



**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)**

**WHP-DHN WELDING & FABRICATING  
OFFSHORE STRUCTURE SPECIFICATION**

D2	13 Dec 24	Re-Approved for Design	 Shahnaz Norwawi	
Rev.	Date	Description	Approved by RNZ	Approved by PVEP-POC
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			TH Hung	Redza	
D1	25 Sep 24	Re-Approved for Design	TH Hung	Redza	
D0	21 Aug 24	Approved for Design	TH Hung	Redza	
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Petrofac

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**CONTRACTOR:**

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**WHP-DHN WELDING & FABRICATING OFFSHORE  
STRUCTURES SPECIFICATION**

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**REVISION RECORD SHEET**

<b>No.</b>	<b>Revision No.</b>	<b>Content of revision</b>	<b>Date of revision</b>
1	C0	Issued for Review	11 Jul 24
2	D0	Approved for Design	21 Aug 24
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# **WHP-DHN WELDING & FABRICATING OFFSHORE STRUCTURES SPECIFICATION**

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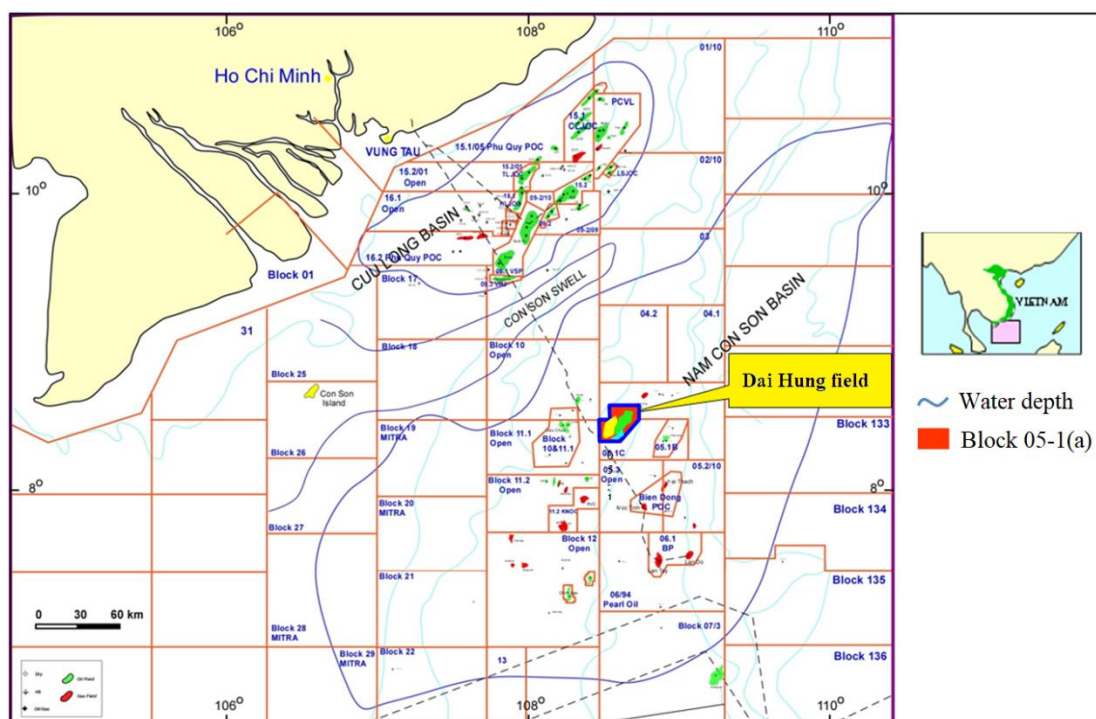
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## 1. PROJECT OVERVIEW

