



**DOMESTIC PETROLEUM OPERATING BRANCH -
PETROVIETNAM EXPLORATION PRODUCTION
CORPORATION LIMITED
(PVEP-POC)**





PROJECT

**DAI HUNG NAM PROJECT, BLOCK 05.1(a)
OFFSHORE VIETNAM**

PHASE

FRONT END ENGINEERING DESIGN (FEED)

**GENERAL SPECIFICATION FOR PIPING
FABRICATION**

| D0 | 10 Sep 24 | Approved for Design |  SHAHAZ NORWAWI | |
|---|-----------|---------------------|---|----------------------|
| Rev. | Date | Description | Approved by RNZ | Approved by PVEP-POC |
|    | | | Document number: WHP-DHN- P-S-0005 | |
| CONTRACTOR: RNZ INTEGRATED (M) SDN BHD SUBCONTRACTOR: PVENGINEERING CONSULTANCY JSC | | | Number of pages: 47 pages (including this page) | |



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| D0 | 10 Sep 24 | Approved for Design | D.T. Van L.V.Binh | H. Ali | |
| C0 | 30 Jul 24 | Issued for Review | D.T. Van L.V.Binh | H. Ali | |
| | | | Name | Name | |
| Rev. | Date | Description | Prepared by | Checked by | Checked by PVEP-POC |
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REVISION RECORD SHEET

| No. | Revision No. | Content of revision | Date of revision |
|------------|---------------------|----------------------------|-------------------------|
| 1 | C0 | Issued for Review | 30 Jul 24 |
| 2 | D0 | Approved for Design | 10 Sep 24 |
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1. PROJECT OVERVIEW

1.1 INTRODUCTION

Dai Hung Nam (DHN) area is located in the southern part of Dai Hung oil field of Block 05-1(a), approximately 250 km from the coastline of the South-Eastern Vietnam and is situated in a water depth of 110 m (average). Block 05-1(a) has been operated by PVEP since 2003. The center of DHN is located approximately 3.5 km from the existing WHP-DH02 and 7.5 km from the current location of the FPU.

The location map of Block 05-1(a) is as hereunder in Figure 1.1.1.

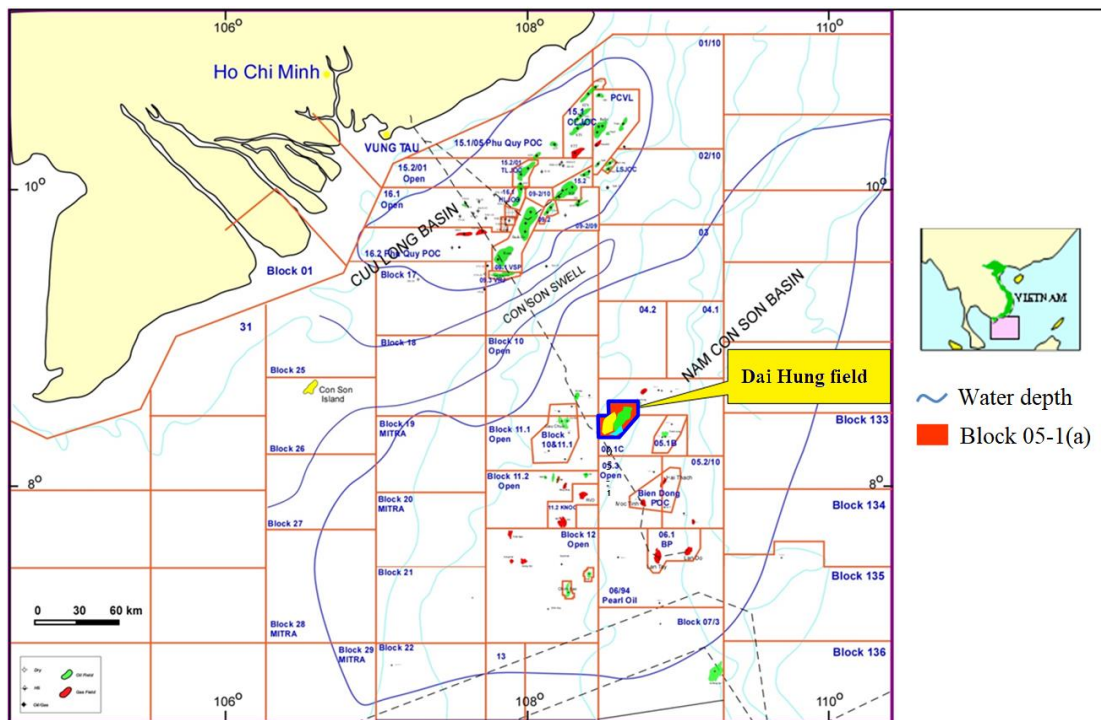


Figure 1.1.1: Block 05-1(a) Location

1.2 BLOCK 05-1(A) EXISTING FACILITIES

The block facilities currently comprise of: Floating Production Unit Dai Hung (FPU), subsea wells, flowlines, mid depth buoy, calm buoy, and a 6" oil export pipeline that routes product liquid from the FPU to the FSO. The Wellhead Platform DH02 (WHP-DH02) is located in southwest direction of FPU at a distance of about 5km, dual 6" subsea export pipeline that transports the liquid from WHP-DH02 to FPU for further processing. Dai Hung gas gathering system with a pipeline length of approximately 20 km to transport gas from WHP-DH02 to BK-TNG of Vietsovpetro Joint Venture (VSP) (Figure 1.2.1); and the wellhead platform DH01 (WHP-DH01) is located in northeast direction of FPU at a distance of about 2.5 km,

GENERAL SPECIFICATION FOR PIPING FABRICATION

10" subsea export pipeline that transport the liquid from WHP-DH01 to FPU for further processing, 6" fuel gas pipeline to supply fuel gas to FPU, 8" water injection pipeline for supplying water injection from FPU to WHP-DH01 and 12" export gas to BK-TNK.

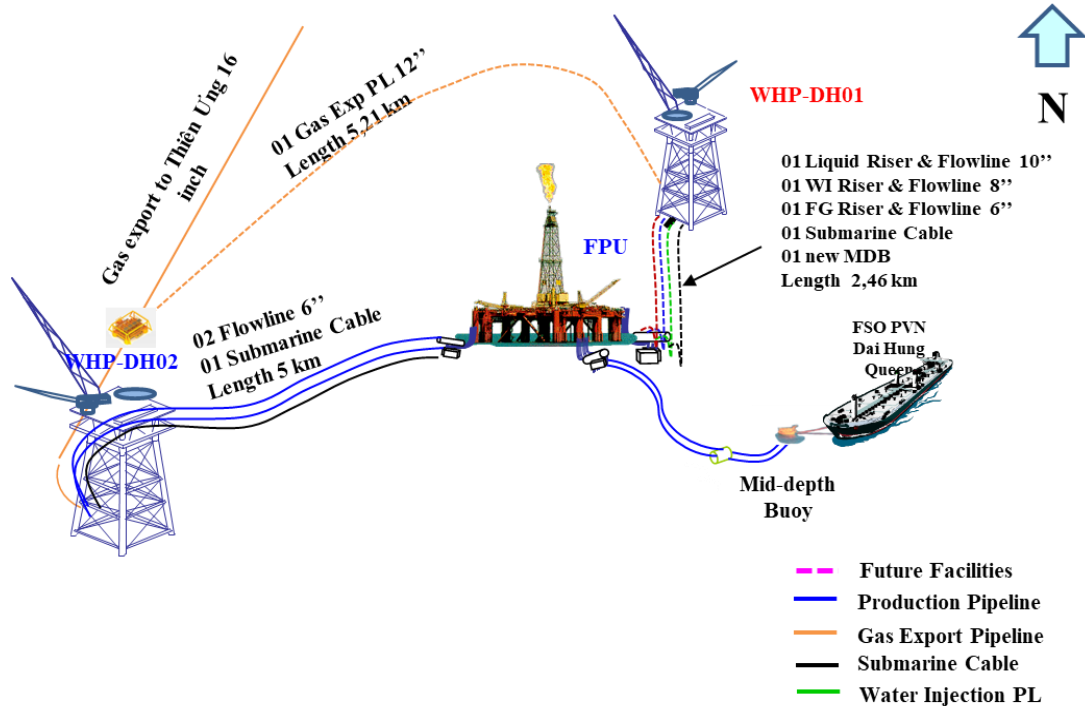


Figure 1.2.1: Existing Dai Hung field facilities in 2024

1.3 DAI HUNG NAM DEVELOPMENT SCHEME

The field facilities in Dai Hung Nam Field Development are as follows:

- New unmanned wellhead platform WHP-DHN located near WHP-DH02. WHP-DHN will be designed with 11 well slots for drilling by jack-up rig. Full wellstream of WHP-DHN will be routed to a Production Separator (on WHP-DHN) then the separated liquid is transported to FPU for further processing, a separated associated gas is exported to BK-TNG.
- Infield Pipelines
 - + One liquid rigid pipeline, transporting separated liquid from WHP-DHN to FPU through subsea tie-in point of existing 10" liquid flowline from WHP-DH01 to FPU.
 - + One gaslift rigid pipeline, transporting gaslift from WHP-DHN to WHP-DH02.
 - + One export gas/source gas, transporting separated associated gas/source gas from WHP-DHN to subsea tie-in point of 16" existing export gas pipeline and via versa.

GENERAL SPECIFICATION FOR PIPING FABRICATION

- + One water injection rigid pipeline, transporting water injection from FPU to WHP-DHN through subsea tie-in point of existing 8" water injection flowline from FPU to WHP-DH01.
- Modification works on WHP-DH02, WHP-DH01 and FPU for connection and processing.

Scheme of Dai Hung Nam Field Development is presented as below.

