Prelude Subsea Assets – Integrity Status Report 2020

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# EXECUTIVE SUMMARY

## Overall Summary of Subsea Integrity Status

The Prelude Subsea Asset is Fit for Service and in good overall condition.

Overlength spans on each of the flowlines require monitoring.

The other integrity issues involve minor anomalies and some assets with insufficient inspection data to establish a baseline integrity status.

The Integrity status has been assigned as per the guidelines described in [Section 3.6](#_Rating_System_for), Rating System for Pipelines Subsea Asset Integrity Status and summarised in Table 1 below.

## Detailed Integrity Status by Asset

The Integrity Status of the individual assets is summarized in the table below. The integrity status has then been rolled up to the asset group, showing the worst-case integrity status for the group.

The integrity status colours used in Table 1 below have 4 classifications based on the Standardized Rating System for Pipelines and Subsea Integrity Status developed in AMS Document MEC\_RP\_04-4.8\_v1 (see Section 3.6). Where an asset has insufficient inspection to confirm integrity status, a “YELLOW” classification has been assessed.

Table 1 - Integrity Status Ranking

|  |  |
| --- | --- |
| STATUS | DESCRIPTION |
| GREEN | All integrity aspects of an asset are fit for service. |
| YELLOW | These integrity issues do not cause any immediate threat to the integrity of the asset but it cannot be ensured that the issue will not affect the asset integrity within its planned field life. |
| YELLOW | This status is given to assets without sufficient inspection data to comprise a baseline inspection. These assets should be inspected on a priority basis during the next planned inspection. |
| ORANGE | Subsea asset has an integrity issue (operating outside applicable code/standard) predicted within one to three years and requires remedial action within one year by the Asset Manager. |
| RED | Subsea asset has an integrity issue resulting in an imminent risk of a loss of containment or failure of the safeguarding system, and therefore requires immediate remedial action by the Asset Manager. |
| N/A | Integrity issues included for information only, the asset is not within the scope of this document. |
| N/A | Surveillance issues which do not affect integrity. |

The summarized integrity status by asset is presented in Figure 1 as a dashboard summary block diagram and is further detailed in

Table 2, Integrity Status by Asset.