### 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.

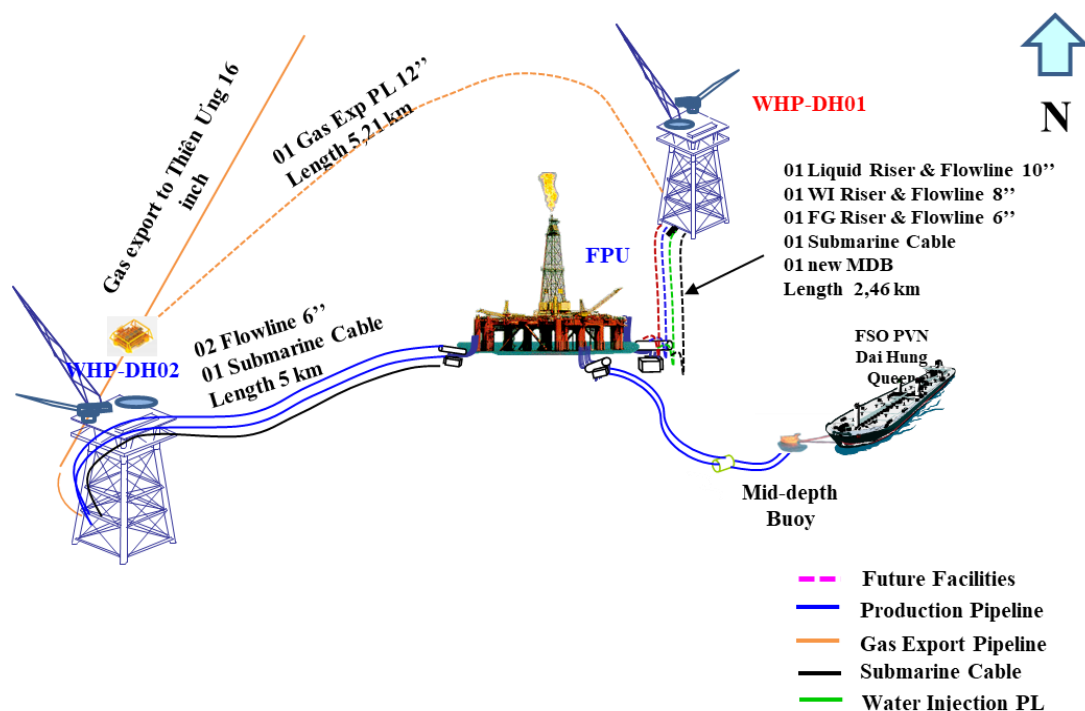


**Figure 1.1.1: Block 05-1(a) Location**

### 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, 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

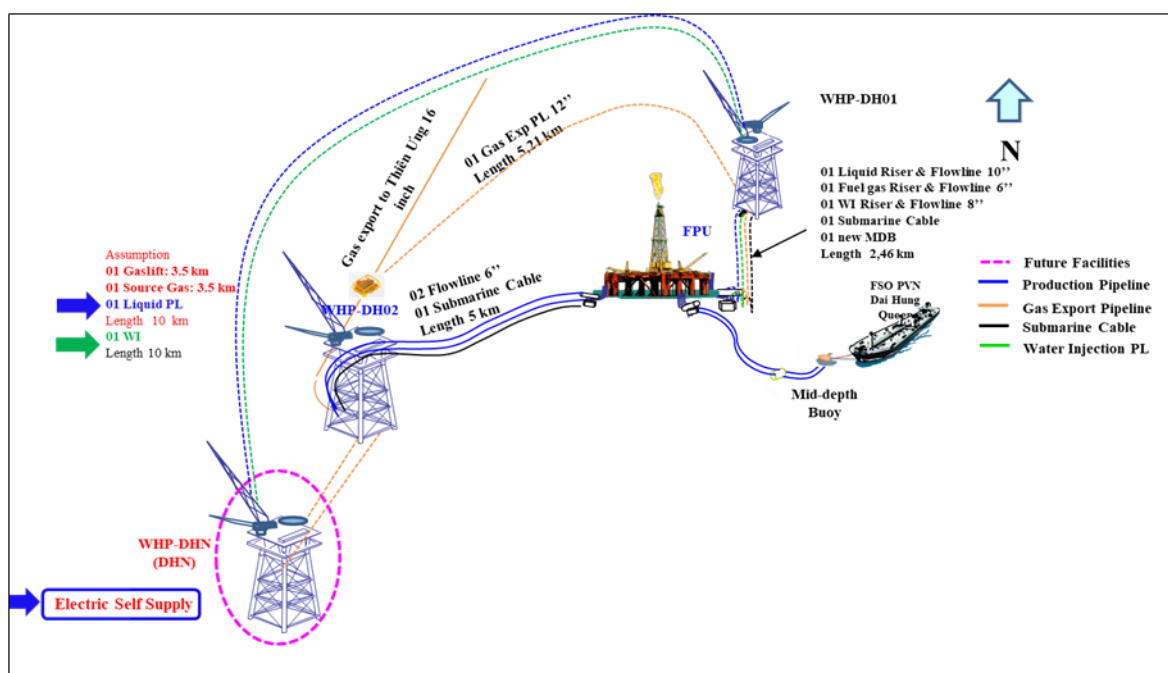
The field facilities in Dai Hung Nam Field Development are as follows:

- 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.

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- + 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 covers the requirements for welding, materials, inspection and fabrication of offshore structures for Dai Hung Nam Well Head Platform.



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## **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	RNZ INTEGRATED (M) SDN BHD
SUB-CONTRACTOR	PVENGINEERING CONSULTANCY JSC
EPCI-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 EPCI-CONTRACTOR

### **3.2 ABBREVIATIONS**

AISC	American Institute of Steel Construction
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
DNV	Det Norske Veritas
ERW	Electric Resistance Welded
FPU	Floating Production Unit
FRP	Fiberglass Reinforced Plastic
FSO	Floating Storage and Offloading Vessel
MDB	Mid Depth Buoy
MWA	Mid-Water Arch
NDE	Non-Destructive Examination
PWHT	Post-Well Heat Treatment
TTP	Through Thickness Property
WHP	Wellhead Platform
WHP-DHN	Dai Hung Nam Wellhead Platform
WSD	Working Stress Design

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SS&DSS

Stainless Steel and Duplex Stainless Steel

#### 4. UNIT OF MEASUREMENT

Unit of measurement will be applied the International System of Units (SI).

#### 5. REFERENCE DOCUMENT, CODES AND STANDARDS

##### 5.1 PROJECT DOCUMENTS

The following project specifications shall be applied to the subject work. In cases of conflict between project specifications and any of the Applicable Codes & Standards and Rules, CLIENT shall immediately be notified for resolutions.

No.	Document No.	Document Title	Rev
1	WHP-DHN-S-A-1001	Jacket Design Basis and Brief	0
2	WHP-DHN-S-S-0001	WHP-DHN Specification for Structural Materials	D2
3	WHP-DHN-S-S-0002	WHP-DHN Welding Procedure & Performance Qualification Specification	D1
4	WHP-DHN-L-R-0048	Pipelines and Risers External Corrosion Selection and Cathodic Protection Design Report	0
5	WHP-DHN-S-A-2001	WHP-DHN Topside Structural Design Basis & Briefs	0

##### 5.2 CODES AND STANDARDS

The applicable versions of the codes, standards, specifications and recommended practices referenced within this document are listed below, unless noted otherwise. These and the documents referenced therein shall form the basis of this specification. Where relevant Vietnamese National Regulations exist, the requirements and recommendations will apply together with the Codes and Standards referenced therein. These regulations may thus complement or amend the provisions of the present documents.

No.	Document No.	Document Title
6	API RP 2A-WSD, 22nd Edition, November 2014	Recommended Practice for Planning, Designing, and Constructing Fixed Offshore Platforms – Working Stress Design
7	API Specification 2B, 6th Edition, March 2021	Specification for the Fabrication of Structural Steel Pipe
8	API Specification 2C, 7th Edition	Specification for Offshore Pedestal Mounted Crane

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No.	Document No.	Document Title
9	API Specification 2H, 9th Edition, Reaffirmed, September 2020	Specification for Carbon Manganese Steel Plate for Offshore Structures
10	API 2W, 6th Edition, January 2019	Steel Plates Produced by Thermo-Mechanical Control Processing for Offshore Structures.
11	API Specification 5L, 46th Edition, November 2018	Specification for Line Pipe
12	ASTM A6/A6M, September 2019	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
13	ASTM A370, August 2020	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
14	ASTM A770/A770M, September 2018	Standard Specification for Through Thickness Tension Testing of Steel Plates for Special Applications
15	ASTM A36/A36M, July 2019	Standard Specification for Carbon Structural Steel
16	ASTM A106/A106M, November 2019	Seamless Carbon Steel Pipe for High Temperature Service
17	ASTM A572/A572M, May 2018	Specification for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
18	ASTM A578/A578M, November 2023	Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications
19	AISC, 9th Edition, 1989	Manual of Steel Construction – Allowable Stress Design and Plastic Design
20	AWS D1.1/D1.1M:2020, 24th Edition	Structural Welding Code – Steel
21	DNVGL-OS-E401, January 2017	Helicopter Decks
22	BS EN-10204, 2004	Metallic Materials-Types of Inspection Documents
23	API RP 2X, 2020	Ultrasonic and Magnetic Examination of Offshore Structural Fabrication and Guidelines for Qualification of Technicians, Fourth Edition
24	DNVGL-CG-0051, Edition December 2015	Non-destructive testing

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### **6. ORDER OF PRECEDENCE**

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

The order of precedence shall be:

- Mandatory local laws and regulations
- Enquiry/ Purchase Order
- Project Specific Data Sheets
- This Specification
- CLIENT General specifications
- National And International Codes and Standards

### **7. QUALITY CONTROL**

1. EPCI-CONTRACTOR shall have a Quality System and Quality Manual covering all construction activities. EPCI-CONTRACTOR shall also prepare a Quality Plan (Inspection and Test Plan) indicating Quality Control activities and the relevant Hold and Witness points.