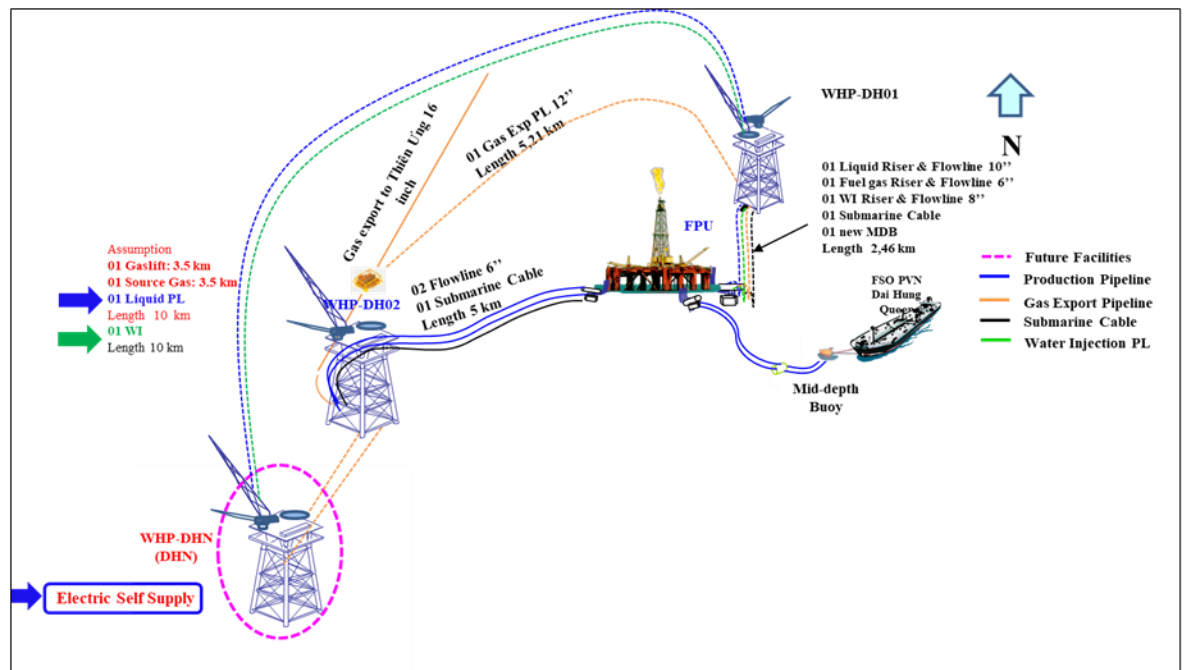


Figure 1.3.1: Dai Hung Nam Field Development Scheme

2. PURPOSE AND SCOPE

This specification defines the minimum requirements for shop and field fabrication, erection, inspection and testing of process and utility piping to be carried out by CONTRACTOR/VENDOR/SUPPLIER/MANUFACTURER or its equipment VENDOR.

The construction drawings and CLIENT specifications indicate the required piping class and valve type. The CONTRACTOR/VENDOR/SUPPLIER/MANUFACTURER shall strictly adhere to the requirements of the CLIENT specifications for the materials, fabrication erection, inspection and testing procedures.

This specification covers the fabrication of metallic pipe only.

GENERAL SPECIFICATION FOR PIPING FABRICATION

3. DEFINITIONS AND ABBREVIATIONS

3.1 DEFINITIONS

| | |
|----------------------------------|---|
| PROJECT | Dai Hung Nam Project |
| CLIENT | Domestic Petroleum Operating Branch – PetroVietnam Exploration Production Corporation Limited (PVEP-POC) |
| CONTRACTOR | The company or consortium which is awarded any or all of the Engineering, Procurement, Construction and Installation for the project |
| VENDOR/SUPPLIER/ MANUFACTURER | The entity which supplies any product/services/ system to the CLIENT against a purchase order issued by the CLIENT or its SUB-CONTRACTOR |
| PURCHASER | It is an entity belonging to the CLIENT or CONTRACTOR responsible to issue order for any product or services complete with all technical and commercial documents |
| CERTIFICATION AUTHORITY | The authority engaged by the CLIENT to review, appraise and certify the WORK in accordance with the applicable codes, standards and specifications |
| WORK | The goods and services provided to the CLIENT by the VENDOR/SUPPLIER/MANUFACTURER |
| THIRD PARTY INSPECTION (TPI) | The independent agency appointed by CLIENT and to perform, design appraisals and manufacturing surveillance activities at the Supplier's works with respect to the subject work on behalf of the CLIENT |
| SUB-VENDOR/ SUB- SUPPLIER | Sub-Vendor/Sub-Supplier to VENDOR/SUPPLIER/ MANUFACTURER |

3.2 ABBREVIATIONS

| | |
|-------|---------------------|
| BOCAD | BOCAD Software |
| EM | Engineering Manager |

GENERAL SPECIFICATION FOR PIPING FABRICATION

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| EMDR | Engineering Master Deliverables Register |
| E3D | Aveva Everything 3D |
| FPU | Floating Production Unit |
| IT | Information Technology |
| MTO | Material Take Off |
| MDS | Multiple Discipline Support |
| PM | Project Manager |
| P&ID | Process & Instrument Diagram |
| WHP-DHN | Dai Hung Nam Wellhead Platform |

4. UNIT OF MEASUREMENT

Unless specified otherwise, International System of Units (SI) shall be used as a Unit of measurement throughout this document.

5. REFERENCES

5.1 CODES AND STANDARDS

5.1.1 International Codes & Standards

The fabrication, erection, testing and inspection of piping systems shall be in accordance with the latest edition of the following Codes and Standards. In case of conflict between this specification and the codes and standards referenced below, the most stringent requirement shall govern.

| | |
|----------------|--|
| ASME B1.2 | Gages and Gaging for Unified Screw Threads |
| ASME B1.20.1 | Pipe Threads General Purpose (Inch) |
| ASME B16.47 | Large Diameter Steel Flanges |
| ASME B16.48 | Steel Line Blanks |
| ASME B16.5 | Pipe Flanges and Flanged Fittings |
| ASME B16.34 | Valves – Flanged, Threaded and Welding End |
| ASME Section V | Non Destructive Examination |

GENERAL SPECIFICATION FOR PIPING FABRICATION

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| ASME Section IX | Welding, Brazing, and Fusing Qualification |
| ANSI / AWS D1.1 | Structural Welding Code - Steel (pipe supports only) |
| API RP 14E | Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems |
| API RP 14J | Recommended Practice for Design and Hazard Analysis for Offshore Production Facilities |
| API RP 520 | Sizing, Selection and Installation of Pressure - Relieving Devices in Refineries, Parts I and II |
| API RP 521 | Pressure-Relieving and Depressuring Systems |
| API 570 | Inspection, Repair, Alteration and Rerating Of In-Service Piping Systems |
| API TR938C | Use of Duplex Stainless Steels in the Oil Refining Industry |
| ASME B31.3 | Process Piping |
| ASME B31.4 | Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids |
| ASME B31.8 | Gas Transmission and Distribution Piping Systems |
| ASME section II part C | Specification for low- alloy steel electrodes & Rods for gas shielded arc welding |
| NFPA 24 | Standard for the Installation of Private Fire Service Mains and their Appurtenances |
| AISC | Manual of Steel Construction (pipe supports only) |
| MSS-SP-44 | Steel Pipeline Flanges |
| MSS-SP-58 | Pipe Hangers and Supports – materials, design and manufacture |
| MSS-SP-69 | Pipe Hangers and Supports – selection and application |
| MSS-SP-75 | Specification for High Test Wrought Butt Weld Fittings |

5.1.2 Vietnamese Standards

The CONTRACTOR/VENDOR shall be responsible for ensuring compliance with all applicable codes, standards and local regulations.

| | |
|---------------------|---|
| QCVN 20:2023/BCT | National technical regulation on safety of metallic rigid gas pipelines |
|---------------------|---|

5.2 PROJECT SPECIFICATION

- WHP-DHN-P-A-2000: Piping Design Basis
- WHP-DHN-P-S-0001: Pipe Material Class Specification

GENERAL SPECIFICATION FOR PIPING FABRICATION

- WHP-DHN-P-S-0002: Valve Material Specifications
- WHP-DHN-P-S-0004: Specification for Thermal Insulation and Personnel Protection
- WHP-DHN-P-S-0006: Painting and Protective Coating Specification
- WHP-DHN-P-D-9200: Pipe Support Standards

6. ORDER OF PRECEDENCE

In the event of conflict between this Specification, and any other Specification, Datasheet, Code or Regulation, VENDOR/SUPPLIER/MANUFACTURER shall inform in writing and receive written clarification from CONTRACTOR before proceeding with the work.

The order of precedence shall be:

- Mandatory local laws and regulations
- Enquiry/ Purchase Order
- Project Specification Data Sheets
- This Specification
- COMPANY General Specifications
- National and International Codes and Standards

7. QUALITY CONTROL

The CONTRACTOR/VENDOR shall have a quality control system and quality control manual covering all fabrication activities. Controlled copies of the quality control manual shall be available for CLIENT approval and for monitoring of all construction activities. CONTRACTOR/VENDOR shall also develop and implement (CLIENT approved) Inspection & Test Plan covering all aspects of fabrication.

The CONTRACTOR/VENDOR establish detailed procedures for control of welding quality. The following procedures shall be submitted for review and approved by the CLIENT prior to starting fabrication:

- Welding and weld repair procedures.
- Purging and Damming Procedures (For GTAW).
- Storage, control, and identification of welding consumables.
- Welder qualification records.
- Inspection/NDE.
- Post weld heat treatment, if required.
- Monitoring the progress and quality of welding.

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- PMI Procedure.
- ITP
- Hydro test procedure
- The CONTRACTOR/VENDOR shall ensure the "in process" material documentation is maintained on a daily basis. All materials, which require documentation in use during fabrication or installation that cannot be identified with documentation shall be immediately removed from the area and replaced at the CONTRACTOR/VENDOR's expense. This will include partially assembled piping assemblies if one or more components are found to be deficient or cannot be identified by material records.
- All piping (pipe and fittings) shall be provided with Mill Test Reports and Certified Test Reports. The reports shall identify the type of steel, composition, material properties, heat number and any special test that has been performed. In addition, the material shall be certified that it meets the applicable requirements of the specified codes.
- The CONTRACTOR/VENDOR shall ensure that all piping components are fully traceable to their final installed location within the facilities.
- For module packagers and for piping inside equipment package/fabricators / contractors, all piping corrosion resistant alloys materials (stainless steel, duplex, inconel, monel, etc) except carbon steel, 90% Cu & 10% Ni, non-metallic, shall be tested to verify alloy content. CONTRACTOR/ VENDOR to develop and implement a (PMI) Positive Material Identification Procedure. Alloy analyzing equipment shall be of the electronic type. Any materials found deficient will be replaced at CONTRACTOR/ VENDOR's cost.

8. PIPING

8.1 GENERAL

Piping design shall conform to Pipe Material Class Specification_Doc No: WHP-DHN-P-S-0001.

Materials shall be new, unused, free of damage, sharp edges and defects, and shall conform to Pipe Material Class Specification WHP-DHN-P-S-0001. Any machining of piping, fittings, flanges, etc, to achieve the specified dimensions, bore, schedule, etc, must comply with the dimensions and tolerances of the material specification or standard.

Piping shall be mounted using properly adjusted hangers or properly leveled supports. The CONTRACTOR/VENDOR shall maintain "clean" and isolated fabrication areas & storage area for the fabrication of Duplex stainless steel, stainless steel and nickel alloy piping to minimize the possibility of contamination. The CONTRACTOR/ VENDOR shall pay specific attention to the segregation of tools and the protection of material.

The CONTRACTOR/SUB-CONTRACTOR shall perform UTM (Ultra Sonic Thickness Measurement) for all metallic material of piping such as pipes, bends, elbows, tees,

GENERAL SPECIFICATION FOR PIPING FABRICATION

reducers, which shall be used for services as attached bellow period to installation. The UTM record have to be collected and submit to CLIENT.