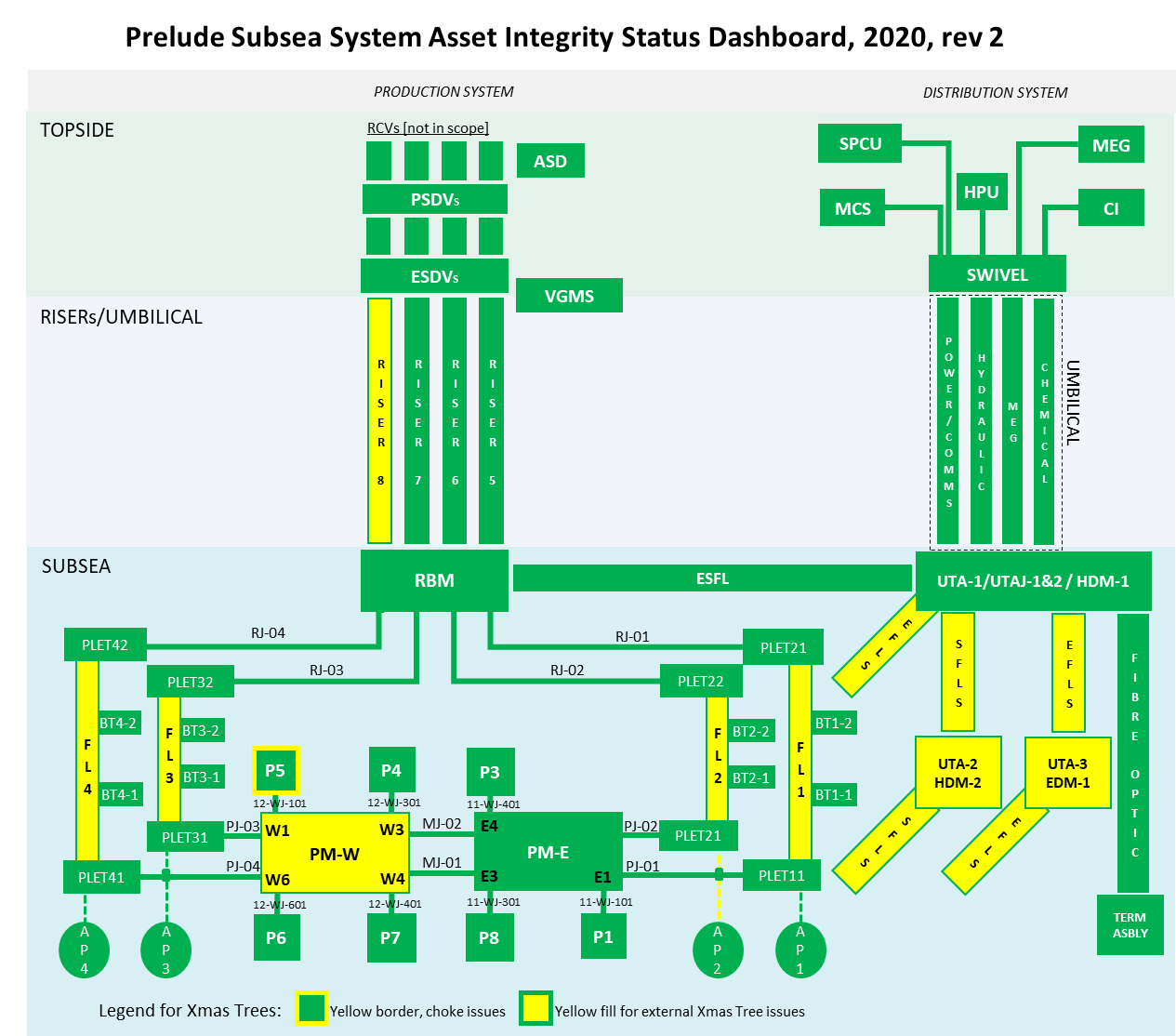


Figure 1 - Prelude Subsea System Asset Integrity Status dashboard, 2020

Table 2 - Integrity Status by Asset

| **Asset Code** | **Subsea Asset / Asset Group / Summary of Integrity Issues(s)** | **Integrity Status 2019** | **Integrity Status 2020** |
| --- | --- | --- | --- |
| **FLS** | **Flowloop System** | [YELLOW](#_Flowloop_System) | [YELLOW](#_Flowloop_System) |
| FLNG-TU | FLNG Turret - Subsea Related Piping & Valves | GREEN | GREEN |
| **FRS** | **Flexible Riser System** | [YELLOW](#_Flexible_Riser_System) | [YELLOW](#_Flexible_Riser_System) |
| FR-001 | Riser 05 | GREEN | GREEN |
| FR-002 | Riser 06 | GREEN | GREEN |
| FR-003 | Riser 07  Isolated – Riser is unavailable and has been flooded with Methyl Ethylene Glycol (MEG) causing the profile to lower by about 20msw than in 2019. The distance from the sag bend to the seabed and from the FLNG hull to the hog bend is currently outside the design range.  Although the riser is unavailable, this is not an integrity issue. Refer also to Flowline 03 for further details. | GREEN | GREEN |
| FR-004 | Riser 08  Continuity Cable – The Subsea End Fitting continuity cable at the 12 o'clock position is detached from the end fitting. This is one of 4 continuity cables running between the 6 anode bracelets and the Bend Restrictor Reaction Collar. The adjacent cable is intact and the CP on the end fitting is -1034mV, indicating adequate protection. | [YELLOW](#_Riser_08) | [YELLOW](#_Riser_08) |
| **FLS.FJ** | **Jumpers – Manifold & Flowline** | [YELLOW](#_Flowloop_Jumpers) | [GREEN](#_Flowloop_Jumpers) |
| MJ-001 | Manifold Jumper 01 – between Production Manifold West & East | GREEN | GREEN |
| MJ-002 | Manifold Jumper 02 – between Production Manifold West & East | GREEN | GREEN |
| PJ-001 | PM-E Flowline Jumper 01 – between PM-East & DC PLET 1 | GREEN | GREEN |
| PJ-002 | PM-E Flowline Jumper 02 – between PM-East & DC PLET 2 | GREEN | GREEN |
| PJ-003 | PM-W Flowline Jumper 03 – between PM-West & DC PLET 3 |  |  |
| Coating-Insulation Observation -Degraded coating was found on the UCON-H-12 (PM-W), between 12 and 4 o'clock, approximately 300mm x 30mm. No other damage observed. | GREEN | GREEN |
| PJ-004 | PM-W Flowline Jumper 04 – between PM-West & DC PLET 4  CP - UCON-H-12 (DC PLET 4) – CP measurement is -1071mV . | [YELLOW](#_PM_Flowline_Jumper) | GREEN |
| Coating-Insulation Observation -Degraded coating was found on the UCON-H-12 (DC PLET 4), between 7 and 10 o'clock, approximately 300mm x 40mm. No other damage observed. | GREEN | GREEN |
| RJ-001 | RBM Flowline Jumper 01 – between RBM PLET1 & RBM | GREEN | GREEN |
| RJ-002 | RBM Flowline Jumper 02 – between RBM PLET2 & RBM | GREEN | GREEN |
| RJ-003 | RBM Flowline Jumper 03 – between RBM PLET3 & RBM | GREEN | GREEN |
| RJ-004 | RBM Flowline Jumper 04 – between RBM PLET4 & RBM  CP Steel, UCON-H-12 RBM PLET 4) – CP measurement of  -1071mV. | [YELLOW](#_RBM_Flowline_Jumper) | [GREEN](#_RBM_Flowline_Jumper) |
| **FLS** | **Flowlines** | [**YELLOW**](#_Flowlines) | [**YELLOW**](#_Flowlines) |
| FL-001  BT-1-1 (KP1.106)  BT-1-2 (KP2.119) | Production Flowline 01  Spans - 4 spans were over the 27m limit; 2 spans are adjacent to BT1-1, 2 adjacent to BT1-2. | [YELLOW](#_Production_Flowline_01) | [YELLOW](#_Production_Flowline_01) |
| FL-002  BT-2-1 (KP1.133)  BT-2-2 (KP2.068) | Production Flowline 02  Spans - 3 spans were over the 27m limit; 2 spans are adjacent to BT2-1, 1 adjacent to BT2-2. | [YELLOW](#_Production_Flowline_02) | [YELLOW](#_Production_Flowline_02) |
| FL-003  BT-3-1 (KP0.932)  BT-3-2 (KP1.965) | Production Flowline 03  Flowline is currently unavailable due to suspected hydrate blockage and is currently flooded with MEG. However this is a flow assurance issue unrelated to integrity.  Spans - 2 spans were over the 27m limit; 1 spans are adjacent to BT3-1, 1 adjacent to BT3-2. | [YELLOW](#_Production_Flowline_03) | [YELLOW](#_Production_Flowline_02) |
| FL-004  BT-4-1 (KP0.987)  BT-4-2 (KP1.937) | Production Flowline 04  Spans - 2 spans were over the 27m limit; adjacent to the BT4-1. | [YELLOW](#_Production_Flowline_04) | [YELLOW](#_Production_Flowline_04) |
| Production Flowline 04  Physical Damage - An area of abrasion was seen on Flowline 04 at KP0.011, on the Northeast side of the flowline | [YELLOW](#_Production_Flowline_04) | [YELLOW](#_Production_Flowline_04) |
| **FLS.MP** | **Pipeline End Terminations (PLETs)** | [YELLOW](#_Pipeline_End_Terminations) | [YELLOW](#_Pipeline_End_Terminations) |
| PL-011 | PLET DC Flowline 1 | GREEN | GREEN |
| PL-021 | PLET DC Flowline 2  CP Steel - Chain Isolation  Plate (w/ 2 anodes) CP out of acceptable range (**-**1126mV**)**  IMSA Anomaly 20-0022 Chain Isolation Plate, CP out of Range, Status: Routine Monitoring. Note, although this anomaly is raised against PL-021, in Figure 1 it has only been identified as the holdback chain. | [YELLOW](#_PLET_DC_Flowline) | [YELLOW](#_PLET_DC_Flowline) |
| PL-031 | PLET DC Flowline 3 | GREEN | GREEN |
| PL-041 | PLET DC Flowline 4 | GREEN | GREEN |
| PL-012 | PLET RBM Flowline 1 | GREEN | GREEN |
| PL-022 | PLET RBM Flowline 2 | GREEN | GREEN |
| PL-032 | PLET RBM Flowline 3 | GREEN | GREEN |
| PL-042 | PLET RBM Flowline 4 | GREEN | GREEN |
| **FLS.MP** | **Manifolds** | [YELLOW](#_Manifolds) | [YELLOW](#_Manifolds) |
| U01100 | Production Manifold East Assembly (PM-E) | GREEN | GREEN |
| U01200 | Production Manifold West Assembly (PM-W)  Connectors – Insufficient inspection done on the connectors during the Hot Baseline Inspection. | [YELLOW](#_Production_Manifold_West) | [YELLOW](#_Production_Manifold_West) |
| U02100 | Riser Base Manifold Assembly (RBM) | GREEN | GREEN |
| **TWS** | **Subsea Tree & Well System** | [YELLOW](#_Subsea_Tree_&) | [YELLOW](#_Subsea_Tree_&) |
| Slot-E1 (P1) | Well Slot East Position 1 (P1) | GREEN | GREEN |
| Slot-E3 (P8) | Well Slot East Position 3 (P8) | GREEN | GREEN |
| Slot-E4 (P3) | Well Slot East Position 4 (P3)  Choke Valve Blockage - On 02 November 2019, the PCV failed to close further than 55 steps. There is an offset of 27 steps. Stopping of movement at 53 steps indicates a potential blockage of the first row of ports. On 15 February 2020, with high MEG injection rate and reverse flow, the blockage was cleared. The choke was returned to normal operation at 22 steps, IMSA Anomaly 19-0039 was closed and the well status changed to GREEN.  *(Flow Module replaced in Mar/Apr and Sep-2019*). | [GREEN](#_EVDT_Choke_Failures) | [GREEN](#_EVDT_Choke_Failures) |
| Slot-W1 (P5) | Well Slot West Position 1 (P5) | [YELLOW](#_EVDT_Choke_Failures) | [YELLOW](#_Choke_Offset_on) |
| Choke Offset, IMSA Anomaly 20-0001 |
| Slot-W3 (P4) | Well Slot West Position 3 (P4) | GREEN | GREEN |
| Slot-W4 (P7) | Well Slot West Position 4 (P7) | GREEN | GREEN |
| Slot-W6 (P6) | Well Slot West Position 6 (P6) | GREEN | GREEN |
| **TWS.WJ** | **Well Jumpers** | [YELLOW](#_Well_Jumpers) | GREEN |
| 011-WJ-101 | PM-E - Well Jumper E1 (P1) | GREEN | GREEN |
| 011-WJ-301 | PM-E - Well Jumper E3 (P8) | GREEN | GREEN |
| 011-WJ-401 | PM-E - Well Jumper E4 (P3) | GREEN | GREEN |
| 012-WJ-101 | PM-W - Well Jumper W1 (P5) | GREEN | GREEN |
| 012-WJ-301 | PM-W - Well Jumper W3 (P4)  One CP Anode reading was taken on an inactive anode on the **W3 EFL panel** that showed a potential of -1088mV. | GREEN | GREEN |
| 012-WJ-401 | PM-W - Well Jumper W4 (P7) | GREEN | GREEN |
| 012-WJ-601 | PM-W - Well Jumper W6 (P6) | GREEN | GREEN |
| **WPF** | **Wet Park Frames** | GREEN | GREEN |
| FLOP.AU.PRL.P2 | P2 Wet Parking Mandrel | GREEN | GREEN |
| **SDS** | **Subsea Distribution System** | [YELLOW](#_Subsea_Distribution_System) | [YELLOW](#_Subsea_Distribution_System) |
| B1111.U05100TS  B1111.U05100UW | Prelude Subsea Umbilical  - Above Water  - Underwater | GREEN | GREEN |
| 051-SFL-00 | Steel Flying Leads 001, 002 & 003  Insufficient inspection | [YELLOW](#_Steel_Flying_Leads) | [YELLOW](#_Steel_Flying_Leads) |
| 051-EFL-00 | Electrical Flying Leads EDM (1), EDM (2), EDM (3) & EDM (4)  Insufficient inspection | [YELLOW](#_Electrical_Flying_Leads) | [YELLOW](#_Electrical_Flying_Leads) |
| FO | Fibre Optic System | GREEN | GREEN |
| **SDS.UM** | **Umbilical Termination Assemblies & Jumpers** | [YELLOW](#_Umbilical_Termination_Assemblies) | [YELLOW](#_Umbilical_Termination_Assemblies) |
| 051-UTA-001  051-UTH-001  051-UTAJ-001  051-HDM-001 | Umbilical Term Assembly 1, HDM-1 comprised of;  UTA-1  Umbilical Termination Head (UTH-1)  Umbilical Term Assembly Jumper 1 (UTAJ-1)  Hydraulic Distribution Manifold 1 (HDM-1) | GREEN | GREEN |
| 051-ESFL-001 | Electrical Steel Flying Lead (ESFL) UTA-1 (HDM-1) to RBM  Insufficient inspection. | GREEN | [YELLOW](#_Electrical_Steel_Flying) |
| 051-UTA-002  051-UTAJ-002  051-HDM-002 | Umbilical Term Assembly 2 (UTA-2)  Umbilical Term Assembly Jumper 2 (UTAJ-2)  Hydraulic Distribution Manifold (HDM-2)  Insufficient inspection. | [YELLOW](#_UTA-2_Hydraulic_Distribution) | [YELLOW](#_UTA-2_Hydraulic_Distribution) |
| 051-UTA-003  051-EDM-001 | Umbilical Term Assembly 3 (UTA-3)  Electrical Distribution Manifold (EDM-1)  Insufficient inspection. | [YELLOW](#_UTA-3_Electrical_Distribution) | [YELLOW](#_UTA-3_Electrical_Distribution) |

Items with integrity status “N/A” have not been rolled up into the Summary

Table 2 above. For details refer to [Section 4](#_INTEGRITY_STATUS).

