe for a particular Piping Class.

e) Branching

Use equal and reducing tees to the extent available (generally up to half size of the main run) to ASME B16.9 for BW connections. Otherwise use integrally reinforced forged branch outlet fittings (Sockolet & Weldolet) to MSS-SP-97.

8.6 Flange

Piping shall use Flange as per piping material specification. Flange of all sizes shall have RF, Smooth Finish (125~250 Micro inch AARH (Arithmetic Average Roughness Height)) roughness as designated by ASME B46.1.

Rating	Size	Type	Remarks
150	Up to 1.50"	WN RF	For spiral wound gasket
	2" & above	WN RF	
300	Up to 1.50"	SW RF	
	2" & above	WN RF	

All Flange joints on piping system including Flange on the equipment, manholes etc. shall be tightened using Hydraulic bolt tensioner as per the requirement given in the following table & stud bolt length shall be longer enough to facilitate bolt tensioning requirement & shall have extra nut to protect the longer length of threads.

8.7 Bolts & Nuts

a) Bolting shall conform to ASME B 18.2.1 or ASME B 18.2.2.

Piping/Flange material	Bolt material	Nut material
CS	ASTM A193 GR. B7 (galvanized)	ASTM A194GR. 2H (galvanized)
SS	ASTM A193 GR. B8	ASTM A194GR. 8

b) Bolt Tensioning Requirement

Nominal Bolt Diameter	Condition	Remarks
All	Vendor/Project specifications	
25 mm & above & below 38 mm	a) Joints with leakage potential	
	b) Critical joints with Equipment	

Notes:

- Joints with leakage potential shall include
 - a) Joints involving tapped holes
 - b) Items not subjected to hydro test (e.g.) Joints for equipment manholes, Equipment mounted temp, pressure & level instruments, line mounted temp connections, online instrument joints like control valves and safety valves, compressor volume bottles.
 - c) Items involving two sets of gaskets with one set of bolts (e.g.) orifice flange joint, joints with spectacle blind, spacer, flangeless wafer check valve, wafer type butterfly valves.
 - d) Tie-in joints with other Contractors & package vendors
 - e) High temperature (above 370deg C) joints in hydrocarbon service.
 - f) Critical joints with Equipment shall include inlet & outlet flanges of pumps, Compressors.

For flange assemblies not covered under the requirements of hydraulic bolt tensioning, but falling in the following categories Bolt Torqueing using pre- specified torque value shall be employed.

8.8 Gaskets

Asbestos materials shall not be used. Only Spiral Wound Gasket with inner and outer ring shall be used.

The gasket materials shall be chemically and thermally compatible with the internal fluid and the external environment, and should be of appropriate hardness, thickness, and style. No flat ring nonmetallic CAF gaskets shall be used in plant. Gaskets shall be as per ASME B 16.20 / 16.21. Gaskets shall be as follows

Rating	Material Service	Temperature (Deg C)	Type	Gasket or Strip material + Filler material / RTJ Gasket Material
150, 300	CS & SS (except FW)	up to 427°C	Spiral wound	SS316+Grafoil + Inner Ring
150	CS (FW)	All	RING	Compressed Non-Asbestos

8.9 Blinds & Spacers

Spectacle Blinds, Blinds and spacers shall be in accordance with the applicable P&IDs. Spectacle blinds shall be used to a maximum weight of 50 Kg. Use Spade & Spacers over this weight.

8.10 Valves

All manual piping valves shall be in accordance with applicable P&IDs and Valve Specification.