- All process Hydrocarbon Liquid / Gas with main flow lines.
- Diesel lines.
- Fuel Gas lines.
- Instrument Gas lines.
- Closed / Open drain piping.
- Chemical injection piping.
- Methanol injection piping.
- Produced Water.
- Flare piping.
- Seawater Injection.
- Hydraulic piping.
- Water service piping.
- Potable water piping.

The CONTRACTOR/VENDOR shall utilize shop tools and equipment compatible with materials in fabrication, including but not limited to grinding discs, cutting tools, and wire brushes designed for use with stainless steel and/or other high alloy materials.

The CONTRACTOR/VENDOR shall prepare for shipment and load all loose spools in a manner so as to minimize damage to the spool and to keep them stable for shipment. Several spools may be placed on a pallet or in a common shipping cargo basket or rack provided they are adequately chocked and supported. Spools may be chocked off each other. No spool-to-spool contact is permitted. Spools shall be secured by banding with a "Band-It" or equal. Each spool shall bear a unique spool number (corresponding to the fabrication/installation drawing) for identification.

The CONTRACTOR/VENDOR shall provide padded slings or straps for handling carbon steel pipe and non-ferrous padded slings for Duplex stainless steel, stainless steel and alloy pipe. CONTRACTOR/VENDOR shall exercise care in lowering, assembling and installing all coated piping. Any damage to the coating caused by the CONTRACTOR/VENDOR shall be repaired at CONTRACTOR/VENDOR's expense to the satisfaction of CLIENT.

Upon completion of installation, painting and insulation (where applicable), CONTRACTOR/VENDOR shall stencil the line number and flow arrow on the piping in accordance with the requirements of CLIENT coating specification.

The CONTRACTOR/VENDOR shall provide adequate break-out points for removal of pipe sections in socket weld construction, even though such break-out are not shown on the piping drawings/P&IDs

GENERAL SPECIFICATION FOR PIPING FABRICATION

All flange bolts of sizes 1.1/2" and larger shall be installed by hydraulic tensioning. Bolts for tensioning shall have one bolt diameter extra length. The extra length shall protrude on one side of the flange only and shall be protected by installing plastic protective caps.

8.2 PIPING FABRICATION

Welded fabrication of piping shall be in accordance with the requirements of ASME B31.3, ASME Section IX and Pipe Material Class Specification_Doc No: WHP-DHN-P-S-0001 for the individual material specification classes.

Miter joints shall not be used.

Pipe spools for hook up pipe work shall be fabricated with an extra 150mm of pipe as minimum at onshore field fit welds.

8.2.1 Fabrication Tolerances

Piping tolerances shall be in accordance with ASME B31.3.

The location of piping terminations, such as at the edge of skids shall be within ± 1.6 mm in each direction and within 1/2 degree of being square.

Dimension shall be taken from the nearest main structural member.

8.2.2 Offshore Installed Spools

Pipe spools for off-shore hook up pipe work shall be fabricated with an extra 300mm of pipe as minimum at off-shore field fit welds.

Offshore installed spools are to be fit up and fabricated onshore complete with hydrotesting, NDE and painting.

The spools will then be removed and prepared for shipment for offshore installation.

If necessary due to misalignment offshore, e.g. caused by platform deflection during transportation, the spool is to be cut, re-fit, re-welded, hydrotested, NDE, and painted offshore, if suitable facilities are available.

However, with CLIENT approval, 100% radiography as well as all other pertinent NDE will be applied to the completion welds in lieu of hydro testing offshore. The CONTRACTOR to submit TQ referencing relevant paragraph in ASME B31.3 that covers this practice and it will be decided on a case by case basis.

Conversely, as directed by the CLIENT, offshore installed spools may be preliminary fabricated and tested onshore by means of offshore laser dimensional survey and an engineered fabrication isometric produce from the survey data. This requires the services of an experienced third party CONTRACTOR.

8.3 PIPE ALIGNMENT

Internal misalignment of pipe-work shall not exceed 15% of the pipe wall thickness up to a maximum of 1.6 mm.

GENERAL SPECIFICATION FOR PIPING FABRICATION

Dimensional tolerances for fabrication and installation of piping shall be plus or minus 1.6 mm at equipment or skid tie-in points unless otherwise noted on the drawings. Tolerances shall not be cumulative. Except for connections to rotating equipment, flange faces shall be aligned within $\pm 1/2^\circ$ from the square with pipe, regardless of orientation.

For piping connections to rotating equipment, pipe strain shall be checked by mounting dial indicators on the coupling at zero point, vertically and horizontally, then installing the piping flange bolts and gaskets. If attachment of the piping causes the dial indicators to move more than 0.05 mm TIR (Total Indicating Run-Out), then the piping must be corrected to prevent undue stress on the equipment. Inline pumps and vertical well pumps do not lend themselves to checking pipe strain by the dial indicator method. The acceptable procedure for checking these types of pumps is to check flange parallelism with feeler gauges. A variance across the face of the flange of 0.635 mm or less is acceptable.

8.4 PIPING TO PUMPS, VESSELS AND EQUIPMENT

Pipe and equipment supports shall be installed in such a manner that supports do not have to be cut out for the removal of the pipe or equipment.

Piping shall be erected and supported in a manner that will not put undue strain on equipment such as compressors, engines, pumps, vessels and heat exchangers. The following procedure shall be observed:

- After the equipment has been set the pipe shall be connected to the equipment without making any tight connections to flanges.
- Align pipework to equipment flanges to within the vendor's tolerances. Adjust pipe support where necessary.
- Flange faces for flanges in pipe to equipment shall be parallel within 1.6 mm measured across.
- Bolt up piping to equipment flanges and torque the bolts to the specified tension.
- For rotating equipment, check the coupling alignment during the bolting and tensioning of the pipe flanges to the equipment flanges. The bolting up and tensioning of the flanges shall not affect the coupling alignment between the driver and driven equipment.
- Check setting of pipe support.
- Flat face flanges and full face gaskets shall be used on piping connecting to equipment with flat face flanges.
- Flanges shall be checked to ensure that no strain is placed on the equipment. If the pipe is not in correct alignment it shall be removed and corrected. The correction in alignment shall not be made while the pipe is connected to the equipment. Heating of piping to correct misalignment shall not be permitted.

GENERAL SPECIFICATION FOR PIPING FABRICATION

- Spectacle blinds shall be provided where indicated on the drawings. All lines to / from vessels shall have a spectacle blind installed. Full access for installation, operation and removal must be provided.
- Normally this shall be done when a vessel manhole / manway is of a sufficient size to allow access.
- Wherever required a removable spool shall be installed at lines connecting to rotating equipment, pumps, vessels etc.
- Alternate procedures may be presented to CLIENT for approval.

8.5 DRAINS AND VENTS

Drains and vents shall be shown on the piping isometrics and spool drawings.

Drains and vents shall be designed, located and piped in accordance with Piping Design Basis_Doc No: WHP-DHN-P-A-2000 & Pipe Material Class Specification Doc No: WHP-DHN-P-S-0001.

Vents and drains not piped to the vent or drain system shall be plugged with hex head plug or blind flange as appropriate. Vents used for hydro testing purposed only, in hydrocarbon systems shall be plugged and seal welded when reinstatement is complete.

8.6 STRAINERS

Piping shall be arranged to permit removal of temporary strainers from flanged joints without altering pipe, pipe supports or equipment alignment.

The CONTRACTOR/VENDOR should consider the installation of temporary strainers at or adjacent to the last bend in the compressor suction lines.

8.7 COLOR CODING

Piping shall be complied with Painting and Protective Coating Specification_Doc No: WHP-DHN-P-S-0006 and identified with 360° bands at 6±1 meter intervals and also where piping enters or exits pipework junction, modules and / or skids. Painting or self-adhesive tape can be used for bands on pipes where the surface temperature is suitable and does not form condensation during operation. It shall also include flow direction arrows. The band shall be white with black texts and arrows (refer to figure 8.7).

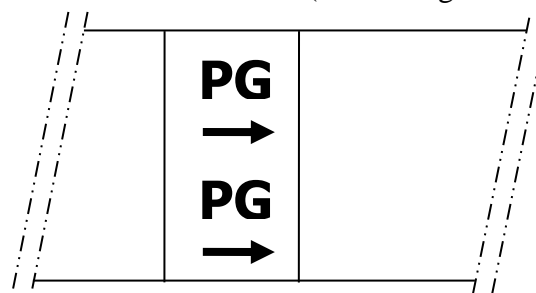


Figure 8.7

GENERAL SPECIFICATION FOR PIPING FABRICATION

The width of band and the height of the letter shall be as follow:

| Pipe Nominal Diameter | Band Width | Letter Height |
|-----------------------|------------|---------------|
| 1/2"-1 1/2" | 150 mm | 15 mm |
| 2"-6" | 150 mm | 25 mm |
| 8" to 20" | 250 mm | 100 mm |

9. PIPING CONNECTIONS

9.1 LINE UP OF BUTT WELD CONNECTIONS

To insure proper line-up, exterior line-up clamps shall be used where possible. Refer to section 8.3 for alignment tolerances.

Alignment of pipe to be joined may be improved by the use of hydraulic or screw type clamp. Hammering or heating the pipe shall not be permitted. Excessive misalignment may be overcome by buttering of the weld preparation but only with prior, written approval of the CLIENT representative.

Internal grinding or machining may be conducted, with prior approval from CLIENT, to improve root alignment of misalignment equal to or less than 3.2 mm. However, the taper shall be 1 in 4 minimum and the minimum wall thickness shall be maintained.

Attempts to improve alignment shall not be carried out by cold working unless a subsequent heat treatment is applied prior to welding and written CLIENT approval is given.

9.2 SPACING OF SOCKET WELD CONNECTIONS

Socket weld valves or fittings shall be spaced with the pipe such that no stresses shall be imparted to the weld due to "bottoming" of the pipe in the socket. **Water soluble socket weld** spacing ring thickness shall be used with 1/16" (2 mm) minimum Gap required as per section 328.5.2 of ASME B31.3. Otherwise CLIENT shall ask CONTRACTOR to perform radiography to validate no "bottoming".

9.3 FLANGE CONNECTIONS

Flange connections shall be made up as follows:

- Clean protective grease from flange gasket faces and position for bolt up. Flange faces shall be parallel and aligned in the horizontal and vertical. Position gasket and install bolts and nuts to hand tight.
- All bolts for flanged connections require extreme attention in assembly to ensure uniform loading on the gasket surfaces. Non uniform bolt loading, dirt at the mating

GENERAL SPECIFICATION FOR PIPING FABRICATION

surfaces or scratched flange surfaces shall be subject to release and flange joint reassembly or flange face redressing.