Items with a non-GREEN status have been hyperlinked to the associated details in [Section 4](#_INTEGRITY_STATUS), Integrity Status.

# INTRODUCTION

## Background

The Prelude Field is located in Field Block (Permit Area) WA-44-L in the Caswell Sub-basin area of the Northern Browse Basin, approximately 475km NNE of Broome, Western Australia (WA). The Prelude FLNG vessel is moored in approximately 250m water depth using 16 mooring lines connecting the turret mooring system to subsea piles (4 clusters of 4 mooring lines/piles). The non-disconnectable internal turret system holds the vessel on station and includes a swivel which interfaces the subsea risers and umbilical to the FLNG whilst allowing the vessel to weather-vane freely.

Seven subsea gas producer wells feed the FLNG host from gas reservoirs at DC-1 drill centre, located approximately 3 km south of the Prelude FLNG facility.

The production system compromises of 2 off 6-slot production manifolds at DC-1 connected to an 8-slot riser base manifold via 4 x 12” 3km CRA clad flowlines. The FLNG facility receives process fluids from the riser base manifold via 4 x 12” flexible risers hung-off in the turret.

Hydraulic and electric power is delivered to the subsea hardware from the facility via a main umbilical and subsea distribution system allowing the facility to control and monitor production.

Processing, storage and offloading of hydrocarbons is also controlled and operated from the FLNG facility.

The onshore operational centre is located in Perth (WA) and the onshore supply base located in Darwin, Northern Territory (NT).

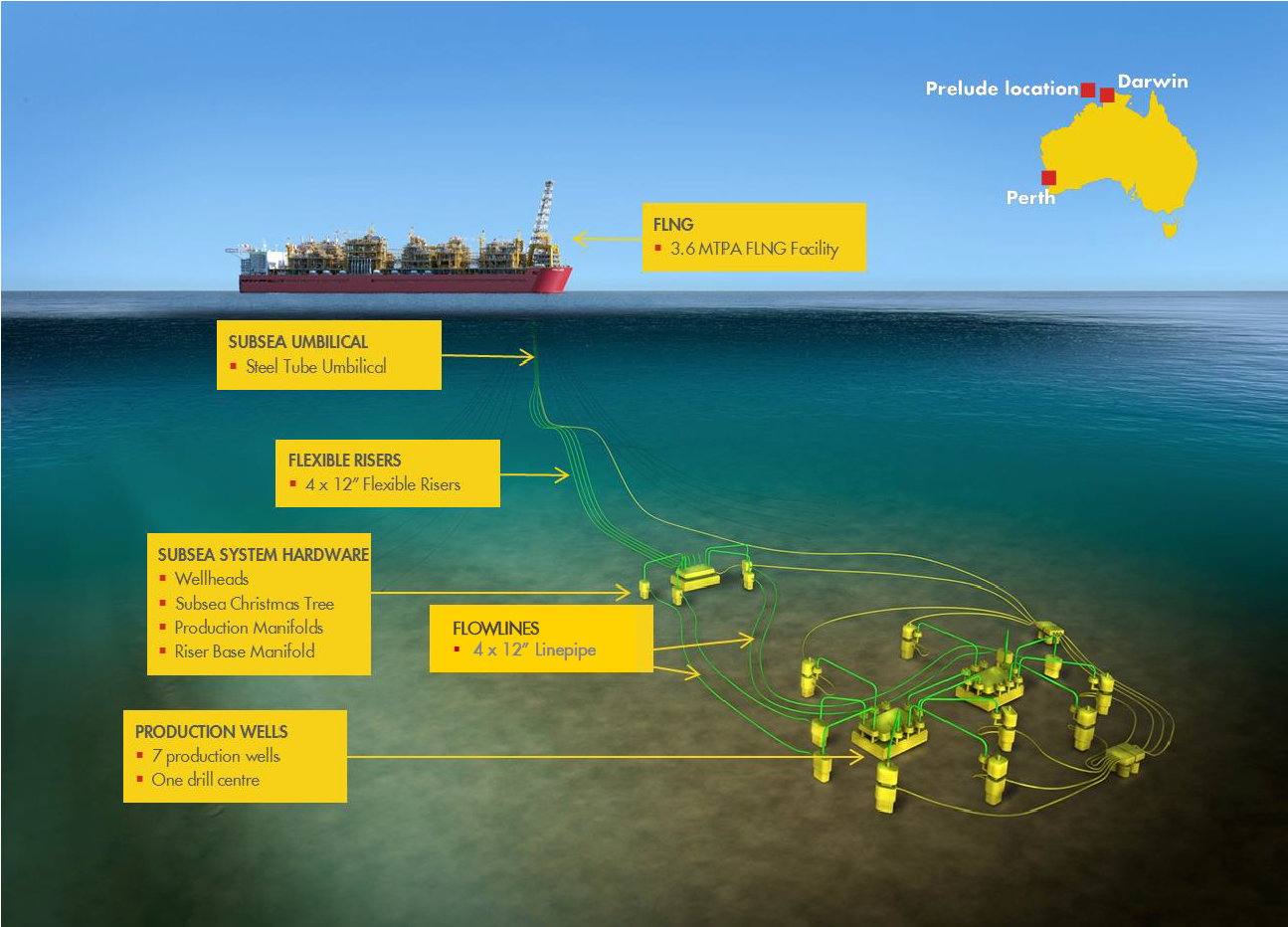


Figure 2 - Prelude Schematic

Prelude moved to the Operating Phase when gas in from wells was achieved in December 2018.

The subsea assets have been inspected several times during the Project Phase and during the Operations Phase as follows:

* Prelude M1 Campaign (Jun 2016) – flowline well jumper metrology.
* Prelude C2 Campaign (Sep 2016 to Nov 2016) – flowline jumpers, well jumpers and SDH installation.
* Prelude C3 Campaign (Jul 2017 to Nov 2017) – FLNG mooring hook-up, flexible risers and main umbilical installation.
* Prelude C4A Campaign (Jan 2018 to Feb 2018) – Cold baseline survey & subsea system cold commissioning.
* Prelude C4B Campaign (Nov 2018 to Dec 2018) – flowloop gas sweeping and subsea system hot commissioning.
* Prelude Hot Baseline Campaigns (Aug-2019 & Sep-2019) – two surveys in total covering FLNG elements and subsea system with a 3-week gap.
* Prelude 2020 C1 Campaign (10 Nov-2020 to 06 Dec-2020) – Includes the Subsea, Water Intakes Risers, Turret Mooring Lines Prelude FLNG Hull Frame inspections.
* In addition to inspection, intervention campaigns have spent considerable time monitoring assets, during such operations as flow module change out for E1(P1) and W6 (P6), in 2020.

The 2020 C1 inspection campaign continued to progress the baseline inspection of the assets, focussing on the dynamic section of the risers, free spanned areas of the flowlines, production manifold inspection and E3 (P8) Tree inspection.

The two Hot Baseline Campaigns covered the complete inventory of Prelude subsea assets (although the full inspection scope for all assets was not completed) and is considered the baseline reference with respect to the Asset Integrity Status Report.

All inspection data for the Prelude subsea assets is loaded into the Integrity Management System Application (IMSA). Integrity Anomaly Management and Risk Based Inspection processes are also managed within IMSA for these assets. In some cases, the assets were not fully inspected during the Hot Baseline Inspection and credit has been taken for inspection data from previous campaigns. Active anomalies were considered during in this Asset Integrity Status Report.