Other general requirements area as under:

- Operating and block valves shall be in accordance with applicable P&IDs and applicable specifications.
- Control valve size and their by-pass and bleed valves shall be in accordance with the applicable P&IDs.
- Valves requiring motor / pneumatic / hydraulic operation shall be as per the applicable P&IDs. Valve closing time shall be selected such that this will not cause detrimental stresses or high surge pressure in the piping system.
- Heavy Valves shall be placed in the horizontal, rather than the vertical to the extent possible.
- Valve stems shall not obstruct access, operating area / passage ways etc.
- Valves in underground piping will be located in easily accessible concrete pits and if needed will have extended stems.
- Piston lift check valves shall not be installed in vertically downward flowing lines.
- Regularly operated valves 2" and larger shall be operable from grade, platform or ladder. The maximum operating hand wheel height above operating level shall be 1.4m for frequently operated valves. Valves under 'NACE' category shall meet the requirements specified in MR-0103 unless otherwise specified.
- Ball Valves shall be of Floating Ball / Trunnion Mounted Type as per following

150#	8" & Below Floating Ball	10" & Above Trunnion
300#	4" & Below Floating Ball	6" & Above Trunnion

- Gear operators shall be provided to ease operation for large sized and high

pressure service valves.

- Unless specified otherwise, Gear operators shall be provided for valves as indicated.

Valve Type	Class	Size Requiring Gear Operation
Gate / Globe/ Diaphragm	150	12" and larger
	300	12" and larger

Gear operator shall be provided, with position indicators for open / close positions Hand wheel diameter shall not exceed 750 mm and lever length shall not exceed 500 mm on either side.

8.11 Strainer

- Allowable pressure drop when specified shall be certified by vendor along with the offer. If asked specifically, vendor shall furnish pressure drop calculations.
- All 2" & higher sized Y type strainers shall be provided with 3/4" threaded tap and solid threaded plug as drain connection. For less than 2" , this shall be 1/2" size.
- For fabricated strainers, all BW joints shall be fully radiographed and fillet welds shall be 100% DP / MP checked.
- All the strainers shall be hydrostatically tested at twice the design pressure, subjected to flange rating limitations.

8.12 Tie-ins

The tie-in points on packaged equipment shall be brought to the edge of the skid and terminate with flange or wherever extending to the skid edge is not reasonable or practical, the Vendor shall consult with Company for approval of exceptions. All tie-in points shall be defined in global tie-in coordinates.

9. INSULATION

Equipment and piping shall be insulated as required for heat conservation, process heat control and personnel protection.

Insulation is required for any of the following purpose, as indicated in P&IDs and line list.

- Heat Conservation
- Process stabilization to assist process control
- Fire Protection

- Personnel Protection

Insulation Classification	Description
PUF-SEHMS	Skin effect heat management system
H	Hot Conservation
P	Personal Protection

10. DEVELOPMENT OF PLOT PLAN

Consideration to be given (OISD, INTERFERENCE) while placing the new facilities based on the previously proposed (Source Drawing issued by COMPANY) and existing facilities (Site Visits).

The following aspects shall be considered during the development of Plot Plan:

- Wind Direction.
- True North
- Plant North
- Equipment Data Sheet.
- Process Package.
- Safety shower location shall be marked in equip. layout req.
- Muster points /assembly location to be shown.
- Provision for vessel internals drop out area.
- Provision for overhead clearance for exchangers and pumps.
- Pipeline Corridor, AG / UG Piping, Pipeline requirements.
- Overhead & horizontal clearance for easy movement of personal working.
- Flare stack shall be located in the upwind of process area as per OISD 118.
- Process Requirement-i.e. proper flow sequence between equipment as per P&IDs to achieve the Intended process parameters. Location of flare KOD drum shall be closer to the flare package in the plot plan.
- Economy of Piping material-Minimize the quantity of costly piping.
- Roads, Storm water Drain collection Channels, Green belt, Emergency exit, Ground Slope (leading to storm water drain channels), Equipment Foundation/ Pedestal, FGL, Other Pits, Toilets, DG Sets, Access to various facilities, Fencing Etc.
- Provision of Monorail for Pumps maintenance which is not accessible from the road or inside shed.
- Similar equipment grouping Ex. Pumps, exchangers etc. should be grouped