- Regardless of the scheme selected for flange joint assembly, i.e. gauge between flanges, torque wrench or bolt elongation, it is important to tighten uniformly and not prematurely set the gasket. Hand tighten all nuts first, then gradually tighten opposite nuts on the joint. Do not bring a single nut to full tightness before the others have been carefully stepped up toward this final position.

The CONTRACTOR shall develop a CLIENT Approved, Flange Management Procedure applicable to all flange joints existing on Brownfield Modification.

Or else engage a “Flange management” group that are specialists in this field of expertise.

9.4 FLANGE FACES

Raised-face flanges shall be wire brushed by hand (no power brushes or grinders) and shall be lightly coated with grease before installing.

9.5 FLANGE BOLTS

Where flange faces are vertical, bolt holes shall straddle the vertical centerline.

Where flange faces are horizontal, bolt holes shall be parallel to the ship's longitudinal centerline or to the platform north south.

Bolt threads shall extend ¼-inch past nuts when tightened in place, approximately 2 -3 full threads.

For ease of identification, bolting PTFE to be colour coded as follows:

- Material A193 Gr. B7 / A194 Gr. 2H – Blue
- Material A320 Gr. L7 / A194 Gr. 7 – Black

9.6 SLIP-ON FLANGES

Slip-on flanges shall be welded on front and back in accordance with ASME B31.3.

Use of slip-on flanges must be approved by CLIENT and will only be considered where space restraints make the use of weld neck flanges impossible or very difficult to install or maintain.

9.7 SCREWED THREAD CONNECTIONS

Screwed threads shall be clean cut with no burrs or stripping and shall be in accordance with ASME B1.1, ASME B1.2 and B1.20.1. Tapered dies shall be new, sharp, and properly designed for the piping material. Male threads shall be made up with Teflon tape or thread sealant (for example as Loctite 567). Teflon tape shall be applied in a single layer wrap and Teflon tape or thread sealant shall not extend beyond the end of pipe. Piping shall be made up sufficiently for the threads to seize.



GENERAL SPECIFICATION FOR PIPING FABRICATION

The length of thread engagement between internal and external taper threads shall be in accordance with Section 3, Table 2 of ASME B1.20.1

The cutting fluid used during thread cutting operation shall be cleaned with a suitable solvent.

Thread sealant used in high temperature service shall be applied smoothly to the thread area only, with care taken not to apply sealant into the pipe interior.

9.8 INSULATION KITS

Generally, the Insulation kits shall be applied for dissimilar metals contacted together with same class and can sustain with system pressure and fire safe certified. Base on recommendation of Topsides Material Selection and Corrosion Study Report for DHN.

10. SPECIAL PIPING

10.1 HYDROCARBON SERVICES

Piping shall be provided as shown on the drawings and as per the above mentioned Specifications and Codes and Standards listed in section 5.

10.2 INSULATION

Piping, valves and associated equipment and fittings to be insulated in accordance with WHP-DHN-P-S-0004 Specification for Thermal Insulation and Personnel Protection. All insulation to valves to be the removable box type.

Box to be designed to allow removal and re-installation without the need for specialist insulators.

Storage shall be in accordance with Vendor's recommendations.

10.3 END COVERS

To prevent the ingress of unwanted material the ends of pipework and associated equipment, unless being actively worked on will be "blinded off" with material "fit for purpose" and CLIENT approved. Pipe shall be inspected prior to assembly to ensure pipe is free of all internal loose rust, soil and debris.

All valves shall be fitted with removable box type insulation, i.e. clip-on type that can be removed and replaced without the need for trained personnel.

10.4 PIPING VALVE AND INSULATION IDENTIFICATION

See Pipe Material Class Specification_Doc No: WHP-DHN-P-S-0001 and Specification for Thermal Insulation and Personnel Protection_Doc No: WHP-DHN-P-S-0004 for line, service and valve designations / tagging.

GENERAL SPECIFICATION FOR PIPING FABRICATION

10.5 PRE-PIPING ERECTION

There will have many piping spools to be connected by field welds, so that the spools not yet hydrostatic tested before erection. Therefore, until completion of pressure testing, all piping joints (including flanged, threaded or welded) shall be left uninsulated and unpainted. Untested welds shall only be prime-coated to a minimum distance of 2 inches on either side of the joint. Special care shall be taken when transporting pipes to site and lifting to their final location to prevent damage to paintwork / coating. Pipe shall be free of all internal loose rust, scale, soil and debris before assembly.

In order to prevent damage of paint while tightening bolts as well as avoiding the loss of bolt tension during operation, the flange face where areas under hex bolts, nuts or washers shall be primer coated only.

Every precaution shall be taken during erection to prevent foreign matter from entering the piping system. Protective covers shall not be removed until final assembly is imminent. Field welds shall be cleaned in site and painted in accordance with Specification.

Chains shall not be used for handling pipe spools, valves or associated piping attachments. When lifting only certified rope or webbed slings shall be used.

All piping shall be installed in accordance with approved CLIENT drawings.

Modifications to pipe routing may be necessary to avoid interference. Such modifications shall be approved by the CLIENT Representative. CONTRACTOR shall execute the modifications in a neat and workmanlike manner. The modifications shall be reflected on 'as-built' record drawings. CONTRACTOR shall update the relevant drawings and E3D model for submission to CLIENT.

Cold springing or forcing of piping for the purpose of joint make up is not permitted at any time.

Valves and heavy components shall at all times be independently supported or suspended to prevent excessive torque, bending and longitudinal stresses being transmitted to or carried by the pipe system.

Where it is necessary for the pipe to move about the support, suitable shoes or slip pads shall be provided to prevent wear.

The CONTRACTOR/VENDOR shall submit to CLIENT for approval suitable sketch plan of the site run piping system showing proposed pipe run, pipe supports location and pipe supports types proposed.

11. ASSEMBLY

11.1 GENERAL

The assembly of piping systems shall be in accordance with CLIENT-approved drawings.

Items, which may be easily damaged, shall be installed after heavy construction is completed if possible.

GENERAL SPECIFICATION FOR PIPING FABRICATION

No piping or tubing shall be laid directly on or under the skid floor without specific written permission from CLIENT.

Temporary supports shall be installed during erection to prevent over-stress of piping or equipment to which piping is being connected.

Pipe and fittings that are not properly stamped and identified shall be deemed unsuitable for intended use and degraded for general use or rejected totally.

Pipe and piping components shall be checked for damage or distortion and any debris removed prior to fit-up.

Minor surface defects may be removed by grinding, provided the wall thickness is not reduced below the allowable tolerances. The CLIENT Inspector shall be informed of any repairs to permit check and approval of wall thickness tolerances.

Piping shall be erected to line and level on pipe supports in a natural unstressed condition. Piping that does not fit shall be removed, cut, and adjusted to suit. The use of force, temporary braces or supports welded to the piping shall not be allowed.

If piping is connected by flange joints, the joint shall be disconnected after completion of the piping erection and welding to indicate correct alignment. Any springing of the flange shall be corrected by refabrication of the piping. The installation and protection of proprietary items shall be in accordance with the vendor's instructions.

Piping shall be erected and supported in a manner that will not put undue strain on pumps, vessels or equipment. All equipment, prefabricated piping and appurtenances shall be fitted and assembled strain-free. The CONTRACTOR/VENDOR shall be prepared to demonstrate, by disassembly of the spool, the strain-free state of all fabricated piping.

For rotating equipment, pipe shall be erected beginning at the piece of equipment, then moving away from the equipment as it is assembled. Where required or specified, field welds in two directions shall be used when installing pipe to equipment.

Valve handles and wrenches shall be modified by CONTRACTOR/VENDOR where necessary for proper valve operation, and when the valve cannot be otherwise rotated to clear an obstruction.

All flanged connections shall be made by tightening the flange bolts in an accepted pattern to an even torque.

For stud bolts 1-1/2" diameter and larger, provisions shall be made for the use of hydraulic bolt tensioning equipment. These stud bolts shall be supplied one bolt diameter longer than specified in ASME B16.5 complete with protective plastic cap.

For stud bolts less than 1-1/2" diameter, the stud threads shall protrude two to three full thread pitches past the nut. The CLIENT will carefully observe uniformity of bolt projection through the nuts of stud bolts. The CONTRACTOR/VENDOR will be required to rectify any non-compliance.

All piping spools shall be cleaned internally by air and/or water before installing.

GENERAL SPECIFICATION FOR PIPING FABRICATION

11.2 PROTECTION OF INSTALLED PIPE ASSEMBLIES

To prevent damage to installed fiberglass pipe assemblies, the following guidelines shall be followed:

- In areas where fiberglass pipe may be subject to damage due to impact from falling objects, the pipe shall be protected by placing temporary plywood shields (minimum thickness 12.7 mm) over the top of the pipe. The plywood shall be secured to the pipe with metal or nylon strapping. The plywood shall be removed from the pipe prior to shipment.
- In areas where fiberglass pipe will be exposed to heat from welding or cutting, the pipe shall be protected from damage by placing a non-asbestos fire resistant blanket between the heat source and the pipe.

Abrasion damage from abrasive blasting operations shall be prevented by installing sheet metal shields around the pipe in the vicinity of the abrasive blasting operations. These shields shall be removed after blasting is complete.

Minor surface defects may be removed by grinding, provided the wall thickness is not reduced below the allowable tolerances. The CLIENT Inspector shall be informed of any repairs to permit check and approval of wall thickness tolerances.

Piping shall be erected to line and level on pipe supports in a natural unstressed condition. Piping that does not fit shall be removed, cut, and adjusted to suit. The use of force, temporary braces or supports welded to the piping shall not be allowed.

If piping is connected by flange joints, the joint shall be disconnected after completion of the piping erection and welding to indicate correct alignment. Any springing of the flange shall be corrected by refabrication of the piping. The installation and protection of proprietary items shall be in accordance with the vendor's instructions.

Open ends of all piping shall be closed to prevent ingress of shot blasting material. Any evidence of shot blasting inside assembled piping shall constitute the removal of all valves and in-line instruments to allow a thorough Retro-Jetting of the effected assemblies.

12. PIPE SUPPORTS

Piping anchors and guides shall be installed in accordance with Pipe Support Standard_Doc No: WHP-DHN-P-D-9200.

Design of pipe supports shall be in accordance with Pipe Support Standard_Doc No: WHP-DHN-P- D-9200.

Pipe supports shall not be welded directly to piping unless previously approved by CLIENT.

If agreement is given, for weld attached supports to be used, all welding shall be completed prior to any heat treatment that may be required.

Corners of supports shall be rounded and all joints shall be seal-welded.

GENERAL SPECIFICATION FOR PIPING FABRICATION

All pipe supports shall be seal welded to prevent corrosion. Any area not able to be seal welded shall be enclosed using 6.4 mm flat plate.

Adjustable hangers shall have double nuts for locking purposes.

U-bolts and nuts shall be PTFE coated or CLIENT-approved equal.