Figure 3 and Figure 4 map out the distribution of inspection events recorded in IMSA against each of the 4 main inspection campaigns; C4A, C4B,HBL and the 2020 C1.

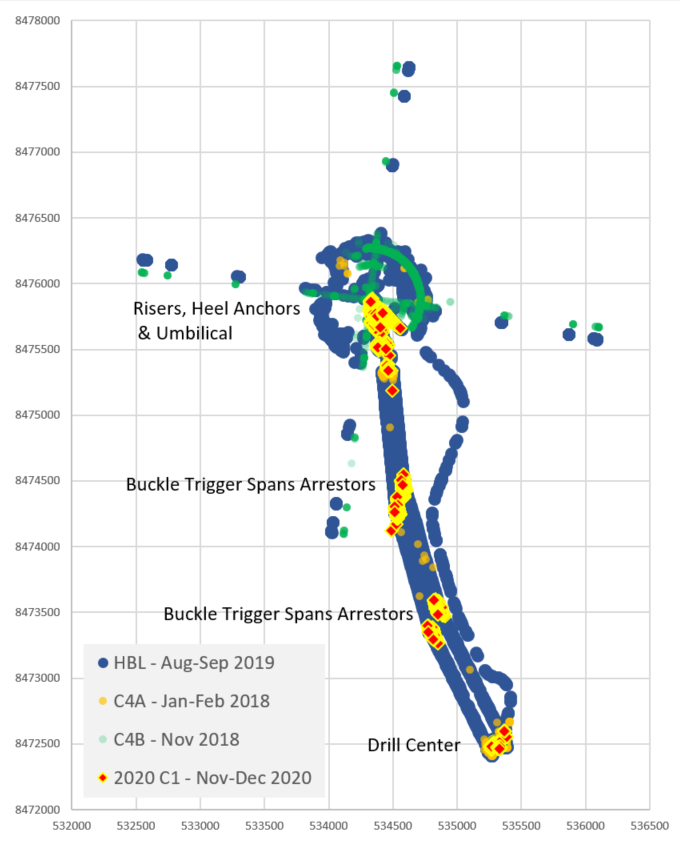


Figure 3 - Prelude Inspection Events Coverage for the Flowlines, Umbilical and Risers, 2018 to 2020

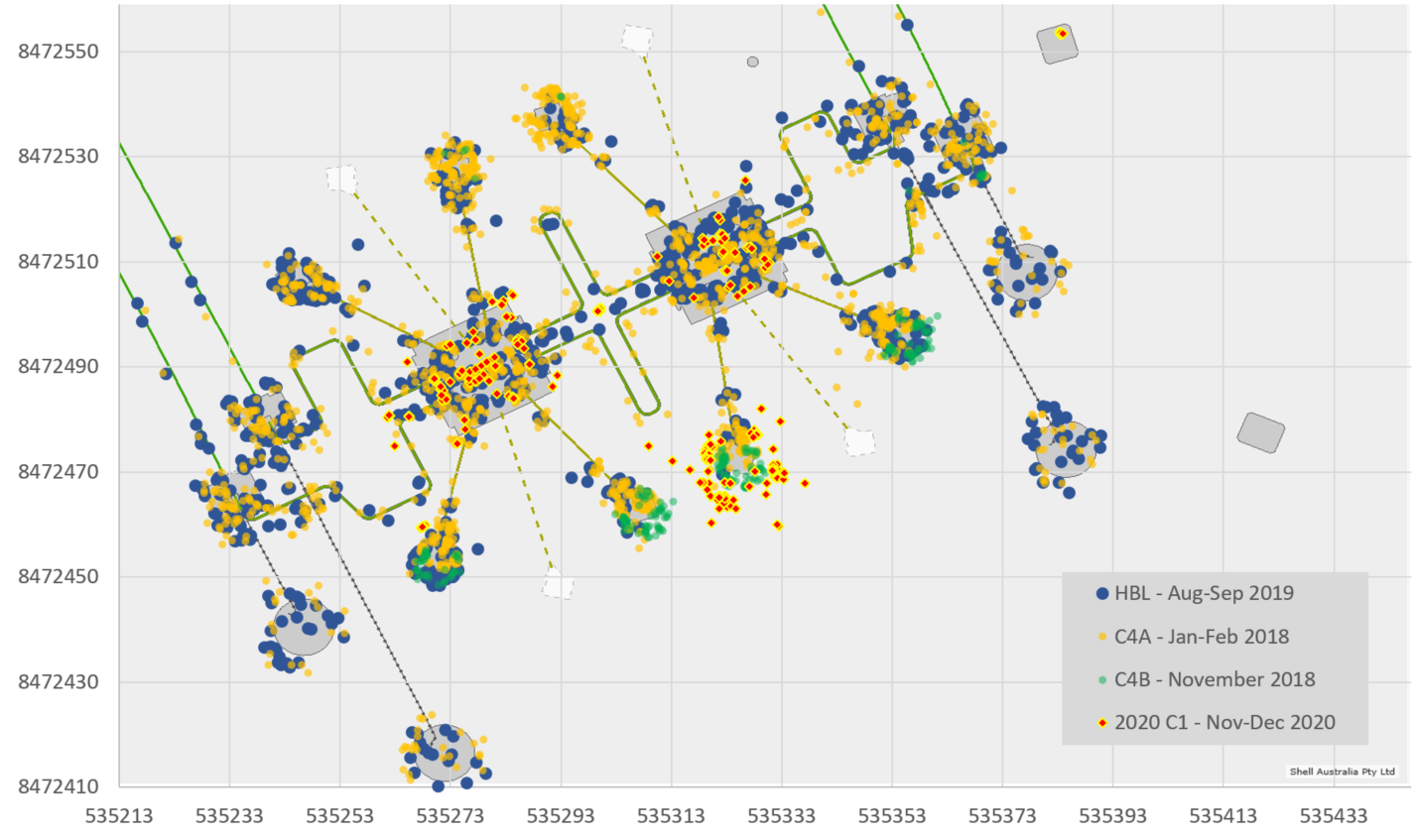


Figure 4 - Prelude Inspection Events Coverage for the Drill Center (DC-1), 2018 to 2020

## Target Audience

This document should be read and understood by the following audience:

• Subsea IMR Department staff

• Maintenance Engineers

• Technical Authorities (relevant disciplines)

• Discipline Engineers (relevant disciplines)

## Scope

The integrity status reported in this document relates to the Prelude subsea assets. In scope is the subsea system including dry sections of risers and main umbilical within turret and subsea related assets located on the FLNG host. Out of scope are FLNG hull, moorings and water intake risers and well downhole assets. The main reason for these scope boundaries is that they include all the assets for which the integrity is managed by the Subsea IMR team. Precise boundaries of the assets covered by this analysis are described in [Section 3.5](#_Definition_of_Battery) below.

Specifically, this review includes the following systems:

Table 3 – Systems within Scope

|  |  |
| --- | --- |
| **System** | **Components/Description** |
| Prelude Subsea Controls  on FLNG Host | 1. Subsea Master Control Stations (MCS) A & B, Subsea Electrical Power and Communication Units A & B, Unit Control Panel, Production Hydraulic Power Unit. |
| Production  Flowloop System | 1. FLNG Turret Flowloop Envelope Related Piping and Valves (upstream of flange of the topside riser choke valve and up to pig trap provision) 2. FLNG Turret - Flowloop Envelope Related Valves & Equipment 3. Flexible Riser System (Production Risers Nos 5, 6, 7 & 8), c/w riser end fittings, bend stiffener, bend restrictor, ballast modules, cathodic protection system and bracelet anodes, heel anchor system, intrusive polymer coupons, instrumentation, and Riser Vent Gas Monitoring System (VGMS). 4. Flowlines (includes buckle triggers, flowline end terminations (PLETs – see h. below), flowline jumpers (see e. below), cathodic protection system, insulation system, flowline isolation valves (FIV), Permanent Flowline Anchor Piles (PFAP) and hold back anchoring system, VIV strakes at drill center (DC) end. 5. Jumpers, including UCON-H connectors (2 off PM Jumpers, 4 off DC Flowline Jumpers, 4 off RBM Jumpers) 6. Manifolds including PM and RBM header and crossover piping, valves, coating, ROV interface buckets, PM and RBM SCMs, UCON-H connectors and instruments (2 off PM and RBM - latter containing 4 off Fail Close Riser Base Valves (FCRBV), Manifold specific EFL/SFLs. 7. Flowline End Terminations, including piping and valves (4 DC and 4 RBM PLETs). |
| Subsea Trees (including tree valves, SCM, Flow Module (c/w choke valve), Tree Cap, Instruments & Well Systems, XT SFL (incl. Cobraheads and end connectors), XT EFL (incl. end connectors)  and Well Jumpers | 1. Well Slot East Position 1 (P1) XT 2. Well Slot East Position 3 (P8) XT 3. Well Slot East Position 4 (P3) XT 4. Well Slot West Position 1 (P5) XT 5. Well Slot West Position 3 (P4) XT 6. Well Slot West Position 4 (P7) XT 7. Well Slot West Position 6 (P6) XT   *It is important to note that the elements of the tree and construction upstream of the production wing valve downstream flange are included in the Subsea PML but the responsibility for the integrity remains with the Production Technology Team.*   1. Well Jumpers (7 off – including Acoustic Sand and Vibration Detectors (ASVD), Intrusive Erosion Detectors (IED), Torus III Connectors, Well Jumper VIV suppression (strakes). |
| Subsea  Distribution System | 1. Main Umbilical (dynamic and static sections) 2. System Wide Steel Flying Leads (SFL) 3. System Wide Electrical Flying Leads (EFL) 4. Electrical Steel Flying Lead (ESFL) (DC to RBM – static umbilical) 5. Umbilical Termination Assemblies, c/w Hydraulic Distribution Manifolds (HDM-1 and HDM-2) and Electrical Distribution Manifold (EDM), Umbilical Termination Hubs (UTH), 3 off: Umbilical Termination Assembly 1 (UTA-1, UTH-1 & HDM-1), Hydraulic Distribution Manifold 2 (UTA-2, HDM-2) and Electrical Distribution Manifold 1 (UTA-3, EDM-1). 6. UTA Jumpers, SFLs (UTH to HDMs), EFLs (UTH to EDM) and Logic Caps 7. Fibre Optic System, including Optical Fibre Lead (OFL) (UTH to FO termination) and Cable Termination, . |