- together for maintenance & safety wherever feasible.
- Mobile and Fixed equipment handling philosophy to be considered.
 - Erection & Construction requirement: -
 - a) Erection scheme and delivery schedule of all equipment must be considered during Plot plan to facilitate smooth erection.
 - b) The primary consideration in the arrangement of plant and equipment should be to provide; Safe operating facility that shall be economically designed for easy and hazard free operation and maintenance.
 - The Plot Plan shall consider provision of appropriate space for future needs and expansion of plant.
 - Platforms, Stairways, ladders, etc. shall be appropriately considered while placing the Equipment.
 - Constructability, Operability, maintainability, safety, versatility, and flexibility features to be considered appropriately including methodology, inter-distances, spaces, access, etc.

11. PIPING LAYOUT

11.1 General

- EPCC Contractor shall prepare the Equipment Layout, within the specified area for FGMP in the Overall Plot plan.
- The piping layout shall be prepared for the complete system supplied by the EPCC Contractor taking consideration of operability, safety of installations, ease of maintenance and construction etc.
- Piping layouts shall have the shortest practicable route with the minimum number of horizontal and vertical bends
- Where practical, piping entering and leaving a plot area or a processing unit shall be grouped together.
- Valves and field-mounted instruments installed in piping shall be easily accessible for operation, maintenance, and monitoring
- Ideal location of manually operated Valves shall be decided according to the accessibility and frequency of operation.
- The piping route shall meet the process requirements specified on the P&ID.
- Pockets in the flare header and blow down system shall be prohibited.
- Pipe routings for horizontal and vertical lines should allow for a common point of support.
- Relief valve discharge piping shall be taken to safe location as per OISD requirements.
- Low point drain and High point Vents shall be provided as required for the

- system.
- Pipe Support feasibility, Piping Flexibility, Access to operation, maintenance, Safety Exits etc. shall be considered while developing the piping layout.
 - Piping layout shall consider Wind direction, Plant north, Equipment data sheets, process packages, vessel drop areas, and laydown and erection feasibility of various Equipment etc, while doing piping design.
 - Safety shower and eyewash locations and Firefighting Equipment and other hazard detector Equipment space shall be considered in piping layout.
 - Piping shall be routed according to the space availability for giving pipe supports and the appropriate pipe support numbers and spans shall be indicated in piping layout.
 - Vents, Drains, Pipe Slope, Insulation representation, Lifting Davits, handrails, platforms, stair ways, cross over, steam traps, expansion loops etc. shall be indicated in piping layout.
 - Piping layout drawing considerations:
 - (a) CAD drawings shall be generated using latest version of AutoCAD. Other computer aided drafting programs may be used with CONSULTANT/Client approval
 - (b) Drawings shall be generated using the standard layers and font sizes. Line type and colors will be layer dependent. CONSULTANT approval shall be obtained for any deviation from these standards.
 - (c) Plan & Sectional Views, Isometric views of intricate piping, enlarged views shall be included in piping layout according to the requirement and better understanding.
 - (d) Minimum drawing scale shall be considered: 1: 33.33
 - (e) Drawing Template, drawing continuation, Drawing Preparation standards / Procedure shall be used as per the agreed format with the client.
 - (f) 3D Model review will be conducted stage by stage which is from 30%, 60% and 90% review during package engineering phase at EPCC location, wherever applicable.
 - (g) All required tag numbers of Equipment /instruments etc. shall be indicated in piping layout as per the P&ID.

11.2 Piping in Pipe Sleepers

- Piping shall be grouped as far as possible for the ease of supports.
- Pipes shall be routed on Sleepers at an elevation of min. 500 mm (BOP) for operability, maintainability of the lines and drains.
- Cross over platforms with access to be provided over pipe sleepers where ever the man movement required.
- Concrete culvers shall be provided above pipe sleepers where ever the vehicle

- access envisaged.
- Where the piping requires flat expansion loops, lines shall be routed on the edge of the sleeper
 - High alloys and stainless steel pipes shall not directly rest on carbon steel insert plates. 3mm thin plates equivalent to the pipe material shall be welded onto insert plates at the contact region.
 - Sleepers shall be designed to give the piping shortest possible run. Minimum spacing between adjacent lines shall be as per piping standard. Actual line spacing, especially at 'L' bend and loop locations, shall take care of thermal expansion / thermal contraction / non expansion of adjacent line.
 - Anchors on the sleepers are to be provided at anchor sleeper.
 - If the valves are coming in pipe sleepers, then the valves are to be grouped and proper access shall be given from both side of the sleeper.