2. The Quality Manual, System and Plan shall be submitted to Client for approval. Client shall indicate on the Quality Plan their intentions regarding Hold and Witness points. Certification Authority shall also advise their Hold and Witness points.

Following approval of the above documents, controlled copies shall be made available for monitoring all construction activities.

3. EPCI-CONTRACTOR shall establish a records and documentation system suitable for identifying and tracing all primary structural members. The system shall be subject to Client approval.

4. EPCI-CONTRACTOR shall establish detailed procedures for the control of welding quality. The following procedures shall be submitted for review and approval by Client prior to starting fabrication:

- Welding and Weld repair
- Storage, control and identification of welding consumables
- Welder Qualification records

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- Inspection/ NDE
- Postweld Heat Treatment if required
- Monitoring the quality and progress of welding
- Material and NDE traceability

### **8. MATERIALS**

The classification and specification of steel shall be as Specification WHP-DHN-S-S-0001 “WHP-DHN Specification for Structural Materials” and the Contract documents.

### **9. WELDING PROCESS AND CONSUMABLES**

Welding processes, storage and handling of consumables shall comply with Specification WHP-DHN-S-S-0002 “WHP-DHN Welding Procedure & Performance Qualification Specification” or AWS D1.1 (20). In case of conflict, Client approval shall be sought for resolution.

### **10. WELDING PROCEDURE QUALIFICATION**

#### **10.1 QUALIFICATION OF WELDING PROCEDURES**

Welding Procedures shall be qualified in accordance with the essential variables of AWS D1.1 (20) and the supplemental requirements of Specification WHP-DHN-S-S-0002 Ref [3].

Previous qualified welding procedures and procedure qualification records may be submitted for Client review and Approval. Where EPCI-CONTRACTOR does not have welding procedures suitable for the Work at hand, EPCI-CONTRACTOR shall qualify new welding procedures in accordance with the Contract requirements. EPCI-CONTRACTOR shall issue a request for inspection (RFI) to Client such that Client may witness the running or new welding procedures or welder qualifications. RFI shall be issued at twenty-four (24) hours in advance of Weld Procedure Qualification Tests (WPQT) taking place

EPCI-CONTRACTOR shall be responsible for ensuring the CA is notified and present as required for any WPQT.

Where Client considers the welding procedures are not acceptable, EPCI-CONTRACTOR shall qualify new procedures in accordance with the Contract specifications.

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Previous qualified and existing welding procedures shall have adequate historical data demonstrating acceptable weld quality, including CA approval in the past five (5) years. In lieu of previous qualified welding procedure acceptance, Client has the right to request production test welds taken either from welder's test or a simulated production test weld. At least one production test weld shall be taken for each material type and diameter / thickness range.

New welding procedures qualified for structural welding do not require production test welds.

### **10.2 REQUIREMENTS OF PROCEDURE QUALIFICATION TEST COUPONS**

Requirements of procedure qualification test coupons shall be in accordance with AWS D1.1 Table 6.2 and other relevant sections of AWS D1.1 (20).

### **10.3 REQUIREMENTS OF CHARPY TEST**

Charpy tests shall be conducted on the weld metal, fusion line, and heat affected zone at the locations given in Client Specification for "Welding Procedure and Performance Qualification". The test temperature and associated energy values shall comply with Section 8.6.5 of Doc. number WHP-DHN-S-S-0002 Ref [3].

### **10.4 WELD REPAIR WPS QUALIFICATION**

Where required by Section 12.14.1, a WPS for weld repairs shall be qualified in accordance with Section 10.1 and the additional requirements of this section.

Repair weld qualification shall be performed in accordance with Figure 1.

Repair weld qualification CVN locations shall be performed in accordance with Figure 2.

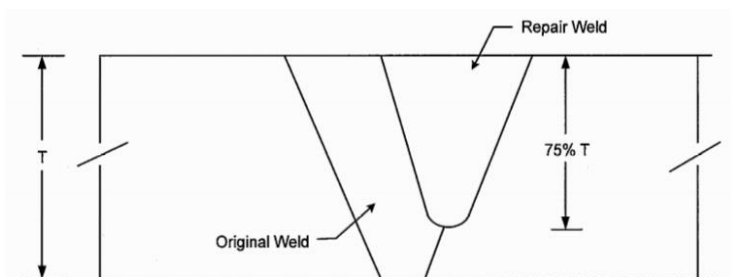


Figure 1 Weld Repair WPS Qualification

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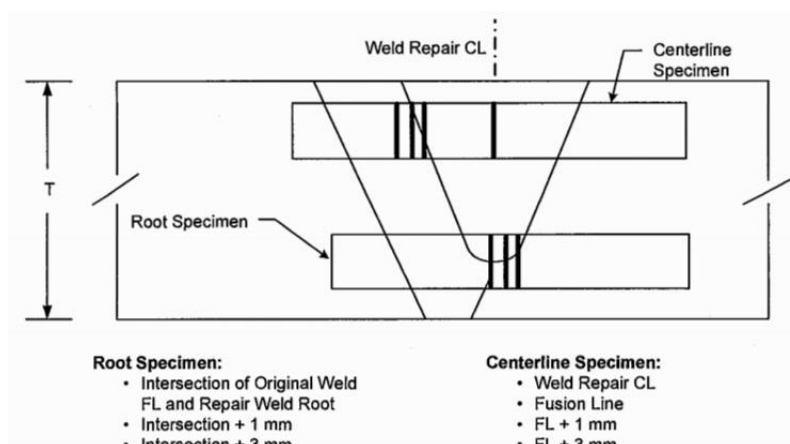


Figure 2 Weld Repair CVN Locations

### 11. WELDER AND WELDING OPERATOR QUALIFICATION

Welders and welding operators shall be qualified in accordance with the essential variables of AWS D1.1(20) and the supplemental requirements of Specification WHP-DHN-S-S-0002.

### 12. WELDING WORKMANSHIP

#### 12.1 BASE METAL PREPARATION

Surfaces to be welded shall be visually examined and must be cleaned to bright metal, free of fins, tears, cracks, loose scale, slag, rust, oil, paint and other defects for a distance of not less than 25 mm (1 in.) from the edge of the weld grooves. All surface finish paints, including weldable primers, shall be removed from the weld groove when welding pre-painted materials. Welding through "weldable primer" is acceptable provided the weld procedure used is qualified using the specific thickness and type of primer and provided the contract documents allow the use of weldable primers. Acceptable mill-induced discontinuities and the repair of visually observed cut surface discontinuities shall conform to AWS D1.1 (20).