Figure 5 shows the subsea assets and Figure 6 shows the topside asset boundaries (Flowloop System).

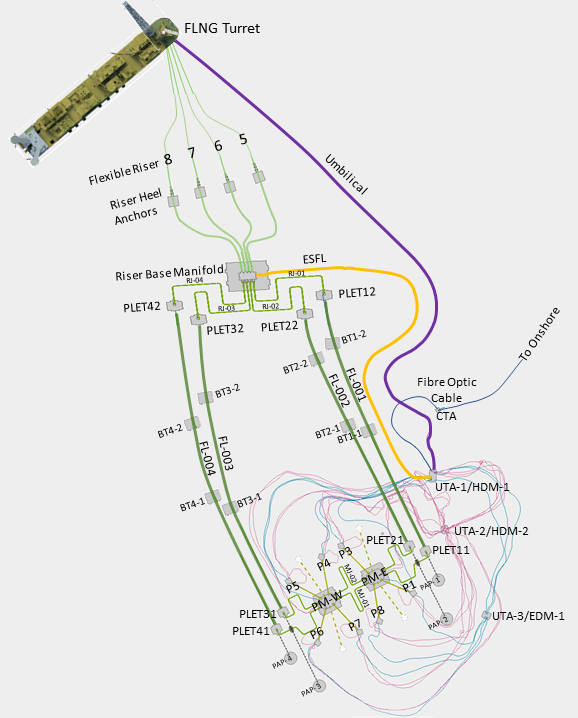


Figure 5 - Subsea Asset Diagram



Figure 6 - Topside Asset Boundaries (Flowloop System)

## Objective

The main objective of this document is to use the results of the 2020 C1 inspection campaign and the 2019 Hot Baseline Inspection for the Prelude subsea assets, along with all other available inputs (including historical results from all previous inspections), to report the integrity status of these assets, both in summary and in detail. The focus of the Hot Baseline Inspection was on the assets subject to the production pressure and temperature cycles, as well as the assets with known anomalous conditions. The execution of the inspection on the other assets, was prioritized on the previous inspection history and anomalous findings.

The effectiveness of subsea asset integrity management is monitored in two ways:

* the extent of execution of activities against the plan, and
* the resultant level of asset integrity, derived from the inspection results.

A detailed determination of the Integrity status of each subsea asset is to be conducted at least annually and captured in the annual Subsea Asset Integrity Status Report. The resultant assessment, along with the level of risk associated with each asset can be used to rank sets of assets such that work plan priorities can be set and non-routine repair or replacement decisions made.

## Description of Facilities

For details of the Battery Limits of the scope of the subsea assets, refer to Document No TEC\_PRE\_012551 *Subsea Asset Integrity Management Manual* Section 1.2 and Section 3.5 of this document.

Please refer to [**Appendix A**](#_Appendix_A_–) for a detailed description of the facilities.

# INTEGRITY MANAGEMENT

## Organization

The key roles and personnel in the Subsea Integrity Management Team and organization chart are as follows;

* Subsea IMR Manager – Philip Manfield
* Senior Subsea IMR Engineer – Brian Lamb
* Pipeline Operations Engineer - Jayaprakash Pendem
* Subsea Hardware IMR Engineer - Dwayne Smith
* Subsea IMR Execution Engineer - Nevil Fenwick

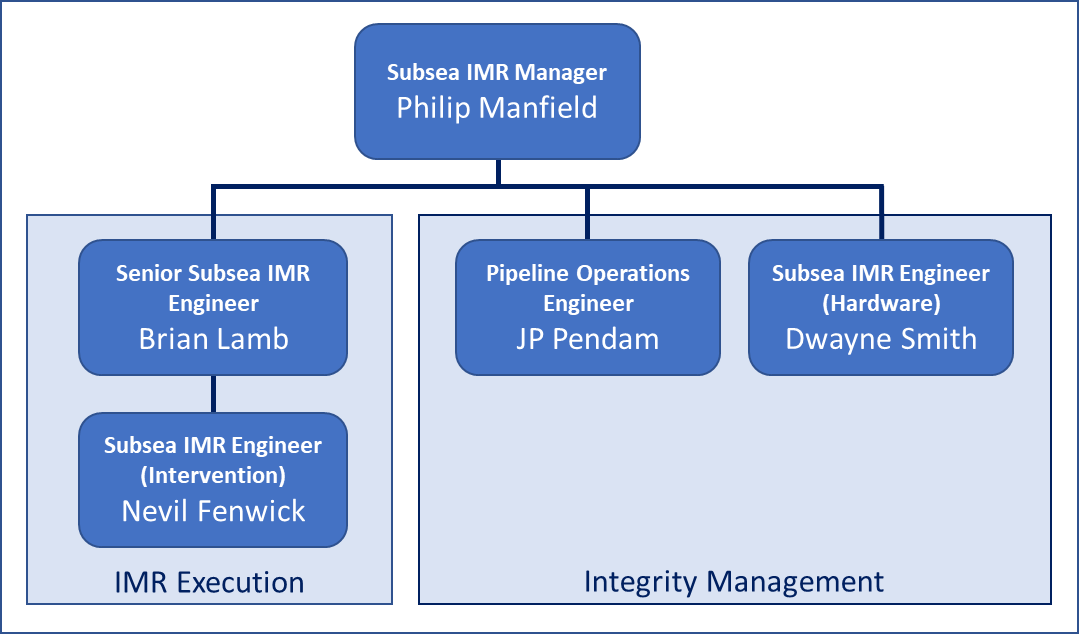


Figure 7 - Subsea Integrity Management Team Organization Chart

## Roles & Responsibilities

The roles and responsibilities for the organization are as stated in TEC PRE 012551 – Subsea Asset Integrity Management Manual for the main personnel as listed in Section 3.1.

In addition to the main personnel, the manual also describes the roles and responsibilities for key external resources in supporting roles. There are, as follows:

* Company Site Representative
* Discipline Technical Authorities

## Risk Management

Several systems are in place to help with risk management of the Prelude subsea assets. These include:

* **Integrity Management System Application (IMSA)** – a database application used to support the integrity management of pipelines and subsea assets. Some features are the storage and retrieval of inspection data, tools to assist in reporting of defects and risk, determination of inspection requirements, and information that helps with risk-based inspection and the creation of work packs.
* **RBI Work Process** – Risk-based Inspection is a standard practice in the industry, and within Subsea IMR is supported by IMSA. Higher risk items identified via RBI are given due priority.
* **Integrity Status and Deviations: FSR** – Integrity status and deviations can be viewed through the Facility Status Reporting tool, which helps visualize from SAP the SCE work orders and notifications by Barrier/SCE group at any level within the asset hierarchy, visualization of Production Critical Element (PCE) work orders and notifications by category such as metering, formal electronic deviation, Management of Change (MoC), and management of Hardware Barrier Analyses (HBA).
* **Corporate Risks: SAPL Risk Register** – corporate register of all risks to the business and which is fed from the Subsea Risk Register.