11.3 Piping in Trenches

- Trench piping shall be minimized.
- A minimum 75mm clearance shall be provided between the bottom of the pipe or its insulation and the trench bottom.
- Access to trench at starting and end point opening to be given for during Trench Water evacuation
- When flanged joints are used, a minimum of 100mm clearance shall be provided between flange top and cover plate or grating and between the flange side and trench wall.
- For drain piping, a minimum of 150mm clearance should be provided between the bottom of a drain valve and the trench bottom.

11.4 Underground Piping

- All valves in underground piping shall be installed inside valve pits to facilitate operation, inspection and maintenance. Trench to be with proper Valve Pit Cover.
- All underground piping shall be painted as per Company external painting and protective specification
- Underground piping shall basically be joined by welding. Flanged or threaded joints should be avoided except for buried Fire Water ring which shall be flanged.
- The underground piping shall be externally coated and wrapped, if required.
- Burying the piping systems shall be minimized wherever possible.
- No underground piping shall be located near equipment or skids.
- Underground piping at road crossing and other vehicle movement area shall be

- protected by using proper encasing pipe.
- All underground piping shall be painted as per approved system.
 - Insulated pipe shall not be used for underground pipe routing.
 - Underground piping at road crossing and other vehicle movement area shall be protected by using proper encasing pipe.

11.5 Piping Around Pumps

- Suction piping should be as short as possible to avoid vapor pockets
- When the line size reduces at a pump nozzle, the reducer shall be located as close to the pump nozzle as possible. No elbows shall be installed after the reducer. Reducers in horizontal suction lines shall be eccentric with the flat portion on top.
- Double suction pumps shall have 5 diameters of straight pipe immediately before the suction nozzle, irrespective of suction piping configuration. These diameters being equivalent to the nominal bore of the suction nozzle. This straight run should be free of any obstruction, with the exception of a top flat reducer positioned at the nozzle.
- Pump drive shall have clear access of 900mm all around the pump supporting skid. Piping shall be done accordingly.
- Pump strainers shall be installed at ground level except for top suction pumps.
- Unless otherwise specified, T-type strainers shall be used on pump suction piping for sizes 2" & above.
- Y-type strainers shall be used for all sizes in steam services & for pump suction line below 2".
- Suction & discharge valves shall be located at operable height.
- Suction and discharge piping shall not be routed over the pump and motor to facilitate removal for maintenance space. The inlet piping to pumps needs to be arranged and supported such that the strainer can be removed for cleaning without disturbing the piping connection at the pump suction nozzle.
- Pump shall be located in such a way that the acceptable NPSH is next without undue elevation of vessels.
- Piping shall be so arranged that the forces & moment imposed on the pump nozzle do not exceed as per code & as per vendor recommendations.

11.6 Piping Around Vessel

- Piping around vessels shall be located radially around towards the Pipe rack side; man ways and platforms shall be located on the access side.

- Access shall be provided to all flanged nozzles for temporary blinding during maintenance, and the piping shall be supported so that a blind may be readily installed.
- Maximum continuous ladder run shall be 9m. Where the height exceeds 9m, rest landings shall be provided at maximum of 6m intervals.
- Starting at 2.5m from the base of the ladder, all ladders shall be provided with safety cages. The safety cages shall extend 1 meter above the top of the ladder and the distance from the rungs to the back of the cage shall not exceed 800mm.
- Platforms shall be positioned so that the manhole centerline is not less than 0.6meter above the platform. The bottom of the manhole entry shall not be more than 1 meter above the platform.
- Piping shall be supported from cleats welded on the vessels as far as possible.
- Unless specifically indicated in PID's control valve shall be kept at grade or on technological platforms.
- Proper guides at recommended intervals shall be provided for long vertical lines.