All relief, blow down and safety discharge piping shall be securely/adequately braced for relieving conditions.

Unless otherwise noted, all bolt holes shall be no larger than 1/16" greater than bolt diameter. Bolt holes shall be punched or drilled. Bolt holes may not be flame cut under any circumstances. Support hangers found to have flame cut bolt holes shall be removed and replaced.

The CONTRACTOR/VENDOR shall purchase and install all support specialty items (such as spring hangers) in accordance with construction drawings, CLIENT specifications, VENDOR recommendations and good engineering practice.

Pipe supports and attachment welding to piping components shall be welded in accordance with a qualified welding procedure developed from the piping WPS.

The CONTRACTOR/VENDOR shall install all equipment supports, anchors, guides and other support attachments in accordance with details indicated on the drawings and as per pipe support specification.

The CONTRACTOR/VENDOR shall ensure that all pipes are adequately supported. However, additional pipe field supports which are not shown on drawing but are seen to be required will be installed by CONTRACTOR, these supports are subject to approval by the CLIENT Representative.

Where U-bolted; wrap around Teflon pads shall be used between the U-bolt and the pipe.

Site run pipework shall be supported in accordance with standard engineering practice with pipe support locations calculated and determined to prevent the over stress and excess deflection.

Maximum spans shall be as per Pipe Support Standard_Doc No: WHP-DHN-P- D-9200.

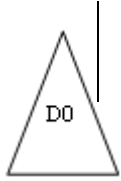
13. WELDING

13.1 GENERAL

Interruption of welding is permitted if 9.5 mm or 25% of the pipe wall thickness, whichever is greater applied for P-nos.3, 4, 5A, 5B, 6 and 15E (paragraph 131.6.1 ASME B31.1). Welding on other materials may be interrupted without restriction, unless otherwise specified in approved WPS. The weld has been insulated with an insulating blanket to slow the cooling rate. The joint shall be heated to the preheat temperature before resumption of welding.

Weld contour shall comply with the requirements of ASME B31.3, Chapter 5.

GENERAL SPECIFICATION FOR PIPING FABRICATION



Socket welds shall have a minimum end gap of 2 mm prior to welding. **The spacing ring 2mm thickness as described in section 9.2 shall be used.**

Piping or supports shall not be welded to coded vessels, unless the vessel is so designed and the supports are installed during vessel fabrication.

Welding operations shall be protected from wind and rain.

Welding is prohibited if the surrounding air temperature is less than 0°C.

13.2 WELDING PROCEDURE QUALIFICATION

Weld procedures shall be in accordance with Welding Procedure & Performance Qualification Specification and ASME IX.

The CONTRACTOR/VENDOR shall submit his welding procedure specifications and qualification records to CLIENT for review and approval.

Specific weld procedures shall be qualified for quenched and tempered material and low-temperature material.

13.3 WELDER PERFORMANCE QUALIFICATION

Welders and welding operators shall be qualified in accordance with Welding Procedure & Performance Qualification Specification and to a qualified welding procedure.

ASME B31.3 shall be the governing fabrication code.

A record shall be maintained by the CONTRACTOR/VENDOR for all qualified welders, which shall indicate the procedures, position, and process to which they are qualified.

Welders and welding operators shall be qualified in accordance with the essential variables of ASME B31.3 and ASME Section IX.

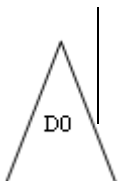
13.4 WELDING PROCESSES

Welding shall be conducted by one of the following processes:

- SMAW: Shielded metal arc welding.
- GTAW: Gas tungsten arc welding.
- SAW: Submerged arc welding.
- GMAW: Gas metal arc welding.
- FCAW: Flux cored arc welding
- ESW: Electro-slag welding
- PAW: Pulsed arc welding

For the root pass of weld, only GTAW process is permitted.

The above processes may be used in combination provided the qualification test has also used the same combination and sequence of processes.



GENERAL SPECIFICATION FOR PIPING FABRICATION

13.5 WELD SPACING

13.5.1 Circumferential Butt Welds

Circumferential butt welds shall be separated by the maximum possible distance and not less than $1 \times D$ without written approval from CLIENT.

However, in some instances, such as between fittings, shorter pup pieces may be required.

In these circumferential butt welds shall comply with Piping Standard Details_Doc No: WHP-DHN-P-D-9100.

Circumferential butt welds closer than the limits described above shall be brought to the attention of CLIENT for approval.

13.5.2 Longitudinal Welds

Longitudinal welds of adjacent pipes shall be staggered by 30 degrees or 75mm, whichever is greater.

13.5.3 Branch Nozzle and Other Pressure Attachment Welds

Branch nozzle and other pressure attachment welds shall not be closer than 75mm to adjacent pressure welds. Any cases which fail to meet the above criteria shall be brought to the attention of CLIENT for approval prior to commencement of fabrication/welding.

13.5.4 Non Pressure Attachment Welds

Non pressure containing attachment welds, such as pipe support weld i.e. trunnions, welded shoes or guides shall be a minimum 50mm from any pressure containing welds.

13.6 FILLER MATERIALS

Welding filler metals shall comply with the requirements of ASME Boiler and Pressure Vessel Code, Section IIC .

Manual metal arc welding electrodes shall be of the low hydrogen type. The CONTRACTOR shall develop and implement a procedure for storage distribution of all weld consumables.

13.7 JOINT BACK-UP

Backing rings shall not be used.

Consumable backings, such as inserts of the compatible type, are prohibited for root pass of single side closures and pipe butt joints.

Argon based shielding gases shall be used for welding.

Hydrogen containing shielding gases shall not be used.

When backing gas is required by applied WPS, backing gas protection during fabrication must be maintained until completion of the first fourth passes or a minimum of 8mm of deposited weld metal which is higher

GENERAL SPECIFICATION FOR PIPING FABRICATION

If tack welding be welded as the root pass and will included in final weld, backing gas also be required.

Argon shall generally be employed as the back purge, in the case of duplex stainless steel containing relatively high levels of Nitrogen. The client Representative may approve the use of Argon/Nitrogen mixtures.

The Oxygen content of the purge gas shall be measured and shall be less than 0.5% prior to welding commencing.

Purging and damming procedures for inert gas welding shall be approved by CLIENT.

13.8 JOINT PREPARATION

End preparation of steel pipe shall be beveled in accordance with ASME B31.3 and the fitting end preparation shall be in accordance with ASME B16.25.

Prior to welding, all internal and external surfaces of the welding bevel shall be thoroughly cleaned of scale, rust, oil, paint and other contaminants for a distance of 25 mm from the bevel.

Welding shall not be started until the pipe is properly aligned and tack- welded. Slag and flux shall be removed prior to starting the next weld bead. Blow holes, porosity, slag, undercut and other defects shall be removed by grinding or other acceptable method before proceeding with welding.

For stainless steels, cutting size and beveling shall be carried out using plasma arc cutting, cold cutting, machining or an appropriate grinding technique.

Where plasma arc cutting is used, all surfaces adjacent to the cut shall be cleaned prior to cutting by light grinding or wire brushing to bright metal. Immediately prior to cutting, the prepared surfaces are to be further cleaned by a suitable degreasant. Subsequent to plasma arc cutting all surfaces shall be ground smooth and returned to a bright metal finish.

13.9 WELDER IDENTIFICATION

Each welder employed for shop or field welding of piping, shall be assigned an identifying number.

Upon completing a joint, the welder shall stencil his identifying number next to the joint, using a sulfur-free paint-marker.

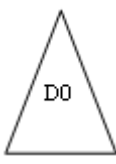
All inspection reports which reference a weld joint shall also reference the responsible welder's identifying number.

13.10 PREHEAT AND HEAT TREATMENT

Preheat shall be in according with ASME B31.3 table 330.1.1 and approved WPS.

PWHT:

For material P1 of any group, PWHT of welds are required for piping with wall thickness 20mm and above regardless of intended service.



GENERAL SPECIFICATION FOR PIPING FABRICATION

For other material, the PWHT shall be accordance with ASME B31.3 table 331.1.1 with exemption are defined in table 331.3.

Post weld heat treatment shall be qualified by weld procedure testing.

Post weld heat treatment of low-temperature piping shall not result in a deleterious decrease of base material notch ductility.

Post weld heat treatment of quenched and tempered material shall be qualified by a specific weld procedure. The soaking temperature shall not exceed the tempering temperature.

14. INSPECTION AND TESTING

14.1 GENERAL REQUIREMENTS

CLIENT has the right to inspect certificates, materials and procedures at any time, if errors are discovered, they shall be corrected to the satisfaction of the CLIENT at VENDOR's expense.

If mill certificates are not available at the time of fabrication, the VENDOR may proceed with fabrication after obtaining CLIENT approval on the understanding that failure to obtain proper mill certificates shall require the removal and replacement of questionable materials at VENDOR's expense.

14.2 INSPECTION RATE

Welds that are to be examined by non-destructive methods shall be finished as required in ASME B31.3 and the standards listed above.

Non destructive examination of piping shall be as below:

- NDT Group 1: Non Flammable/Toxic Fluids – including Open Drain systems, fabricated from carbon steel or Austentic stainless steel materials with a MDMT $\geq -29^{\circ}\text{C}$ and a maximum design temperature of 185°C ,
- NDT Group 2: All Systems excluding Systems categorized as NDT Group 1 for ASME flange ratings $\leq 300\text{LB}$
- NDT Group 3: All Systems for ASME flange ratings $\geq 600\text{LB}$

| NDT Group | Connection type | Visual Examination | Volumetric (RT/UT) | Surface (MT/PT) |
|-----------|-----------------|--------------------|--------------------|-----------------|
| 1 | Buttwelded | 100% | 10% | 10% |
| 2 | Buttwelded | 100% | 20% | 100% |
| 3 | Buttwelded | 100% | 100% | 100% |

Angular branch welds shall be examined to the same degree as buttwelded connections. Branch connections, socket welds, O'lets, shall be subject to visual and surface NDE as above.

GENERAL SPECIFICATION FOR PIPING FABRICATION

For 10% NDE, progressive examination shall be applied according to ASME B31.3 Section 341.3.4.

14.3 WELD INSPECTION

All welds shall be visually inspected.

Visual inspection and examination of welds shall be conducted in accordance with the requirements of ASME B31.3, table 341.3.2.

Radiographic inspection of welds shall be conducted in accordance with the requirements of ASME B31.3, paragraph 344.5, and ASME Boiler and Pressure Vessel Code, Section V, Article 2.

The following extra requirements are required at branch welds and reinforcing pad welds:

- For flange ratings ASME Class 900 pound and higher, all welds shall merge smoothly with the surface of the pipe with no notches or under cut.
- Sharp corners on reinforcing pads shall be ground off.

14.4 RADIOGRAPHY

Pipes containing liquids shall be drained, clean and dry prior to being radiography test. If inspection reveals a rejectable defect, the weld shall be repaired or replaced at CONTRACTOR/VENDOR's sole expense.