## Integrity Management Work Planning

The general principle is that subsea equipment will be inspected dependent on its integrity risk assessment. As inspection data is generated; the Risk Based Inspection (RBI) assessment is performed to ensure that the current mitigations are actively directed towards the most relevant threats to integrity. Higher confidence around equipment condition gained through inspection and online monitoring data will drive inspection intervals to be lengthened unless there is unexpected deterioration after the initial years of operation.

All Inspection requirements for the subsea system are documented in their respective Production Maintenance Libraries (PML) in accordance with the overall Prelude MIE process. The initial inspection interval has been determined by the Subsea Failure Mode and Effects Analysis (2000- 005-S001-GE00-G00000-RA-7180-00002) which was completed by the Project team prior to handover to the Asset team.

FMEA determined the initial inspection interval:

• The baseline inspection campaigns (Cold and Hot) were initially planned based on the initial inspection intervals

• Inspection data generated through execution is entered into IMSA for assessment

* IMSA will drive the RBI and anomaly management assessment to determine a new inspection interval or if Corrective Maintenance (CM) is required
* The new inspection interval will be generated and updated via Z6 in the Prelude CMMS (SAP)

## Definition of Battery Limits

The Battery limit commences immediately downstream of the production wing valve on the subsea trees, to the flange upstream of the Topsides Choke including the subsea pig launcher and associated valve or pig trap connection as this is not permanently installed on the FLNG facility. Subsea utility systems such as hydraulics and chemicals are also part of the scope.

The FLNG Hull, moorings, water intake risers (WIR) and topsides are not included within the scope of this document with the exception of parts of the flowloop system as listed in Section 2.3 above.

The tree valves and downhole well assets are not included within the scope of this document.

Figure 5 shows the main subsea asset boundaries and Figure 6 shows the topside asset boundaries.

## Rating System for Subsea Asset Integrity Status

The system shown below is based on the Standardized Rating System for Pipeline and Subsea Integrity Status developed in AMS Document MEC\_RP\_04-4.8\_v1.

The integrity evaluation of each subsea asset should lead to the integrity status being determined and rated in accordance with the following “traffic light” system:

Table 4 - Rating System for Subsea Integrity Status

|  |  |
| --- | --- |
| **STATUS** | **DEFINITION** |
| **RED** | **Subsea asset has an integrity issue1 resulting in an imminent2 risk of a loss of containment, or failure of the safeguarding system, and therefore requires immediate remedial action3 by the Asset Manager.**  This entails:   * Failure to meet the requirements of the relevant performance standards4, or equivalent, presenting and imminent risk to the subsea asset without risk management mitigation in place, includes but not limited to: * The Remaining Life5 of the subsea asset under current operating conditions is shorter than one year, * Non-age-related defects (e.g. dents, gouges, cracks/planar defects, spans) that have not been shown to be acceptable as per code. * A demonstration of subsea asset integrity6, based on available data, evidence and analysis is not possible. |
| **ORANGE** | **Subsea asset has an integrity issue1 (operating outside applicable code/standard) predicted within one to three years and requires remedial action3 within one year by the Asset Manager.**  This entails:   * The Remaining Life5 of the subsea asset under the current operating conditions is between one and three years. |
| **YELLOW** | **Subsea asset does not have an immediate risk of loss of containment but the integrity cannot be ensured for the life of the field/installation and requires remedial action3 by Maintenance Focal Point7.**  This entails:   * The Remaining Life5 of the subsea asset under the current operating conditions is between three years and the end of field life8 or life of the installation * Inspection history is insufficient to provide an adequate baseline. |
| **GREEN** | **Subsea asset is being actively managed in accordance with practices defined in the Subsea Operations and Maintenance Manuals, Prelude Subsea Asset Integrity Management Manual or equivalent.**  This entails:  The Remaining Life of the subsea asset under the current operating conditions is greater than the end of field life8 or life of the installation. |

Specific Notes:

1. **Integrity issues** are when the subsea asset is operating outside applicable code/standard including (but not limited to):
   1. Internal Corrosion
   2. External Corrosion
   3. Third Party Damage
   4. Mechanical Defects
   5. Failures of ancillary equipment
   6. Natural Causes (e.g. earthquakes, ice scour, subsidence, spanning)
   7. Operational Error
2. **Imminent** risk implies that now, or predicted within the next year, a process safety failure to the subsea asset might happen.
3. **Remedial actions** include, but are not limited to, one or more of the following such that the remaining life has been established to be greater than one year:
   1. Shut in and preserved
   2. More detailed assessment
   3. Containment barriers e.g. clamp
   4. Derate
   5. Repair
   6. Replace
   7. Rectification of subsea freespans
   8. Significant fabric maintenance
   9. Fixing serious underperformance or corrosion control
   10. Repair/replacement of anodes, rectifiers or isolation sets
   11. Change-out of ESDV
4. Pipelines and Subsea Assets Integrity related performance standards e.g. PC006, PC008, SD004, SD005, SD006 and SD007.
5. **Remaining Life** is the estimated period that the asset will remain safe to operate within the agreed defined envelope.
6. **RED** subsea assets should be further demarcated as follows:
   1. Immediate known risk of loss of containment as per point 2.
   2. Insufficient integrity information and conservatively assessed as YELLOW.
7. **Maintenance Focal Point** is the person responsible to the Asset Manager for ensuring maintenance actions are completed.
8. **End of Field Life** is defined as the date at which the asset will no longer be use for production as specified in the Asset Reference Plan.

# INTEGRITY STATUS

## Overall Summary of Subsea Integrity Status

The overall integrity of the subsea assets is good with details of minor integrity issues detailed in Section 4.2.

**Cathodic Protection Potential Summary for Manifolds and PLETS**

The cathodic protection potentials (CP) taken on structural steel have been mapped for the manifold areas and are presented in Figure 8 and Figure 9.

The legends of each diagram list the type of components on which the CP steel readings were taken. Each CP value plotted on the diagrams represents an averaged value for the CP measurements taken on each component, during the HBL survey. The acceptable range for the CP Steel measurements is -850mV to -1100mV, with the level of cathodic protection potential increasing as the values become more negative.

All the components of the Riser Base Manifold and PLETs show a high level of cathodic protection potential. The CP values more negative than -1050mV but are within the stated acceptable range of -850mV to -1150mV and are not an integrity concern.

The majority of the components of the Drill Center showed a CP range with values more positive than the RBM site, and all measurements were well within the acceptable range of -850mV to -1100mV. The only exceptions to this are the CP values associated with the PLET to suction anchor pile hold back chains, which are not cathodically protected and therefore show measurements that are less negative than the other Drill Center components. In addition to the chain CP’s, there is one outlier value on the isolation plate between the DC PLET 1 and the hold back chain to the suction anchor pile, which has a value of -1126mV. This value is well outside the acceptable range and should be rechecked during the next inspection campaign.