11.7 Drains and Vents

The objective of this section is to specify the design/engineering requirements and selection of Vent and Drain System for FGMP at QPS-SE#3. The vent and drain systems are needed for maintenance of equipment, piping and instruments. It shall safely collect and transport residual process fluids from various part of the facility to an appropriate disposal location giving consideration to protection of personnel, plant, equipment and environment.

11.7.1 Drain system

Drain system shall be designed to cater for the following as a minimum:

- Meet statutory and regulatory discharge requirements.
- Drain minor spills and limit the potential and extent of pool fires.
- Effectively remove deluge water and rain water from plant areas.
- Prevent escalation of fire by minimizing drainage system interconnections

The Drain system normally comprises of fluid from the following streams:

- Equipment / skid drain
- Instrument drains
- Drainage of overflow, wash down, rain water, deluge water.

The drain system can be classified as follows:

- Closed drain system
- Oily water collection system

Close Drain System

The closed drain system shall be designed to drain the fluids from process equipment

and it shall be considered as a low-pressure hydrocarbon system. Draining activity normally takes place prior to entry or other maintenance operations such as long-term shutdown. Before equipment is drained to the closed drain system, operating procedures shall ensure the following:

- Equipment shall be emptied to the lowest extent possible.
- Equipment that is drained into the closed drain system is to be fully depressurized to atmospheric pressure.
- All the collected liquids shall be routed to Closed Drain Drum located in a pit where any flashed gas shall be routed to flare system. Liquid shall be pumped to Off-spec crude storage tank using Condensate Transfer Pumps.
- All process drain connections shall be equipped with positive isolation to avoid accidental draining of pressurized liquids.
- Drain piping shall be adequately and continuously sloped to eliminate the possibility of creating liquid pockets.

Oily Water Collection (OWC) System

- The Oily water collection system collects predominantly rain water and deluge water from bund wall area of the process systems and also from other process system. It also collects lube oil, diesel fuel spillage during normal operation or during other routine operations (e.g. maintenance). Check pit and valve pit shall be provided in each process systems as required.
- Drains shall be located so that there is sufficient free space underneath to install temporary facilities to discharge the drained liquid.
- Rainwater or deluge water from process system shall be collected in respective check pit from where it shall be routed to valve pit through hard pipe and finally routed to existing effluent collection pit.

11.7.2 Vent System

- The location of vent outlet shall be located such that in the event of accidental ignition of vent, it will not impinge upon adjacent equipment and heat radiation to equipment or personnel shall be within the limit specified in relevant codes.
- For vents associated with flammable materials, and chemical injection shall be provided with suitable safety devices e.g. Flame Arrestors.
- The end of the discharge pipe shall be cut off squarely and rounded off to minimize the risk of ignition by static electricity and the pipe earthed. The vent velocity should be as high as practicable.
- Test drain and vents shall be provided at all high points and low points of piping. Post hydro test, these valves shall be removed and blinded unless they are required for operation and maintenance purpose.
- Vents and drains shall be as short as possible.

11.8 Fire Fighting

- All firefighting facilities shall be as per OISD-STD-189 norms.

12 CLEARANCES:

12.1 Overhead Clearances

Equipment, structure, platforms, piping & its supports shall be arranged to provide the following clearances overhead:

Over rail roads, top of rail to bottom of any obstruction	7.5 m
Over plant roads for major mobile equipment	7.5 m
Over secondary roads (bottom of pipe) and access ways for mobile equipment	5 m
Over grade & bottom of steel (inside battery limit) at pump row access way	3.5 m
Over walk-ways, pass-ways & platforms to nearest obstruction and inside building	2.2 m
Clearance below offsite Pipe rack	2.2 m

12.2 Horizontal Clearances

Between exchangers (aisles between piping)	0.9 m
Around pumps (aisles between piping)	0.9 m
At driver end of pumps, where truck access is required	3 m
At driver and of pumps, where truck access is not required	1.8 m
At shell cover end of exchangers at grade, for access way	1.3 m
Between shells of adjacent horizontal vessels	1.2 m

Over and above clearances specified above equipment manufacturer's recommendation for maintenance clearances shall be adhered to as a minimum.