After repairs are complete, welds shall be reexamined and evaluated based on the criteria of section 14.3.

The CONTRACTOR /VENDOR shall take appropriate safety measures when doing radiography work. The CONTRACTOR /VENDOR shall have a dosimeter to check stray radiation in the work area.

Progressive examination of additional welds shall be required upon the rejection of welds subject to random inspection. Progressive examination shall meet the requirements of ASME B31.3 paragraph 341.3.4.

Welds which cannot be effectively radiographed such as socket welds, branch connections utilizing weld-o-let, thread-o-let, sock-o-let, or elbow-let fittings, and welds which cannot be radiographed because of obstructions in the vicinity of the weld, with CLIENT's prior approval, be inspected as follows:

- Socket welds and/or branch connections (at pipe to fitting joint):
 - + Magnetic particle inspection shall be used for ferrous materials.
 - + Liquid penetrant inspection shall be used for non-ferrous materials.
 - + In addition to the above, a randomly-selected 20% of socket welds in piping
 - + Hydrocarbon services shall be radiographed to verify proper pipe insertion depth. Additional NDT shall be performed if defects are found.

GENERAL SPECIFICATION FOR PIPING FABRICATION

- Butt welds on pipe sizes ≥ 2 inches or with wall thickness of ≥ 0.25 inches:
 - + Ultrasonic inspection and magnetic particle inspection shall be used together to inspect the weld.
 - + Inspection techniques and evaluation of flaws shall meet the requirements of ASME B31.3 section 344 except as modified in paragraph 344.7.2.
 - + Liquid penetrant inspection may be substituted for magnetic particle inspection only when inspecting non-ferrous materials and non magnetic material e.g. stainless steel and duplex stainless steel.
- Butt welds on pipe sizes < 2 inches or with wall thickness < 0.25 inches:
 - + Magnetic particle inspection shall be used for ferrous materials.
 - + Liquid penetrant inspection shall be used for non-ferrous materials and non magnetic material.

Initial radiographs and radiographs required due to defective welds shall be provided by CONTRACTOR/VENDOR.

CLIENT reserves the right to require additional radiography or reshoots if the quality of the radiographs is not in accordance with the ASME Boiler and Pressure Vessel Code, Section V, Article 2.

Additional radiography due to poor quality, damaged, or defective radiographs shall be at CONTRACTOR/VENDOR's expense.

CLIENT may employ a third party to examine any weld. The CONTRACTOR/ VENDOR shall grant the third party access to his yard. Copies of the radiography reports will be given to the CONTRACTOR /VENDOR. If a defect is found, the CONTRACTOR/VENDOR shall bear all costs of repairs and re- radiographed.

Radiographs shall be the property of CLIENT and shall be turned over to CLIENT upon completion of the Contract Scope of Work.

The CONTRACTOR/VENDOR shall inventory and box all radiographs in suitable containers prior to delivery to CLIENT. The CONTRACTOR/VENDOR shall perform thiosulphate tests and refix films as necessary to provide for a minimum film life of 5 years after contract completion.

CLIENT shall have unencumbered access to radiographs during the project.

CLIENT may take possession of radiographs prior to the end of the Contract.

If CLIENT takes possession of radiographs prior to the end of the project, the CONTRACTOR/VENDOR shall be relieved of the requirement to inventory and box the radiographs, but CONTRACTOR/VENDOR shall provide copies of traceability documentation upon completion of the Contract Scope of Work.

GENERAL SPECIFICATION FOR PIPING FABRICATION

14.5 EXTENT OF RADIOGRAPHY

Welds on piping ASME 300# class or higher (hydrocarbon and non-hydrocarbon) and welds on piping subject to high frequency cyclic loads from reciprocating machinery such as compressors or engines (all pressure classes and services), shall be 100% radiography inspected.

Welds on all other piping shall be inspected by section 14.2. CLIENT's inspection personnel shall select all welds for random radiography. Welds inspected by random radiography shall be radiographed around the full circumference of the pipe (no spot radiography).

14.6 ACCEPTANCE CRITERIA FOR RADIOGRAPHY

Acceptance criteria for radiographs shall be as follows:

- Welds subject to 100% radiography shall be evaluated on the basis of ASME B31.3, Table 341.3.2, "Severe Cyclic Conditions".
- Welds in piping which operates at pressures in excess of that allowed by the ASME B16.5 Class 2500 rating shall be evaluated by the provisions of ASME B31.3, Table K341.3.2.
- Welds subject to random radiography shall be evaluated on the basis of ASME B31.3, Table 341.3.2, "Normal Fluid Service".

14.7 ULTRASONIC EXAMINATION

Ultrasonic examination of welds, when directed by the CLIENT representative, shall be performed with the supplementary requirements of B31.3 paragraph 344.6.2.

CLIENT shall reserve the option to radiograph socket welds to confirm proper clearances and fit-ups.

14.8 MAGNETIC PARTICLE EXAMINATION

Magnetic particle examination shall be conducted on branch connection welds of ferritic materials in services defined as requiring radiography. The yoke method with white background and black ink shall be used.

14.9 LIQUID PENETRANT EXAMINATION

Dye penetrant examination shall be conducted on branch connections on non-ferrous materials in services defined as requiring radiography.

14.10 PHASE ARRAY ULTRASONIC TESTING

For weld joints of Pipe to Pipe, The Phase Array Ultrasonic Testing (PAUT) method may be applied in lieu of Radiographic Testing (RT).

For weld joints of Pipe to Fitting, The PAUT method conjunction with MT or PT method may be applied in lieu of RT.

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PAUT procedure shall be developed and be qualified base on the ASME BPVC Section V, Article 4, Mandatory Appendix V and IX. For advanced PAUT technique application, the requirements of Mandatory Appendix VIII shall be followed.

All PAUT inspectors shall be passed the practice mock-up test following the approved procedures under witness of Client's Inspectors.

PAUT evaluation results of first five (5) joints of production weld for each of the PAUT techniques shall be cross-checked by RT.

14.11 ACCEPTANCE CRITERIA FOR PAUT

- All of the discontinuity that are interpreted to be crack, lack of fusion, or incomplete penetration are unacceptable regardless of length.
- For weld thickness less than 25mm, discontinuity other than linear-type shall be evaluated for acceptance according to the ASME B31.3 Paragraph 344.6.2.
- For weld thickness equal to or greater than 25mm, discontinuity other than linear-type shall be evaluated for acceptance according to the ASME B31.3 Table R308.1 and Table R308.2.

14.12 NDT FOR REPAIRED WELDS

NDT methods for repaired welds shall be the same as the original inspection methods and performed by the same party. In additional, the repaired areas shall be inspected by MT or PT despite these methods are not required in original.

15. POST FABRICATION EXAMINATION

15.1 GENERAL

Prior to the assembly of component parts of the piping system, each prefabricated piece, straight length of pipe, or fitting shall be visually checked for dirt, rubbish, grease, loose scale, etc., and cleaned if necessary. The following post fabrication examination activities to be performed by CONTRACTOR.

15.2 INTERNAL CLEANING

Blasting (where required)

Piping shall be cleaned internally by air to remove any foreign particles.

Material used for blasting shall be dry and free of organic material.

Straight pipe lengths of 6096 mm maximum are recommended to ensure proper cleaning and removal of blast material.

CONTRACTOR or Its Sub-CONTRACTOR shall develop a Chemical (acid) Cleaning Procedure for all require systems. Procedure and Sub-CONTRACTOR shall be approved by CLIENT. Fuel gas lines is not required.

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Threaded connections and flange faces shall be protected during blasting.

Immediately following blasting, or after hydrotesting, the inside of piping shall be sprayed with a suitable corrosion protection solution approved by CLIENT, or as an alternative, the protection may be applied in a crystalline powder form.

After interior surfaces are treated, openings shall be sealed off as rapidly as possible, to prevent exchange of atmosphere.

All piping and piping systems with evidence of being contaminated with Construction Shot blast material, shall be subject to re-flushing by utilizing high capacity water pump or CLIENT – APPROVED equivalent.

15.3 FLUSHING

The flushing shall be circulation of water at high velocity (3-4 m/s) through the pipes.

After flushing, piping system shall be completely drained, dried, protected against corrosion.

Unless otherwise specified, piping systems shall be flushed with fresh clean water.

Water used to flush austenitic or duplex stainless steel shall have less than 30 PPM chloride content.

Equipment shall be blanked off and shall neither be flushed through, nor allowed to accumulate foreign matter and shall be removed from the piping.

15.4 PICKLING and passivation (WHERE REQUIRED)

Pickling and passivation shall include degreasing, rinsing, passivating, drying and the application of protective coating.

A detailed pickling, passivation and protective coating procedure and a list of materials to be used shall be supplied.

Normally piping from the scrubbers to compressors through the re-cycle line back to scrubbers will be the minimum requirement needed.

15.5 PRESSURE TESTING

The CONTRACTOR/VENDOR shall develop procedures covering system preparation, flushing, pressure testing, drying and preservation. The procedures shall define the methodology, materials, safety equipment and instrumentation for documentation, testing media, duration and disposal. The procedures shall provide sufficient detail for the CLIENT to evaluate the work to be performed. The CONTRACTOR/VENDOR shall be responsible for ensuring the safety of all personnel engaged in the witnessing of the tests. The safety provisions shall be clearly stated in the hydrostatic and pneumatic testing procedures.

The CONTRACTOR/VENDOR shall provide all supervision, labor, equipment, materials and consumables required for the system preparation, flushing, pressure testing, drying,

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preservation and reinstatement. All test equipment and temporary materials shall be compatible with the pressure rating and materials of the system under test. Gaskets intended for final assembly shall not be used for temporary test purposes. The welding of temporary fittings for test purposes shall be carried out to the same standards as for the piping under test. No NDT (except for welding attachments to permanent job piping) will be required by the CLIENT on these welds unless otherwise stated by CLIENT.

The CONTRACTOR /VENDOR shall ensure that adequate temporary supports, vents, drains and blinds are provided to test the facility in accordance with this specification.

The CONTRACTOR/VENDOR shall provide all high points in the piping with vents and all low points with drains, regardless of whether or not they are specifically shown on the drawings.

All pressure tests shall be witnessed and accepted by the CLIENT.

The Hydrostatic testing fluid shall be clean water, non-corrosive water & free of undissolved solids. If freezing conditions are expected, appropriate anti-freeze will be added. The CONTRACTOR/VENDOR shall add a non-hazardous, corrosion inhibitor to the hydrotest water in concentrations recommended by the material vendor.

Test/wash fluid quality and exposure limits shall be as follows:

- When austenitic stainless steel equipment designed to operate above 105 bar (1500 psi) will be exposed to hydrostatic test water, the water shall have less than 30 mg/kg (30 ppm) chloride ions and a pH between 6 and 9.
- Except as noted in Item above, water having less than 250 mg/kg (250 ppm) chloride ions and a pH between 6 and 9 shall be used. Potable water will meet this requirement.