#### 12.2 CUTTING, EDGE PREPARATION AND REPAIR

1. Shearing shall be limited to plate material with thickness not exceeding 15.9mm (5/8 in.). A minimum of 1 mm (1/25.4 in.) shall be ground or machined from the cold sheared edge prior to use.
2. All cut edges shall be visually examined for laminations, cracks, and other defects. Sharp edges shall be removed by grinding. Edge defects shall be repaired subject



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to Client approval in each case. Prior to making repairs a repair method statement shall be submitted to Client for approval.

3. For fabricated beams, all web and flange plates shall be cut such that the principal rolling direction of the plate lies along the longitudinal axis of the finished plate girder.
4. Thermally cut surfaces by electric arc cutting and gouging processes and oxyfuel gas cutting processes shall be ground to bright metal prior to subsequent welding. Surfaces inaccessible to grinding shall be abrasive blasted to white metal with subsequent removal of all abrasive and residue near the weld groove.
5. Oxygen gouging shall not be used for joint preparation of quenched and tempered or normalized steels in accordance to AWS D1.1 (20).
6. Chamfering is not required if the two to be welded plated thickness difference is less than and equal to 3mm for Topside and 5mm for Jacket.
7. Trimming tubular braces in situ to open root gaps is not permitted unless approved by Client.

### **12.3 TACK WELDS**

All tack welds, originally performed to hold members in alignment and later incorporated into the completed weld, shall be made by Client approved welders using the qualified welding procedure for the root pass. These welds shall be subject to all applicable structural welding requirements in this document. Tack welds shall have the same preheat requirements as the root pass of the appropriate structural welding procedure. Prior to continuation of welding, the "tack" weld shall be ground to a feather edge to permit acceptable weld metal tie-in. Tack weld lengths should not be less than 100 mm (4 in.), and in any case minimum length of tack welds shall be 50 mm (2 in.).

Tack weld or construction aid weld not be incorporated into final weld or in tension zones of cyclically loaded structure shall be removed, except as permitted by AWS D1.1 Paragraph 4.16.2 (20) for cyclically loaded structures.

Tack welds shall have adequate cross section to prevent cracking. Any cracked tack welds shall be completely removed by grinding and shall not be incorporated into the finished welds. After removal, the parent material shall be subjected to magnetic



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particle examination to ensure that crack has been completely removed and that propagation from the tack weld into the parent plate has not occurred.

### **12.4 RUN ON AND RUN OFF TABS**

Run-on and run-off tabs shall be used for all welds at the plates, tubular end locations, and at beam splices and terminations. These tabs shall be produced from material of the same type as being welded. EPCI-CONTRACTOR may be required by Client to demonstrate control, distribution, receipt and use of run-on/run-off tabs.

### **12.5 PREHEAT AND INTERPASS TEMPERATURE**

EPCI-CONTRACTOR shall develop a general preheat control procedure for joints with an effective thickness of 19mm and greater. This procedure shall be submitted for CLIENT approval prior to use. The procedure shall specify the method of heat application, maximum steel surface temperature, time required for each application and the temperature measurement method. It shall also address temperature maintenance techniques throughout the welding operation.

The preheat and interpass control procedure shall apply to welding procedure qualification and all production welding.

1. Minimum preheat for all steel shall be the greater of 38°C (100°F), AWS D1.1 Table 5.8 (20), or the Client approved welding procedure specification (WPS) whichever is higher.
2. Maximum interpass temperature or preheat for structural welding carbon steel shall not exceed 232°C (450°F) for thickness greater than 1-1/2 in (40mm), unless otherwise qualified as in AWS D1.1 (20).

### **12.6 ARC STRIKES**

Arc strikes outside the weld groove area are not allowed. Arc strikes outside the weld groove area shall be removed by grinding or removal and replacement of the section affected by the arc strike. All arc strike areas outside the weld area shall be subject to magnetic particle inspection. All indication(s) of cracking shall be subject to grinding and re-inspection to insure complete removal.

### **12.7 WELDED JOINT COVER UP**

All welded joints to be subsequently covered by an abutting member weld shall be accepted by NDE in accordance with Section 14 of this specification prior to fit-up or

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welding of the covering member. All plate butt welds that will be subsequently covered by an abutting weld shall be ground smooth and subject to magnetic particle inspection on the attachment surface for a minimum distance of 50 mm (2 in.) either side of the intended attachment. A gradual transition shall exist between the ground and ungrounded areas of welded joint.

### **12.8 COPE AND WELD ACCESS HOLES**

1. EPCI-CONTRACTOR shall develop fabrication sequences and weld details to minimize the requirement for cope holes. Cope holes shall only be permitted at the locations specified on the Contract Drawings, or as subsequently shown on approved EPCI-CONTRACTOR Shop Drawings.
2. Cope holes shall have an edge finish that complies with the requirements of AWS D1.1 Section 7.16 (20) and a size sufficient for welding and coating application. EPCI-CONTRACTOR shall develop and demonstrate details for all configurations including the ability to control, check and measure size and surface finish of all cope holes in production trials.
3. Cope holes shall be covered with minimum 5mm thick plate on both sides and seal welded or sealed with Client approved filler prior to painting.

### **12.9 WELD IDENTIFICATION**

A set of structural drawings shall be marked with an appropriate identification system detailing the location of each weld to be examined and referenced as an integral part of the inspection record. All welds shall be uniquely identified and be traceable to the individual welder or welding operator.

All welders shall permanently mark with paint stick or low stress metal stamp, each weld with his identifying mark. Note: Paint stick markings shall be subject to Approval from CLIENT's Painting Inspector.

### **12.10 INTERRUPTION OF WELDING**

Whenever possible, welding of joints shall be completed in one continuous operation. Where interruption is unavoidable, at least one-third of the weld joint thickness over the full weld length shall be completed before welding is discontinued. All cases of interruption shall be approved by Client.

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### **12.11 CORRECTION OF UNACCEPTABLE FIT UPS AND WELDS**

1. Welding (buttering through member) in-situ to reduce excessive root openings is not acceptable without specific Approval by Client. Through member buttering will only be approved by Client when proper consideration is given to materials, loading, NDE, and welding requirements. Out-of-position brace buttering shall require Client Approval.
2. Buttered layers on removed branch members shall be ground to the desired profile and shall be subject to 100 percent visual, magnetic particle examination, and ultrasonic examination prior to refitting into the structure.
3. Correction of excessive root gaps by in-situ buttering is acceptable provided the gap is less than or equal to 1/2 in. (12.7 mm). A Client approved buttering procedure is required. For root gaps greater than 1/2 in. (12.7 mm) buttering proposals require specific Client Approval. The maximum gap to be corrected by buttering shall be limited to the lesser of 3/4 in. (19 mm) or twice the thickness of the thinner part to be joined.