12.3 Pipe Berthing

Under ground	300 mm minimum clear gap between pipes
Above ground	Normal - Flange to bare pipe (or insulation) plus 25mm

12.4 Equipment Spacing

Small pumps (3.7 kw & less)	Mounted on common foundations 900 mm clear
Medium pumps (22.5 kw & less)	900 mm clear aisle
Larger pumps (above 22.5 kw)	900 mm clear aisle
Exchangers and other equipment on structures	900 mm minimum clear aisle

Over and above clearances specified above equipment manufacturer's recommendation for maintenance clearances shall be adhered to as a minimum.

12.5 Platforms

Towers, vertical & horizontal vessels:	
Distance of platform below centerline of Manhole flange - side platform.	900-1050 mm
Width of manhole platform from manhole cover to outside edge of platform	900 mm
Platform extension beyond centerline of manhole - side platform	900 mm
Distance of platform below underside of flange- head platform	175 mm
Width of platform from three sides of manhole - head platform	750 mm

12.6 General

Check/Confirm all the clearances as per OISD-STD-118 TABLE-2/ ASME 31.3.

12.7 Accessibility for Valves and Instruments

Valves, Instruments, Equipment to Be Operated	Centre Line of Item to Be Operated, Located Less Than 3.6m Above Grade, 2.75m Above Floor or Platform Or 1.8m Above Wing Platform	Centre Line of Item to Be Operated, Located More Than 3.6m Above Grade, 2.75m Above Floor or Platform or 1.8m Above Wing Platform
Exchanger Heads	Nil	Platform
Oper. Valves 1.5" & Smaller	Fixed Ladder	Fixed Ladder
Oper. Valves 2" & Above	Platform	Platform

Motor Operated Valve	Platform	Platform
Control Valves	Platform	Platform
Relief Valves 1.5" & Smaller	Fixed Ladder	Fixed Ladder
Relief Valves 2" & Above	Platform	Platform
Block Valves 1.5" & Smaller	Portable Ladder	Platform
Block valves 2" & Above	Platform(Note-1)	Platform(Note-1)
Battery Limit Valves	Platform	Platform
Pressure Instrument	Fixed Ladder If Above 2.2m Height	Fixed Ladder
Temperature Instrument	Fixed Ladder If Above 2.2m Height	Fixed Ladder
Sample Points	Nil	Nil
Gauge Glasses	Fixed Ladder	Fixed Ladder
Level Controllers	Platform	Platform
Process Blinds & Spacers 2" & Smaller	Portable Ladder	Nil
Process Blinds & Spacers 3" & Above	Nil	Nil
Manways / Manholes	Platform	Platform
Hand holes / Inspection Holes	Platform	Platform
Nozzles	No Access Req'd. (Note-2)	No Access Req'd. (Note- 2)
Vessel Vents	Portable Ladder	Fixed Ladder
Line Drains & Vents	Portable Ladder	Portable Ladder
Orifice Flange	Portable Ladder	Portable Ladder

Note-1: Block valves with centerline located above 2 m from the operating floor, which are required for normal operation shall be provided with portable platform or chain for operation of valves

Note-2: Temporary arrangement for access should be feasible.