The CONTRACTOR / VENDOR shall submit the proposed inhibitor system to the CLIENT for approval.

15.6 PRESSURE TEST

All welding, heat treatment and nondestructive testing shall be completed prior to pressure testing.

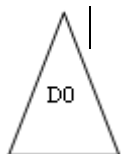
CLIENT shall approve the system prior to testing.

Pressure test shall be performed in accordance with ASME B31.3 as described below:

- Hydrostatic test: 1.5 time design pressure.
- Pneumatic test: 1.1 time design pressure.

All test procedures shall be submitted to Client for review and approval prior any testing. The test pressure shall be maintained for minimum 1 hour, or for sufficient time to allow the CLIENT representative to inspect the piping after test pressure has been reached and there is no drop in pressure. Except the difference pressure caused by temperature change which will be determined by Client's representative.

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Substitution of an air or nitrogen test for the hydrostatic test shall require CLIENT approval.

Test procedures, test sheets and schedules shall be submitted to CLIENT for approval.

Lines venting to atmosphere locally shall not be tested.

Drain lines shall be pressure tested upstream of the last block valve in the line.

Deck drain piping shall be leak-tested by blocking the deck discharge point and filling the system with water. Normally this is achieved deck level by deck level.

High and low pressure vent/flare lines shall be pressure tested.

Atmospheric vent lines connected to an atmospheric vent system shall be pressure tested.

Nondestructive inspection and hydrotesting of carbon steel lined piping shall be performed before lining or external coating is applied.

If a valve is to be tested in the closed position, vendor's written approval of the maximum test pressure that may be applied to the valve in the closed position shall be obtained if the test pressure will exceed published seat pressure rating of the valve.

CLIENT does not recommend testing against valve, therefore, CLIENT approval will be required.

All test systems shall be reviewed to ensure that all vents, drains, blind flanges, etc. are installed as necessary whether shown on drawings or not.

Instrument piping up to the first block valve shall be tested with the piping or equipment to which it is connected

All in-line valves shall be open. (Extent of opening to be determined)

Open ends of a system shall be fitted with flanges, blinds or plugs prior to pressure test.

Positive provisions shall be made to protect pressure-sensitive equipment and instruments such as gauges, level controllers, pressure controllers, relief valves, etc. Any instruments, which are suspected to have been hydrotested, shall be inspected and recalibrated.

During tests, both pressure and temperature of the test fluid shall be recorded and submitted for approval by the CLIENT. Dual recorders are acceptable for this purpose.

Prior to testing, piping systems shall be flushed with test fluid until the inside of the lines is thoroughly cleaned utilizing high capacity water pump or CLIENT-approved equivalent.

After testing and flushing, all lines shall be completely drained. Precautions shall be taken to ensure that debris is not flushed into associated vessels, equipment or dead ends. Soft seat valves shall be removed and "pup" pieces installed until flushing is completed.

Until completion of pressure testing, all piping joints (including flanged, threaded or welded) shall be left uninsulated and unpainted.

Untested welds shall only be prime-coated to a minimum distance of 2 inches on either side of the joint.



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Pumps, compressors and exchangers shall be excluded from piping pressure tests.

15.7 PNEUMATIC TESTING

Pneumatic tests shall be to 1.1 times design pressure. All instrument gas piping shall be prepared for test, as for hydrotest. In addition, all flanges shall be wrapped with duct tape and a small hole punched through the tape at the top of the flange. Alternate procedures to the test described below may be presented to CLIENT for approval.

The piping shall be pressurized to a pressure of 1.72 bar with clean, dry air and gross air leaks shall be remedied. The piping shall be slowly pressurized to 50% of the test pressure at test temperature and then increased in increments of 10% until the test pressure is reached. When leaks are identified, the pressure shall be reduced before flange bolts shall be torqued up to stop the leak. Where the leak cannot be stopped, inspection for evidence of other problems shall be carried out; this may require depressurizing and stripping.

A start time shall be agreed between the CLIENT and the CONTRACTOR/VENDOR and this time recorded.

The piping under test shall be carefully inspected for leaks and evidence of other problems at the end of the test period and at the least pressure. All joints, welds and connections shall be swabbed with a soap solution. For acceptance, no leaks are permitted.

The piping pressurization steps and test pressure at the test start time, hold period and finish time shall be recorded on a chart recorder.

Test duration shall be for a minimum period of one hour after leaks are stopped, or as much time as required for the CLIENT representative to examine the piping which is being tested.

15.8 TESTING MATERIALS AND EQUIPMENT

The CONTRACTOR/VENDOR shall supply all materials and equipment for the test.

The hydrotest shall employ two pressure gauges, one pressure recorder (chart type) and one temperature recorder (chart type). These may be dual type. A current calibration certificate (within previous 6 month) shall be provided for the pressure and temperature chart recorders. In-house function test shall be done for both chart recorders every 1 month.

Material such as gaskets, bolting, etc., damaged during tests shall be replaced.

Packing shall be replaced in equipment such as valves if leaks cannot be stopped by normal tightening of the packing glands.

Materials shall be suitable for the hydrostatic test temperatures. Special consideration shall be given to the possibility of brittle fracture.

15.9 TESTING SYSTEM PREPARATION

The CONTRACTOR/VENDOR shall prepare a procedure and schedule for testing all piping within the limits of his responsibilities. The procedure shall follow the guidelines established by this specification. The procedure and schedule shall be presented to the

GENERAL SPECIFICATION FOR PIPING FABRICATION

CLIENT at least thirty (30) days prior to the scheduled start of pressure tests. The procedures shall include, but are not limited to, the following:

- Mark-ups of piping and instrument diagrams (P&ID's) showing the limits of piping and equipment to be included in each test.
- Test medium to be used. Include chemical analysis of water if applicable to show PPM chloride content.
- Test pressure and duration.
- Location of all isolation blinds, high point vents, low point drains, and temporary piping supports.
- Procedures for flushing lines including fill points and equipment to be removed for flushing.
- Procedures for pressurization of the system, including the location of the injection points and specified test pressures.
- The form which shall be used to record hydrostatic test data.
- Prior to testing, all piping shall have been cleaned to remove mill scale, weld spatter, dirt and other foreign matter. All welding, NDT and stress relieving shall be complete.

15.9.1 Block Valves

A block valve shall not be tested in the closed position with pressures greater than the valve's working pressure.

If a valve must be exposed to pressure greater than its working pressure, the valve shall be left "half" open to equalize through the valve body.

15.9.2 Check Valves

A check valve shall not be tested against the flapper with a pressure greater than its working pressure.

If a valve must be exposed to pressure against the flapper greater than its working pressure, the flapper shall be removed or the pressure shall be equalized across the valve by means of a jumper.

Any valve flapper that is removed shall be secured to or near the valve during the test.

Flapper replacement shall be verified by the CLIENT Inspector in writing.

15.9.3 Relief Valves

Relief valves in the system shall be isolated from the test pressure.

Isolation of relief valves from the test pressure may be accomplished by removing the valve and blind flanging or by installing a skillet at the valve's inlet flange.

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15.9.4 Blind Flanges

If blind flanges are used to isolate systems, the piping downstream that is disassembled shall be hydrotested after reassembly.

15.9.5 Pressure Vessels

Pressure vessels that have a working pressure equal to or greater than that of the system may be tested with the system in the special case (can not isolate with vessel) with prior approval from CLIENT; however, the following precautions shall be taken:

- The rupture disk and relief valve shall be removed and blind flanges installed.
- All sight glasses shall be tested to their working pressure, then isolated and vented.
- Instrument devices and block/plug shall be removed.

16. WRITTEN TEST PROCEDURE

Prior to any testing, the CONTRACTOR/VENDOR shall provide a written test procedure to CLIENT for approval. This procedure shall include the following information:

- Drawings showing the location of blind flanges, check valves with flappers removed and other modifications to the system for the test.
- Listing of systems to be tested including test pressure.

16.1 PRESSURE TEST PACKAGE

The CONTRACTOR/VENDOR shall provide documentation to record each pressure test. Each pressure test shall be given a unique test number and this test number shall be referenced on the front sheet of the pressure test pack. A pressure test pack shall be produced for each pressure test.

The pressure test pack shall contain the following documentation:

- Marked test boundary ISO and P&ID drawing
- Calibration Certificate of test equipment
- All welding, NDT and PWHT are complete and piping is ready for test.
- Test flowsheets and flushing, testing, reinstatement procedure.
- Pressure and temperature recorder chart showing pressurization, test start, hold time, temperature fluctuations and finish time signed by the CONTRACTOR/ VENDOR, CLIENT and third party as applicable

If the piping fails the pressure test then no test chart will be signed off. The CONTRACTOR/VENDOR shall be responsible for all remedial work, repairs and retesting. All rework shall be carried out in accordance with the relevant specifications and procedures.

Piping will not be accepted unless covered by a fully signed off test chart.

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As per Vietnam Standard TCVN 6171:2005, testing may be witnessed by CONTRACTOR /VENDOR.

16.2 NOTICE OF TESTING

The CONTRACTOR/VENDOR shall provide CLIENT 24 hour for hydrocarbon system, 12 hours for other ones notice prior to the start of any testing.

16.3 ACCEPTANCE OF TESTING

The CLIENT Inspector shall accept the pressure test based on the following criteria:

- The test was carried out in accordance with these specifications and approved test procedure.
- The system was free of leaks, seeps and other abnormalities by visual inspection while under pressure.
- All test shall be witnessed by the CLIENT Inspector or a third party designated by CLIENT and verified by the pressure recorder and temperature recorder charts. The charts shall include the date and time of the test, as well as the CLIENT Inspector's and VENDOR's representative's signatures.

16.4 POST TEST PROCEDURES

After testing, the system shall be returned to operational condition and verified by the CLIENT Inspector in accordance with the following:

- Temporary blanks and blinds shall be removed, operating blinds shall be returned to proper position, and all lines and piping components shall be completely drained.
- All vents of lines being drained shall be open.
- Piping systems downstream of check valves shall be inspected to ensure complete drainage.
- The system shall be purged with dry oil and water free compressed air.
- Drain and vent valves shall be operated several times during purging to remove the maximum amount of water.
- Valves, orifice plates, expansion joints and short pieces of piping which have been removed shall be reinstalled with correct and in good condition gaskets in place.
- Flanges shall be tightened to the satisfaction of the CLIENT Inspector. The Inspector may require, at his discretion, a leak test for the flange.
- Check valve flappers removed for the test shall be reinstalled to the satisfaction of the CLIENT Inspector.
- The Inspector may require, at his discretion, a leak test for the reassembled piping.