### **12.12 HEAT STRAIGHTENING**

Heat straightening may be used on a case-by-case basis with prior Client Approval. A heat straightening procedure shall be submitted to Client for Approval prior to use in fabrication.

For API 2Y, API 2W, or any quenched and tempered or thermo-mechanical control processed steel, the maximum temperature shall not exceed 593°C (1100°F) or the tempering temperature, whichever is less. Accelerated cooling of steel above 315 °C shall be prohibited.

### **12.13 MECHANICAL STRAIGHTENING**

When material received from the mill does not satisfy the required tolerances for camber, profile, flatness or sweep, cold straightening may be accepted to perform corrective work if the strain induced by the straightening will not exceed 5%.

During fabrication, local application of mechanical means is also permitted to correct camber, curvature and straightness of materials.

All mechanical straightening shall be approved by Client prior to carrying out the work. The EPCI-CONTRACTOR shall develop a procedure or method statement to cover mechanical straightening.

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### 12.14 WELD REPAIR

1. For all welding processes written repair procedures approved by Client shall be utilized. These may be developed from Client approved full penetration groove welding procedures or procedures specifically qualified for repairs. If the repair WPS is a change of process or a different WPS from the original WPS used to weld the joint, a repair PQR shall be qualified.
2. Work piece temperature shall be a minimum of 38°C (100°F) higher than the minimum preheat temperature required for the original approved welding procedure. The number of repair attempts shall be limited to not more than two.
3. Before repair welding, the defect shall be completely removed. The excavated area shall have smooth transitions to the metal surface and allow good access for both NDT after excavation and subsequent repair welding. After excavation, complete removal of the defect shall be confirmed by MT or PT.
4. The excavated groove shall be minimum 50 mm long, measured at defect depth even if the defect itself is smaller. Defects spaced less than 100 mm shall be repaired as one continuous defect.
5. After repair welding the complete weld (i.e. the repaired area plus at least 100 mm on each side) shall be subjected at least to the same NDT as specified for the original weld.
6. PWHT shall be performed after repair if specified for the original weld.

### 12.15 CONTROL OF DISTORTION AND SHRINKAGE

EPCI-CONTRACTOR shall develop erection sequences which shall include welding sequences to control fabrication tolerances within the specified limits and prevent the build-up of excessive internal stresses in the structure.

T-joints (T, Y and K connections between tubulars or tubulars welded to plates, branch OD  $\leq$  500mm), if specified by applicable technical standard, shall normally be fabricated permitting necessary grinding and welding of the root from the internal surface, to assure full penetration without notch. This shall be achieved by means of stub. The sequence of welds shall be such that the access to the internal surface of the individual welds is maintained until the required NDE is completed.

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### 12.16 ARC-AIR GOUGING

Arc/air gouged surfaces shall be dressed to bright clean metal by grinding at an additional depth of minimum 1 mm below the arc-air gouged surface. The gouged/ground profile shall be suitable for welding with the applicable process. All gougers shall be qualified in accordance with approved air carbon arc gouger qualification procedure.

EPCI-CONTRACTOR shall ensure that welders / gougers are instructed to pay particular attention to ensure that the arc shall not be struck before full airflow is established.

Client and / or CA shall approve the arc-air procedure prior to gouging.

### 12.17 PRODUCTION TEST PLATES

A production test program shall be established for the contracted scope of work. Verification of previously qualified WPS and weldability of actual material used shall be considered when establishing the program.

The production test program shall be submitted to Client for Approval prior to the start of structural fabrication. EPCI-CONTRACTOR shall make provisions for at least one (1) production test plate (PTP) to be welded as an attachment / extension to a production weld for each wall thickness to be welded in primary structural steel. Client may test up to twenty (20) production test plates.

Each production test shall be tested and documented as for the relevant welding procedure qualification test unless otherwise agreed. Where any PTP fails to meet the mechanical properties of the parent metal or welding procedure test requirements, EPCI-CONTRACTOR shall carry out an investigation into the failure and take appropriate remedial action. When a PTP fails mechanical testing, Client reserves the right to take either course of action:

1. An additional two (2) test specimens, for failed specimens only, may be taken from the failed PTP or;
2. An additional PTP shall be welded and tested as per the original PTP and corresponding WPQT

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**13. FABRICATION****13.1 GENERAL**

Final fabrication tolerances shall be as per API RP 2A WSD (6) except as modified or supplemented in this specification or design drawings. When appropriate, dimensions shall be measured and corrected to a standard temperature of 30°C (86°F) if the ambient temperature is more than  $\pm 11.1^{\circ}\text{C}$  (52°F) from 30°C (86°F). In some cases, measurements should be carried out at night so as to avoid local distortion due to daytime temperature changes. Fabrication and welding, including all attachments/appurtenances shall be complete prior to the application of top and mid coats of their respective paint systems.

Where the tolerances are not detailed in this specification, the deviation shall be not exceeding  $\pm 12.7\text{mm}$  from nominal design size, shape or position.

Fabrication and yard assembly main supports at final position shall be set to within 5mm of the appropriate level plane shown on the setting-out drawings. As soon as field erection of structure commence, the main support shall be monitored level plane to ensure that they remain within tolerance.

The permanent survey station shall be established with the accurateness to within 1mm on level and 1mm on position.

**13.2 JACKET**

1. Jacket lifting eye angles shall be within half (0.5) degree of the design angle. All lifting eye holes shall be drilled and reamed to the design diameter  $\pm 0.8\text{ mm}$  (1/32 in.).
2. Drift tolerances: All skirt pile guides, conductor guides, J-tubes and all other items identified shall be drifted with a template at least 305 mm (1 ft.) long and with at least 25.4 mm (1 in.) greater diameter than diameter of the member that will pass through the leg, or guide inclusive of shim plates, centralizer plate or shear keys where applicable.
3. The dimensional tolerance of skid-way/ launch-way centre lines shall be within 20mm of the theoretical position and also be within 6mm of reference elevation. The variation in elevation between any two points on a skid-way / launch-way shall be not exceeded 3mm within any 3m.