12.8 Table of Basic Piping Support span

	PIPE- VAPOUR- INSULATION	PIPE- LIQUID INSULATION	BARE PIPE EMPTY	BARE PIPE WATER FILLED
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Pipe Size DN	SCH/TH K (mm)	BASIC SPAN (L)M		BASIC SPAN (L)M						PIPE SIZE DN
		UP TO 175 °C	176 °C to 315 °C	UP TO 175 °C	176 °C to 315 °C	SPAN (L)M	WEIGHT KG/M	SPAN (L)M	WEIGHT KG/M	
20	SCH 40	3.5	3.5	3.5	3.0	4.5	1.68	4.0	2.04	20
25	SCH 40	4.5	4.0	4.5	3.5	5.0	2.52	4.5	3.07	25
40	SCH 40	5.0	5.0	5.0	4.5	6.0	4.08	5.0	5.4	40
50	SCH 40	5.5	5.0	5.0	4.5	6.5	5.47	5.5	7.65	50
80	SCH 40	7.5	6.5	6.5	6.0	8.0	11.35	6.5	16.15	80
100	SCH 40	8.0	7.5	7.5	7.0	9.0	16.2	7.5	24.45	100
150	SCH 40	10.0	9.5	9.0	8.0	10.5	28.3	9.0	46.7	150
25	10 S	4.0	3.5	4.0	3.0	4.5	2.08	4.0	2.7	25
40	10 S	5.0	4.5	4.5	4.0	5.5	3.12	5.0	4.57	40
50	10 S	5.0	4.5	4.5	4.0	6.0	3.94	5.5	6.33	50
80	10 S	7.0	6.0	6.0	5.5	7.5	6.45	6.0	11.91	80
100	10 S	7.5	7.0	6.5	6.0	8.0	8.34	7.0	17.67	100
150	10 S	9.5	9.0	8.0	7.5	10.0	13.82	8.5	34.54	150

8 MISCELLANEOUS

- Positive material identifications (PMI) test at construction site shall be done as per Standard Specification for positive material identification.
- Potable water shall be used for hydro testing of Carbon steel & Alloy steel piping. For testing of Stainless-Steel piping maximum chlorine content in water shall be 15- 20 ppm.
- Item codes for surplus & spare materials shall be as per Company codes at the time of handing over of the Project.

9 NDE REQUIREMENTS

- As per applicable codes

10 INSPECTION & TESTING

- All items and their parts shall be subjected to all mandatory as well as

supplementary (wherever specified) tests and checks call for respective codes/standards/data sheets

- The examining personal shall have the requisite qualification and experience.
- Client and its authorized representative reserve the rights to the vet and suggested changes in vendor's procedure
- EPCC's and its vendors', subcontractor's works and facilities shall be accessible to the client/representative at all reasonable times.
- Test reports for all mandatory as well as well as supplementary tests whatever specified shall be furnished.
- Positive material identification test at vendor's work shall be done as per standards specified for positive material identification PMI at vendor's work
- Inspection and testing shall be per approved QAP.

11 MARKING

- All items shall be marked (stamped/etched) in accordance with the applicable code/standards/specification. In addition, the item code, if available, shall also be marked.
- For ease of identification, the colour of painting strip (wherever required) shall be as per the applicable standard.
- Paint or ink for marking shall not contain any harmful metal or metal salts which can cause corrosive attack either ordinary or in service. Special items/smaller items shall have attached corrosion resistant tag providing salient features.

12 DESPATCH

- All items shall be dry, clean and free from moisture, dirt and loose foreign material of all kinds.
- All items shall be protected from rust, corrosion, and mechanical damage during transportation, shipment and storage.
- Rust preventive on machined surface to be welded shall not be harmful to welding and shall be easily removable with a petroleum solvent.
- Ends shall be suitably protracted, and the protectors shall be securely and tightly attached.
- Each variety and size of item shall be supplied in separate packaging marked with the purchase order no, item code (if available), and the salient specifications
- Carbon steel, LTCS and low alloy steel valve shall be painted with one coat of Onorganic zinc silicate primer

13 WELDING

- All welding work, equipment for welding, heat treatment, other auxiliary functions and the welding personnel shall meet the requirements of the latest editions of the following accepted standards and procedures:
 - Process Piping - ASME: B31.3
 - IBR
- In addition, the following codes and specifications referred in the code of fabrication shall be followed for the welding specifications, consumable qualifications and nondestructive test procedures.
- Welding and Brazing Qualifications ASME BPV Sec. IX. Non-destructive examination ASMEBPV Sec. V. Material specifications: Welding rods, electrodes and filler metals ASME BPV Sec II Part C.
- The additional requirements mentioned in this specification, over and above those obligatory as per codes, shall be followed wherever specified.