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- Flanges and/or weld caps welded at the end of a pipe to facilitate hydrotesting shall be removed after the test is completed and the pipe end shall be beveled in accordance with ASME B31.3.
 - Direct connected transmitters at orifice flanges shall be disconnected when replacing orifice plate to avoid distorting the connections.
 - After lines have been drained, temporary supports shall be removed and insulation and painting completed.
 - Spring hangers provided with stops to carry the test load shall have these stops removed after offshore installation.
 - Flanged joints at which test blinds have been removed shall be leak tested, where possible, as noted in 13.4 bullet point 7 and 10.
 - Special length bolting and gaskets for testing shall be removed and replaced with line class bolts and gaskets.
 - Instruments, which were removed or blocked out, for test, shall be reinstalled and blocks placed in the normal operating position.
 - Vessels and piping shall be treated with low pressure N2 preservation and marking outside for reconigzation to minimize internal corrosion.
 - Lubricating, seal and control oil systems shall receive a hot oil flush in lieu of water. After final assembly at the site, the filter casings, cooler shells, and other system components shall be opened and wiped clean. Heated flushing oil (66°C to 82°C) shall then be circulated until it runs clean, but for not less than eight hours. The method of checking the cleanliness of the system shall be determined by the equipment vendor's representative. Bearings shall be by-passed during flushing.
 - Preservation after test: immediately after drying and inspection, pipe and flanged ends shall be fully protected against the ingress of foreign material using a procedure supplied by the CONTRACTOR/ and approved by CLIENT.

16.5 TEST REPORT

Test procedures and results shall be documented in a report, which shall include:

- Verification that the system has been returned to operational condition.
- Pressure and temperature recorder charts.
- A pressure test system drawing for each piping system or spool. The drawing shall indicate:
 - + Test medium.
 - + Test pressure.
 - + Test duration.

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16.6 LEAK TEST

Helium nitrogen leak test is applied for hydrocarbon system only, the following procedures shall be used:

- Prior to testing, CONTRACTOR shall submit to CLIENT three (3) sets of Piping and Instrument Diagrams colour coded to depict individual test limits and their corresponding test pressure. In general, these limits shall follow ASME pressure classification. The leak test pressure shall be at least equal to the 1.1 design pressure of the system being tested.
- The test medium shall be 99%N₂/1%He mix gas.
- With the CLIENT's approval, pressure relief devices to be used during operation may be included in the leak test system. The leak test pressure may be reduced to prevent the operation of, or damage to, the pressure relief devices, but shall not be less than 90% of the lowest set pressure of the pressure relief devices in the system.
- All valves and piping system shall be leak tested and clearly labeled on these diagrams with an identification number. Package shall be prepared by CONTRACTOR and submitted to CLIENT for approval and shall be utilized to record the results.
- Helium shall be utilized as the tracer gas for the purpose of detecting and quantifying leaks. A portable mass spectrometer calibrated to detect helium shall be utilized. All leaks greater than 5 SCF/year (resilient seals) and 10 SCF/year (metallic seals) shall be repaired. This detection shall be carried out a joint at a time by puncturing tape on the joint.
- When testing a system adjacent to previously tested system, tape of a different colour shall be utilized on all possible sources of leakage. Tape shall be retained until completion of any test.
- Pressure shall be held against all valves undergoing seat and flange leakage (service) testing for a minimum of 5 minutes. During this period, the pressure shall be monitored for decline. In addition, during this period an ultrasonic detector shall be utilized on each system holding pressure to determine if seat and flange leakage is occurring. Results shall be recorded on the System Test.
- The CONTRACTOR shall sequence tests, if possible, so that nitrogen is conserved. Sequencing is subject to the approval of CLIENT.
- Prior to the introduction of nitrogen into any system, all reasonable steps shall be taken to remove any pockets of water. These steps shall include opening all drain valve and/or plugs, pressurizing/purging with air, etc. If necessary, nitrogen may be used to pressurize a system in order to dislodge trapped pockets of water.
- An initial gross leak test with air shall be conducted at 30 to 40 psig to identify all damage gaskets, missing plugs, open valves, etc. This test shall be conducted prior to taping of possible leak sources. Following a successful gross leak test, N₂ is filled and the pressure shall be brought up incrementally in steps of approximately 20 to 25

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percent of the maximum test pressure. At each step all joints shall be tested for leakage and repaired as required.

- Upon completion of a test, the oxygen content within that system shall be determined and recorded. After all tests are concluded, a CLIENT representative will determine if additional reduction in oxygen content is necessary. In any event, the oxygen content should not exceed 2%.
- After the test is completed, pressure in the system shall be reduced in controlled steps of 25%, from 100% to 75%, 50%, 25% with minimum of 5 minutes interval in each step. The CONTRACTOR shall ensure that bleed down rate of the test pressure is carried out in sufficient time so as not to cause any damage (shrinkage or explosive decompression) to any of the components in the system being tested. At the conclusion of the nitrogen test, all spectacle blinds, spades, skillets, blank insert chokes, blind flanges and means of positive closures that do not form part of the permanent process system shall be removed and the piping and insulation (if applicable) shall be re-instated. The CONTRACTOR shall leave a 50 psig nitrogen blanket in the entire tested piping system on the platform, including vessels and skidded equipment (if recommended by the equipment Vendor)
- Tightening leaking joints under high gas pressure shall not be carried out and the system section shall be isolated and depressurized.

When approved by CLIENT, a system leak test using air or inert gas with the system in its normal operating condition (i.e. with blinds removed, all piping reassembled, orifice plates installed, equipment connected and instruments installed) shall be followed the leak test.

16.7 VALVES SITE TEST

All valves size 2" and above (small size shall be selected one per size for each model) when arrive to site shall be leak tested by CONTRACTOR and witnessed by CLIENT Representative.

17. DOCUMENTATION

17.1 GENERAL

Piping drawings shall show dimensions in the metric system.

Isometric drawings shall include:

- Fabrication dimensions.
- Call-out of CLIENT-supplied material.
- Required NDE inspection.
- Welding procedure.
- Location and type of pipe supports for pipe sizes 2" and above.
- Material take-off, to be split into fabrication and erection requirements.

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- Insulation requirement.
 - Weld numbers.
 - Shop welds and field welds.

17.2 INFORMATION REQUIRED

The CONTRACTOR may propose a numbering system to identify each weld on the shop drawing.

Pipe isometric and spool fabrication drawings shall show piece marks and spool breaks either flange breaks, field welds or erection welds.

Weld numbering system shall be used for welding and NDT identification purposes.

Field installed pipe spools shall be identified on the shop drawings together with field weld locations.

17.3 AS BUILT DRAWINGS AND SPECIFICATION

As-built drawings shall:

- Be prepared by revising original fabrication drawings, supplemented by additional drawings as necessary.
- Reflect changes, additions, corrections and revisions made during fabrication and installation.

Specifications shall be corrected to reflect any changes made during the purchase of material, equipment or machinery. Any deviation from specification shall be covered by DDR or Site Query.

17.4 WELD RECORDS

A record of all welds shall be maintained and shall indicate as minimum:

- Project number
- Project name
- Type of weld, material
- Drawing No.
- Line and weld numbers.
- Welder identification.
- Dates and type of NDE performed. (Including NDE report numbers cross reference).
- Repairs and associated NDE. (Including NDE report numbers cross reference)

18. DOCUMENTATION OF PIPE, FITTINGS, FIXTURES AND VALVES

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18.1 MILL TESTS CERTIFICATES

Mill certificates and testing for all pipes, flanges, fittings, fixtures and valves shall be required for all process and hydrocarbon service.

Mill certificates shall be provided for CLIENT Inspector review in a timely manner (prior to fabrication or installation).

18.2 TRACEABILITY

The CONTRACTOR/VENDOR shall maintain an identification procedure of all materials, parts and components, including partially fabricated assemblies. Traceability, either “total” traceability (from raw materials) or “forward” traceability shall be maintained on all equipment, materials, parts and components, if required by the specifications. Identification of an item shall be addressed either by using tags, stamps, color coding, stencils or labels or by records traceable to an item throughout fabrication, shipment, erection, installation, repair, modification and use of item. The CONTRACTOR/VENDOR documentation shall include material traceability ISO’s of all process and hydrocarbon piping systems showing MTR heat numbers of all piping components.

The CONTRACTOR/VENDOR shall keep complete records of mill certification of each component (pipe, valves, fittings, bolts, etc.).

19. MATERIAL HANDLING, STORAGE AND PROTECTION

19.1 GENERAL

The CONTRACTOR shall be responsible for the off-loading, storage and control of piping materials.

19.2 STORAGE

The control of handling, Storage, Packaging, Preservation and Delivery of piping materials ensures that the material continue to meet specified technical requirements prior to their installation or use.

Materials and equipment shall be stored in a manner approved by CLIENT and detailed procedures shall be produced and be subject to CLIENT approval for all aspects of Handling, Storage, Packaging, Preservation and Delivery.

Materials subject to damage from the elements shall be protected by painting, greasing, installation of rust preventive oil, coverings or protectors, etc. to protect externally and internally from mechanical damage or damage due to humidity, precipitation, temperature and atmospheric conditions or environment.

Upon delivery of any material, the CONTRACTOR/VENDOR shall assume responsibility of the materials and the certification covering the materials.

The CONTRACTOR/VENDOR shall be responsible for ensuring that all materials fully comply with applicable CLIENT specifications. Materials shall not be considered for use

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unless the CONTRACTOR/VENDOR is in possession of the necessary documentation. No substitution of materials shall be permitted unless prior written approval is obtained from the CLIENT.

Separate area shall be identified for Stainless Steel, carbon steel and Nickel alloy spools storage and handling in order to prevent contact with each other.

Stainless steel piping shall be protected from exposure to chlorides during shipment, storage, testing, flushing, and painting

Prior to shipment, all piping components, flanges, valves and filters shall be protected to prevent damage in transit and during storage at erection site.

Pipe and fittings shall be handled with care and at all times protected from impact, or from being climbed on, or used to support other materials or equipment.

Pipe and fittings shall not be thrown or dropped and shall be protected from bumping or hitting during any handling phase.

Chains shall not be used for handling pipe. When transporting or using mechanical means of lifting, only rope or webbed slings shall be used.

Pipe shall not be piled directly on the ground, steel or concrete floors. The pipe shall rest on supports properly spaced to prevent bending of the pipe or damage to the fittings.

Prefabricated piping shipped for field assembly shall be marked with white paint giving the spool number and an arrow indicating the direction of flow. Pipe spools shall be numbered consecutively in the direction of flow. In addition, prefabricated piping shall be colour coded as to service, i.e. fire water, potable water.

The CONTRACTOR/VENDOR shall be responsible for the receiving, offloading, handling, storage, material control, and preservation of all material.

Materials shall be stored in a designated area for the project.

The CONTRACTOR/VENDOR shall provide indoor storage area for storage of items, which could be damaged by exposure to weather.

All materials for CLIENT's project shall be marked by color coding, or other method, upon receipt, to allow easy identification.