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### **13.3 TOPSIDE**

1. Permissible variation in straightness of welded beams and other shapes is 3.2 mm (1/8 in.) multiplied by total length (mm) divided by 10. Maximum deviation allowed is 9.5 mm (3/8 in.). Prior to installation of production system on the decks, centreline of deck beams at their ends should be within 13mm (1/2 in.) of the drawing location and no point along deck beams centreline at any beam should be out of line more than 19mm (3/4 in.) in horizontal and 13mm (1/2 in.) in vertical planes.
2. The centrelines of cap beams at their ends should be within  $\pm 13$  mm (1/2 in.) of the drawing dimension. At no point along the centreline should the cap beam be more than 10 mm (3/8 in.) out of line horizontally or 6 mm (1/4 in.) vertically.
3. Diagonals of a Rectangular plan layout should be identical within 19 mm (3/4 in.) At all deck levels, the horizontal distance from center line of any column to the center line of the column adjacent in any direction should be within a tolerance of  $\pm 13$  mm (1/2 in.) except top of jacket and bottom of deck columns where the horizontal distance from centre line of any column to the centreline of other column adjacent in any direction should be within a tolerance of  $\pm 10$  mm (3/8 in.). The deck fabricator shall check and verify with the jacket fabricator (if applicable) to ensure that the cumulative out-of-tolerance between deck and jacket is less than 19mm (3/4 in.) at each leg intersection.
4. In general, handrail sockets and panels shall be erected such that all panels are straight, level to the eye, and top rail is straight in either vertical or horizontal planes within 5mm in any 3m length measured, as detailed on the approved drawings. However, the removable handrail panels, that will be offshore installed, shall fit snugly in the sockets such that there is less than 9.5 mm (3/8 in.) total movement or "play" measured at the top of the handrail panel.
5. Deck plate shall be installed smooth and seal welded such that the plate is level within  $\pm 9.5$  mm (3/8 in.). A ponding test shall be carried out at the open areas that expose to weather or produced water during platform operation to demonstrate that there are no excessive water ponds. Water ponds, with a water depth  $> 6.4$  mm (1/4 in.), are unacceptable. If ponds exceed 6.4 mm (1/4 in.), necessary drains and lines shall be installed and connected to the drain system by EPCI-CONTRACTOR. An acceptable alternative to a ponding test is to use a long,



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accurate level and measure the deck plate deviation in local areas. Weld reinforcement shall be ground smooth where equipment is placed in a particular area.

6. Landing elevations measured at top of steel (TOS) shall be within  $\pm 12.7$  mm (1/2 in.) of the drawing dimension while landing and stairways shall be within  $\pm 50$  mm (2 in.) of their horizontal drawing dimension.

### **13.4 GENERAL STRUCTURAL DETAILS**

Splices may be introduced into the fabrication of members in accordance with API RP 2A (6) . This requirement applies equally to open and closed sections. The location of all splices shall be clearly indicated on the Shop Drawings and shall be subject to approval by Client.

### **13.5 SHAPES AND PLATES**

- For cantilevered beams, no splices may be located closer to the point of support than one half of the cantilevered length. For span beams, there shall be no splice within one eighth of the span from beam center nor within the one eighth of the span nearest a support, nor directly over a support.
- Web to web and flange butt weld locations shall be offset a minimum of 150mm. Single sided welds are not permitted.

### **13.6 TUBULAR T, K AND Y JOINTS**

1. Adjacent structural braces which are not specifically shown as overlapping shall be provided with a separation between adjacent weld toes. Gap shall be:
  - 75 mm (3 in.) when measured prior to welding - measured as an extension of brace surface, and
  - Weld toe to toe distance shall not be less than 50mm (2 in.).
2. All appurtenances, temporary, or other welds (T butt weld, butt weld and fillet weld) shall be at least 50 mm (2 in.) measured toe-to-toe after welding from any structural joint weld.
3. Overlapped member joints shall not be permitted unless specifically detailed on the drawings. When overlapped joints are detailed, the assembly order shall be strictly in accordance with the detail as stipulated in API RP 2A (6).



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4. Tubular members shall not intersect a larger through member within 50 mm (2 in.) of an existing weld on the through member. This is applicable to both girth and longitudinal welds on the through member.
5. The root face of T-, Y-, and K-joints is zero unless dimensioned otherwise. The actual root face size and tolerances shall be in accordance with the WPS for the particular weld.

### **13.7 TUBULAR BUTT JOINTS**

1. When joining tubular members (butt welds) that differ in wall thickness by more than 3.0 mm (1/8 in.) for Topside and 5.0mm (1/5 in.) for Jacket, there shall be a smooth transition accomplished by chamfering the thicker member with a minimum transition of 1 to 4.
2. Jacket legs, Piles, conductor pipe, and large diameter brace pipe welded by the submerged arc welding (SAW) process may employ gas metal arc welding (GMAW) for root and/or hot pass only. If GMAW-S (short arc) is used in conjunction with SAW, the maximum deposit GMAW thickness shall not exceed 6.4 mm (1/4 in.). If the GMAW-S weld deposit is not completely removed, and radiography is the method for NDE, 100 percent UT examination shall be required on 5% of the welds selected by Client (as minimum). If extensive lack of fusion defects is found, additional inspections or the discontinuance of GMAW may be required at Client's discretion.

### **13.8 TEMPORARY WELDS**

1. Temporary welds for fabrication aids shall not be made in high-stress areas where tubular members intersect. If unavoidable, these welds should be subject to the same welding and material requirements as other structural welds. These welds shall not be made within 100 mm (4 in.) or 2 times the chord thickness of a tubular joint, whichever is greater.
2. Preheat for temporary welds (attachment members) shall not be less than 100°C or the minimum value specified on the applicable welding procedure whichever is greater.
3. All fabrication aids shall be removed unless approved by Client. Removal shall be accomplished by cutting no closer than 2.0 mm (0.125 in.) from the main member and the remainder ground flush. It is permissible to grind up to 1.6 mm (1/16 in.)

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into the base metal surface to remove any undercut associated with the attachment weld. If Client observes damage to the primary structure as a result of flame cutting or gouging, the damage shall be rectified by grinding followed by repair welding and the cutting position shall be changed to 6.4 mm (1/4 in.) from the base metal surface.

4. When approved by Client, some erection aids weld may remain on the structure. These welds shall be trimmed to within 10 mm (3/8 in.) of the main member. All rough edges shall be ground smooth. There shall be no crevices. Additional seal welding may be required to eliminate crevices, temporary attachments/welds. In this case they shall be visually acceptable in accordance with AWS D1.1 (20) and subject to magnetic particle inspection.
5. All areas of primary structural members from which temporary attachments are completely removed shall be examined by magnetic particle inspection. Gouges deeper than allowed by the material specification thickness tolerance shall be reported to Client and repaired.