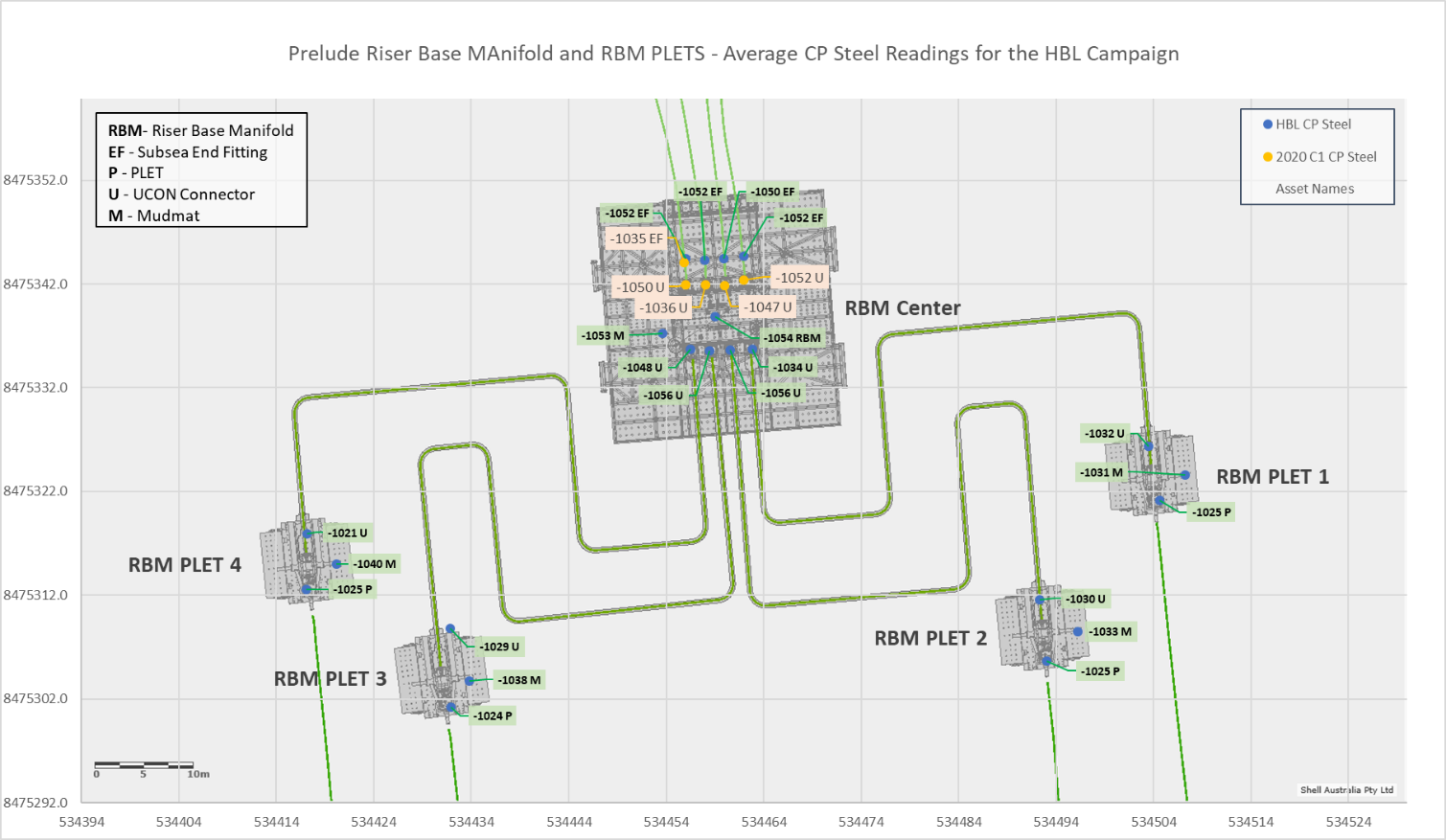


Figure 8 - RBM and RBM PLETS - Average CP Steel Readings, 2020 C1 and the HBL Campaign

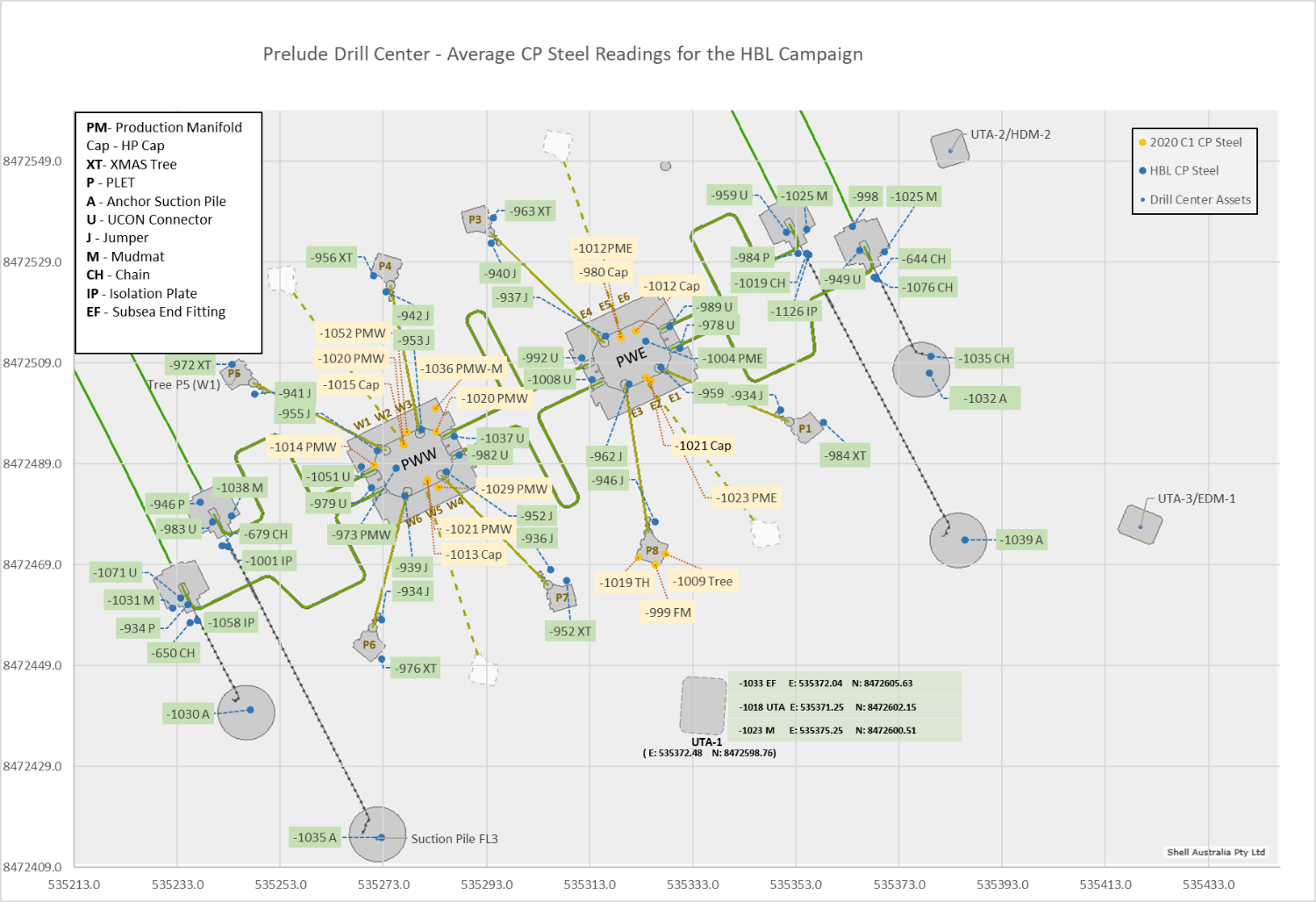


Figure 9 - Prelude Drill Center - Averaged CP Steel Readings, 2020 C1 and the HBL Campaign

## Detailed Integrity Status by Asset

The integrity status has been organized by asset type, generally from the results of the 2020 C1 inspection and the Hot Baseline survey, with additional integrity data included from previous inspections where relevant.