14 COLOUR SCHEMES & IDENTIFICATION LETTERING SPECIFICATION

19.1 Purpose

This covers the requirement of color scheme & lettering for the identification of the contents of the piping carrying fluids. This specification also covers the lettering identification on static & rotary equipment. In general, the piping color shall be in accordance IS 2379-colour code for identification of pipelines

19.2 Procedure

Procedure for colors scheme: Below table shall be followed for the color scheme on piping.

FLUID	FUNCTION OF	STRIP COLOR
Fire Fighting	Water	Green
	Foam	Aluminum
	Co2	White
Flammables and Fuels	Diesel	Dark Brown
	Flare	Black
	Gas	White
	Fuel Gas	Safety Yellow
	HP Production Fluid	Safety Orange

	LP Production Fluid	Safety Blue	
Gas Flammables	Diesel Engine Exhaust	Aluminum	
	Nitrogen	White	
		1st and 3rd Strip Colors	2nd Strip color
Non-Flammables	HP Hydraulic Fluid	Aluminum	Safety Red
	Lubricant	Aluminum	Green
	Dirty Lubricant	Aluminum	Black
Chemical Product	Mercaptan	Safety Orange	White
Water	Potable	Green	Safety Blue
	Cooling	Green	White
	Hot	Green	Safety Red
	General Service	Green	Dark Brown
Drainage	General	Green	Black
	Sanitary Sewage	Green	Safety Orange
Compressed Air	Instrument	Safety Blue	Safety Yellow
	Utility	Safety Blue	Safety Red
	For Bulk System	Safety Blue	White
Vents	General	Green	Safety Blue

- Three strips (150 mm width each) shall identify all piping (except firefighting, gas, flammable and fuel lines), where the first and the third strips indicates the network or fluid and the second strip indicates the function of future. These three strips shall be placed each 9-meter length whenever necessary for identification (branches, valves tanks, drums, at curves, close to maneuver equipment, close to the entrance and exit of equipment and before and after crossing of a bulkhead)
- Firefighting, gas, flammable and fuel lines shall be painted full length with a single painted or taped strip (strip color 300 mm width) placed in such a way that everybody of the working staff would see and identify the piping and the product that it contains. These strips shall also be placed each 9 meters length whenever necessary for identification (branches, valves, tanks, drums, at curves, close to maneuver equipment, close to the entrance and exit of equipment and before and after crossing of a bulkhead).
- All strip colors shall be painted or marked by viny or PVC tape, in accordance with the specified color of the table above.
- Insulated piping shall also be identified.

19.3 Procedure for Lettering

Font of letter shall be BOLD for pipes, equipment and building

(a) On Pipes:

Letter will be in black on pipes painted with light shades & white painted with dark shades to give clear and readable contrast.

Line tags & arrow shall to indicate flow direction shall be painted or marked by vinyl or PVC tape. Text height shall be 20mm up to DN80 & 80mm above DN80.

(b) On Tanks & Vessels:

Size of letters stenciled/written for equipment shall be as follows:

- Tanks & Vessels etc: 300mm
- Pump compressor & other machinery: 100mm
- Stenciled shall be 0.3 H from top of tank.

(c) On Buildings:

Rectangle of size 1000 X 450 shall be painted on the wall of the building with yellow color & letter size of 4" to 6" in black color shall be stenciled/pain over the yellow box for specifying the building.

CONTROL ROOM

Sign board of acrylic, PVC flex material shall be posted on the ground at a height of 3 feet with a letter size of 3" to 4".