**14. POST-WELD HEAT TREATMENT (PWHT)**

Post-weld heat treatment (PWHT) is required only when specified by contract documents, identified on drawings, or required by welding procedure. For units which are intended to operate continuously at the same location for more than 5 years, PWHT shall be applied for joints in C-Mn steels in special areas when the material thickness at the welds exceeds 50 mm. If, however, satisfactory performance in the as-welded condition can be documented by a fitness-for-purpose assessment applying fracture mechanics testing, fracture mechanics and fatigue crack growth analyses, PWHT may be omitted. PWHT shall be in accordance with AWS D1.1 (20) except as follows:

1. When PWHT is required, EPCI-CONTRACTOR shall submit a PWHT procedure and obtain Approval from Client prior to application of any PWHT. The maximum temperature for API 2Y, API 2W, or any quenched and tempered or thermo-mechanical control processed steel, shall not exceed 593°C (1100°F) or the tempering temperature, whichever is less.
2. Thermocouples shall be attached directly to the weldment (near the weld) to be PWHT and the full temperature cycle automatically recorded, witnessed and

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approved by Client. The thermographs produced shall be included in the final documentation package.

3. All final visual inspection and NDE shall be completed or repeated after PWHT.
4. Welding shall not be conducted on PWHT components without the Approval by Client except for welds to connect items to the structure (i.e., stub to brace welds, core or barrel to leg welds, etc.).
5. The PWHT of nodes, when required, shall be performed on the node as a complete component if practical.
6. Weld that are subject to PWHT and the surrounding area shall be covered with insulation material for a minimum of 300mm from each side of the weld. The insulation material shall not be removed before the temperature is below 250°C. When PWHT is applied to open ended structural tubulars, the open ends shall be covered / closed to avoid cooling draught inside the tubular during the heat treatment process.
7. PWHT temperature/time charts shall be clearly identified to the weld joints and shall be retained for inclusion into as-built records. The information shall be accurately transferred from the charts to PWHT reports and subject to Client Approval.

### **15. INSPECTION AND EXAMINATION**

1. For the weld made by Submerged Arc Welding (SAW) and the weld thicker than 25mm then final NDT shall performed after 48 hours since from completion of welding. If any crack indication detected, the related WPSs shall suspended for investigation and all the weld joints made by those WPSs must be NDT accepted after 96 hours since from completion of welding.

**If SAW welds thicker 25mm that are inspected by radiographic, they also be additional Ultrasonic testing after 48 hours since from completion of welding for detection of any transverse or delay cracks.**

2. Inspection and non-destructive examination shall comply with the requirements of API RP 2A – WSD (6), AWS D1.1 (20) and the additional requirements of this specification. Each inspection or examination shall be carried out using a written procedure approved by Client.

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3. All inspector shall be AWS QC1 certified (or acceptable equivalent) except specialty technicians (PT, MT, UT, and RT) who shall be qualified and certified according to the guidelines ASNT SNT-TC-1A or equivalent. EPCI-CONTRACTOR shall develop a procedure to detail the process of qualification for NDT Operators. Client reserves the right to proficiency test, at no additional cost to Client, any NDT operative working at any of the EPCI-CONTRACTOR or Sub-Contractors facilities, irrespective of their current qualifications. The test shall comprise a practical demonstration of the NDT operative's abilities on a sample test piece together with the ability to record and report the Work relative to the duties for which they are qualified.
4. **Lamination survey:**

For lamination survey of base metal under areas of incoming member shall comply with ASTM A578 and additional below requirements:

  - Where the tested material thickness less than 20 mm, normal probes with diameter 10 to 15 mm and frequency 4 to 5 MHz shall be used. The sensitivity shall be at level of Distance Amplitude Curve (DAC) constructed from Flat Bottom Hole 5 mm.
  - Where the tested material thickness greater than or equal to 20 mm, normal probes with diameter 20 to 30 mm and frequency 2 to 2.5 MHz shall be used. The sensitivity shall be at level of DAC constructed from Flat Bottom Hole 8mm.
    - The area of incoming members are defined as note 3 and note 4 in table 1.
    - The recording or reporting level for lamination imperfection shall be DAC level.
5. The required NDE methods and the minimum extent of inspection shall comply with API RP 2A – WSD (20) Table 16.1 and the additional requirements in Table 1 of this Specification.
6. **Welds that are subject to radiographic or magnetic particle testing shall comply with the quality level requirements of AWS D1.1 (20) acceptance standards for cyclically loaded structures.** Acceptance standards for cyclic loading shall be used on welds as specified by the contract documents for welds ground for improved fatigue performance. Magnetic particle inspection (MPI) shall be by the Wet Method using a white background and black ink. MPI using Dry Method may be

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used for the specific situation (e.g. MPI for hot metal after back gouging) and shall be approved by Client prior to application.

7. Ultrasonic Examination.

- Ultrasonic examination procedures shall be established by an ASNT Level III ultrasonic specialist. The procedure shall define equipment, techniques, and methods consistent with the design requirements. As a minimum the essential variables listed in API RP 2X shall be detailed in the written procedure and submitted for Client Approval prior to use during trial and subsequent examinations. Variations from the proven procedure shall be cause for re-qualification. For anisotropic steels such as TMCP materials, the Ultrasonic examination procedures shall be detailed for calibration of testing with refer to DNVGL-CG-0051. Edition December 2015 Non-destructive testing - Guidelines Regarding Ultrasonic Testing Of TMCP Materials.
- Ultrasonic examination of groove welds in structural shapes and plates shall comply with AWS D1.1 Section 8 (20) and Annex O. Acceptance - rejection criteria shall be as per Table O.1 Cyclically Loaded - Annex O with the following notes:
  - (i) Discontinuity level 1 and 2 shall be separated by at least 2L, L being the length of the longer discontinuity, except that when two or more such discontinuities are not separated by at least 2L, but the combined length of discontinuities and their separation distance is equal to or less than the maximum allowable length under the provisions of Level 1 or 2, the discontinuity shall be considered as single acceptable discontinuity.
  - (ii) Discontinuity Level 1 and 2 shall not begin at a distance less than 2L from weld ends carrying primary tensile stress, L being the discontinuity length.
- Ultrasonic examination of tubular structural welds shall comply with API RP 2X. T, Y, or K connections shall comply with Level "C" acceptance weld quality. Unless otherwise approved by Client representative, Level "A" acceptance weld quality shall apply where UT is substituted for radiography.
- Plate or pipe to be used as lifting aids, node cans in chord members, flanges or critical girders requiring substantial stiffening, and all critical applications where the member is subject to substantial Z-direction loading as indicated in design by requirement of through thickness tensile test (Z-test) and complete joint

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penetration (CJP) or partial joint penetration (PJP) weld shall be ultrasonically examined. Examination and reporting requirements of ASTM A578 (18) shall apply.

- The intersect location (footprint), including a 150 mm (six (6) in.) wide band shall be examined in accordance with ASTM A578 with supplement S1 acceptance standard-level “C”. Refer to Table 1 for details of location category.
- Members with flaws that would interfere with weld inspection may be positioned so that acceptable material is located under all brace footprint areas.
- Weld repairs of members with unacceptable flaws up to 6500 mm<sup>2</sup> (10 in.<sup>2</sup>) may be made using a Client approved weld repair procedure.
- Weld inaccessible for Ultrasonic examination shall be substituted by Magnetic Particle or radiographic testing upon Approval of Client QC.

### **8. Phased Array Ultrasonic Testing (PAUT)**

When the weld configuration allows to access, the Phased Array Ultrasonic Testing (PAUT) method may be applied in lieu of Radiographic Testing (RT). PAUT procedures will be developed and be qualified base on the Annex H of AWS D1.1 2020 (20). All PAUT inspectors also be passed practice mock-up followed the approved procedures.

Acceptance criteria for PAUT:

- Discontinuities shall be characterized as follows:
  - (i) Spherical (individual pores and widely spaced porosity, nonelongated slag)
  - (ii) Cylindrical (elongated slag, aligned pores of porosity, hollow beads)
  - (iii) Planar (incomplete fusion, inadequate joint penetration, cracks)
- Welds shall be acceptable provided they have no: (all article references are related to AWS D1.1 2020)
  - (i) Cracks.
  - (ii) Planar indications of welds in structural shapes and plates.
  - (iii) Planar indications other than crack of tubular welds which have amplitude above disregard level (DRL) and length exceeds that specified in Figure 8.1.
  - (iv) Any indications whose amplitude or length exceeds that specified in Table H.2 for the applicable type of loading. Discontinuities shall be classified based on their maximum amplitude in accordance with Table H.3 (also see Figure H.4):

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- Manual supplemental PAUT and/or alternative NDT Techniques shall be used when necessary to verify questionable indications found in the collected data.
- Indications characterized as cracks shall be considered unacceptable regardless of length or amplitude.
- Class B and C indications shall be separated by at least 2L, L being the length of the longer indication, except that when two or more such indications are not separated by at least 2L, but the combined length of indications and their separation distance is equal to or less than the maximum allowable length under the provisions of Class B or C, the flaw shall be considered a single acceptable indication.
- Class B and C indications shall not begin at a distance less than 2L from the weld ends carrying primary tensile stresses, L being the indication length.
- For Class C indications, the depth of the discontinuity shall be determined by the location of the peak amplitude, at the angle producing the maximum signal amplitude.

### **16. REPORTS AND RECORDS**

The following reports and data sheets shall be supplied to Client:

1. Mill test reports and certificates.
2. Client approved welding procedure package.
3. Welder and/or welding operator qualification test results.
4. Temperature charts or records for all stress relieving and/or post-weld heat treating  
(When required by Client specifications and/or regulatory authorities).
5. NDE reports and results, including repairs.
6. As-built construction drawings.
7. Welder Register
8. WPS / WPQT Register
9. NDT Operator Register
10. QC Personnel Register
11. Calibration Register
12. Calibration Certificates
13. Welding Consumables Register
14. Welding Consumable Certificates
15. Dimensional Control Reports



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TABLE 1: EXAMINATION REQUIREMENTS SUPPLEMENTAL TO API RP2A

LOCATION / TYPE OF WELD	EXTENT <sup>Note 1</sup>	METHOD <sup>Note 2</sup>
<b><u>Lamination Surveys (Location of Structural Plate)</u></b>		
Joint Cans <sup>Note 3</sup>	100%	UT
Padeyes	100%	UT
Plate to which padeyes or crane pedestals are attached <sup>Note 4</sup>	100%	UT
<b><u>Fabricated Tubulars for Piles, Braces, Jacket Legs, Deck Legs, Stabbing guides</u></b>	100%	RT or UT + MT
<b><u>Tubular Connections</u></b>		
Primary T, K, Y joints with brace diameter $\geq 323.9$ mm (12 $\frac{3}{4}$ in.) and wall thickness $\geq 12.7$ mm ( $\frac{1}{2}$ in.) <sup>Note 5</sup>	100%	UT + MT
All (either primary or Secondary) T, K, Y joints with brace diameter $\geq 219.1$ mm (8 in.) and wall thickness $\geq 9.5$ mm (3/8 in.)		20 % UT + 100% MT
All other T, K, Y joints	100%	MT
<b><u>Plate Girder, Beam and Shape Connections</u></b>		
Secondary full penetration welds	10%	RT or UT + MT
Primary fillet welds	100%	MT
Secondary fillet welds	10%	MT
Primary Full Penetration Welds	100%	RT or UT + MT
<b><u>Padeyes</u></b> <sup>Note 9</sup>		
Full penetration	100%	UT + MT
Fillet	100%	MT
<b><u>Miscellaneous Fabrication</u></b>		
Structural fillet	10%	MT
Arc strikes	100%	MT
Weld repairs <sup>Note 6</sup>	100%	See Note 6
Sea fastening	100%	UT + MT



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LOCATION / TYPE OF WELD	EXTENT <sup>Note 1</sup>	METHOD <sup>Note 2</sup>
Full penetration welds on launch legs, launch lugs and skirt pile sleeves.	100%	(RT+UT+MT)
Fillet welds on launch legs, launch lugs	100%	MT
Grout, flood, and inflation lines	10%	RT + MT
Full penetration Ring stiffeners	100%	UT + MT
<b><u>Connections Made During Offshore Installation</u></b>		
Pile/conductor field girth welds	100%	UT+MT
Pile-to-deck girth welds	100%	UT+MT
Jacket leg-to-deck girth welds <sup>Note 7</sup>	100%	UT+MT
Pile-to-shim Welds <sup>Note 8</sup>	100%	MT
Transition piece to jacket/topside	100%	UT+MT
All other CJP or PJP welds	100%	UT+MT
All fillet welds	100%	MT

**Notes:**

1. Based on percent of total weld length. Client to designate welds inspected to less than 100%.
2. All welds (structural and non-structural) and structural steel are subject to 100% Visual Test (VT) at all times. VT may include Penetrant Test (PT). When the weld configuration allows to access, the Phased Array Ultrasonic Testing (PAUT) method may be applied in lieu of Radiographic Testing (RT).
3. Projection of the brace onto the joint can plus an additional 150 mm (6 in.) radius around the circumference of the projection.
4. Projection of the padeye or pedestal plus an additional segment equal to 5 times the padeye thickness.
5. Although conventional techniques are generally limited to these dimensions, smaller or thinner members may require examination if they are designated primary welds.
6. NDE shall be the same as the original inspection and performed by the same party.
7. For jackets with skirt piles.
8. Visual examination of each pass and Magnetic Testing (MT) upon completion of welding.
9. Primary structural padeyes utilized by EPCI-CONTRACTOR during the construction phase shall be subject to the applicable 100% NDE both before and after use.