### Flowloop System

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| FLNG Turret – Subsea Related Piping & Valves | | | | | | | | | | | | |
| Subsea responsibility for integrity includes topside piping and valves upstream of the Risers Chokes.  These piping and associated valves are inspected and maintained by the MMI Department.  The visual inspection of the FLNG Turret, subsea related piping and valves was done 30 November 2020 under work orders 610999090, 1, 2 & 3. The results are summarised below and further details can be found in the referenced IMSA anomalies. | | | | | | | | | | | | |
| **Small Bore Piping and Valves** | Comments summarised for all 4 risers:  The valves were foung to be in good condition with all connections secure. The valve positions could not be determined during the visual inspection.  All stainless steel tubing was found to be in good condition | | | | | | | | | | | GREEN |
| **Hang Off Assemblies** | Minor areas of coating breakdown were noted on the hang off flanges with surface corrosion evident where the coating was removed. The most extensive protective coating deterioration was associated with the hang off assembly for Riser 05.  (IMSA Anomaly 21-0019, External Coating Damage/missing, Status: Open)  During the hang off assembly for Riser 05, one loose fastener was found.  (IMSA Anomaly 21-0020, Stud/nut Loose, Status: Open) | | | | | | | | | | | GREEN |
| **Flexible Riser Movement Above the Water Line** | The main concern with the risers, above water, is the positioning of the risers with respect to the I-tube sections at the Mid-Turret Installation deck and Installation deck. These areas are to be monitored for relative movement during poor Metcoean conditions.  Measurements were taken between the I-Tube (Dia.1000mm) and the risers (Dia.526mm) and will be repeated on an annual basis as a SAP routine maintenance plan.  There was no obvious damage to the umbilical due to contact with the I-Tubes.  (IMSA Anomaly 21-0011, Movement of Equpment, Status: Closed) | | | | | | | | | | | GREEN |
| Flexible Riser System | | | | | | | | | | | | |
| The 2020 C1 inspection of the production risers included a visual inspection of each riser and all of its components as well as a vertical profile of the Lazy Wave section showing the depths of the hog and the sag bends and the positions of all the ballast and buoyancy modules.  Each Production Riser comprises of:   * Termination Head UCON-H-12, connection to the RBM, with 6 anodes; * Subsea End-Fitting; * Bend Restrictor, including 5 segments and a reaction collar with 4 anodes; * Bracelet anodes x 6 bracelets with continuity wires; * Riser Heel Anchor, Clamp, and Hold-Back System x 2 chains, with 11 anodes; * Buoyancy Section x 23 modules; * Ballast Section x 44 modules and 16 stopper clamps; * Abrasion Layer, extending approximately 7m below the bend stiffener; * Bend Stiffener 4.597m in length; * Bend Stiffener Latching Mechanism (BSLM) via turret I-Tube & hang-off collar. * Riser dry section within the Turret   The detailed summary of findings is included in the following 4 sections:   * [Riser 05](#_Riser_05) * [Riser 06](#_Riser_06) * [Riser 07](#_Riser_07) * [Riser 08](#_Riser_08)   The vertical profile of each riser is recorded by an average of 38 location fixes along the riser with additional XYZ points taken on each major component, each buoyancy module and each ballast module. Table 5 summarises 4 main points along each riser that defines the profile of the Lazy Wave bend. The full profiles of each riser are included in the detail sections.  Notes on measurements (as shown in Table 5):  Measurement H1, between the Sag bend and the seabed, was calculated at between 64msw and 66msw for risers 5, 6 and 8, all within the design range of ~56msw to ~67msw, and **41msw for Riser No. 7**, which is out of range.  Measurement H2, between the FLNG hull and the riser Hog bend, ranged between 101msw and 111msw, for risers 5, 6 and 8, all within the design range of ~97msw to ~115msw, and **137msw for Riser No. 7**, which is out of range.  Measurement H3, between Buoyancy Device 23 and the seabed, ranged between 64msw and 73msw, for risers 5, 6 and 8, all within the design range of ~57msw1 to ~74msw, and **45msw for Riser No. 7**, which is out of range.  Measurement L2 and L3 were estimated from the ROV videos with the bend stiffeners all terminating at approximately 25msw and the abrasion sleeves terminating at an average of 31msw. | | | | | | | | | | | | |
| Table 5 - Riser Profiles Key Points Taken During 2020 C1 Inspection | | | | | | | | | | | | |
| **Riser**  **(position)**  **Hyperlinked to Vertical Profile** | **Touch Down Point (TDP)** | | | **Lazy Wave – H3**  **Buoyancy Module 23** | | | **Lasy Wave – H2**  **Hog Bend** | | | | **Lazy Wave – H1**  **Sag Bend** | |
| **KP**  **(km)** | | **Depth**  **(msw)** | **KP**  **(km)** | **H3 (Depth)**  **(msw)**  **Spec Range**  **[~57 to 74]** | | **KP**  **(km)** | **H2 (Depth)**  **(msw)**  **Specc Range**  **[no spec]** | | | **KP**  **(km)** | **H1 (Depth)**  **(msw)**  **Spec Range**  **[~56 to 67]** |
| [**05**](#_Riser_05) / (01) | 0.329 | | -244 | 0.384 | 67 (-167) | | 0.440 | 105 (-124) | | | 0.517 | 66 (- 180) |
| [**06**](#_Riser_06) / (02) | 0.338 | | -244 | 0.389 | 64 (-181) | | 0.442 | 111 (-134) | | | 0.504 | 64 (-181) |
| [07](#_Riser_07) / (03) | 0.361 | | -244 | 0.411 | 45 (-199) | | 0.434 | 137 (-156) | | | 0.501 | 41 (-204) |
| [**08**](#_Riser_08) / (04) | 0.332 | | -244 | 0.389 | 73 (-167) | | 0.440 | 101 (-120) | | | 0.509 | 66 (-179) |
| Configuration data dervied from GE Oil & Gas Document: 2000-UI3609-B01-00009\_04- Installed Configuration - 12" Production Riser R5-8 | | | | | | | | | | | | |
| BSLM Cathodic Protection Potentials:  Figure 10 summarises the Cathodic Protection Potential measurements taken just below the turret on the BSLM’s for the 4 risers and the umbilical. All of the CP measurements taken on the BSLM’s show good levels of cathodic protection and are within the acceptable range of -850mV to -1100mV.    Figure 10 - Prelude Turret BSLM - CP Steel Measurement for the 2020 C1 and HBL Campaigns | | | | | | | | | | | | |
| Riser Heel Anchor Cathodic Protection Potentials:  Figure 11 summarises the Cathodic Protection Potential measurements taken Riser Heel Anchors for the 4 risers. All measurements taken on the RHA were within acceptable range of -850mV to -1100mV.    Figure 11 – Riser Heel Anchor - CP Steel Measurement for the 2020 C1 and HBL Campaigns | | | | | | | | | | | | |
| **Riser 05** | | | | | | | | | | | | |
| The integrity of Riser 05 is summarized below, grouped by the inspection type. | | | | | | | | | | | | |
| **Type** | **Comments** | | | | | | | | | | | **Status** |
| **GVI** | In general, Production Riser 05 is in good condition. 2 findings were raised on the riser and the only one of concern is minor coating loss on the UCON-H-12 connector with possible surface corrosion. However, the CP measurement of -1052mV indicated a good level of cathodic protection potential. Monitoring required. | | | | | | | | | | | GREEN |
| **Anode** | **Anode Depletion** – 14 Anode depletion checks were done out of 27 anodes on all the ancillary components of the riser and all inspected anodes were found to be <25% depleted, secure and active. This include all 6 anodes on the UCON connector.  **Continuity Wires** were previously checked, during the HBL survey, on the guide frames, UCON, carrier handle, bracelet anodes x6, and the Riser Heel Clamp. All were in good condition and positively identified except for the RHA holdback clamp, which was buried. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | **CP Steel -** 3 measurements were taken: on the BSLM, the Riser Heel Anchor and the UCON-H-12 and the readings ranged from -1044mV to -1052mV, all within the acceptable range of -850mV to -1100mV.  The Riser Heel Anchor hold back clamp was buried and no CP’s could be taken on it. | | | | | | | | | | | GREEN |
| **Bolted Items** | All bolted flanges were checked at the I-tube to the BSLM and the end fitting for the UCON connector and all were found to be aligned, secure and intact. | | | | | | | | | | | GREEN |
| **Connector** | The UCON connector was checked on both sides and was found to be aligned, secure and intact.  During the 2020 C1 inspection, a discolouration at the 12 o’clock position on the collet connector was noted, which was not previously noted. | | | | | | | | | | | GREEN |
| **Displacement** | Possible displacement was noted due to the absence of marine growth in a band at the bottom of the bend stiffener. The band was approximately 25mm, evidenced by the gap in MG formation. This could indicate regular riser movement within the bend stiffener. The OEM and TA concluded that this was not an integrity issue.  (IMSA Anomaly 19-0053, Movement of Equipment, Status: Routine Monitoring, no change in 2020). | | | | | | | | | | | GREEN |
| **Span** | Minor spanning was seen either side of a riser support at KP0.004 and on the approach to the Riser Heel Anchor, where the riser sits in a centralized channel on the RHA. | | | | | | | | | | | GREEN |
| **Trenching** | Trenching of the seabed was noted at KP0.329, near the riser touchdown point. Trenching should be monitored but should not be an integrity concern. | | | | | | | | | | | GREEN |
| **Burial** | **HBL Survey: The riser static section** - in general was buried over 75% and was fully buried at 3 points, up to 20m in length.  **The RHA chains to the riser clamp** are buried within 2.5m of the RHA **(KP0.2059)** all the way to and including the clamp. | | | | | | | | | | | GREEN |
| **Scour** | **The Riser Heel Anchor Base** had scour up to 0.2m with all 4 corners being undermined by the scour. Although this does not appear to be an integrity issue currently, it should be monitored.  The **RHA** **Bullseye** was videoed showing 0.5° Quadrant 2 (previously1 degree to the North). However, this has not been trended further by comparing the previous readings. | | | | | | | | | | | GREEN |
| **Lazy Wave Configuration**  **(see** Figure 12 **for the overall vertical profile)** | Figure 12 shows the overall vertical profile, as presented in DOF Subsea Report 220283-FR-SV-CL-401-0007 (Client Doc # 2000-625-AA-7180-00012).  Buoyancy – All 23 buoyancy modules were secured and in their designated positions.  Ballast Module and Stopper Clamps – All the Ballast strings appeared to be secure with all of the ballast modules being secured by bandit straps and the stopper clamps having bolted clamps. Stopper clamps 1 through 14 are separated by 3 ballast modules and stopper clamps 15 and 16 are separate by 2 ballast module each.  Anomaly 21-0003 /Stopper Clamp No.07, 09 and 15 have ‘string-like debris’ is possibly damage to the securing bands on the stopper clamps. This possible failure mechanism is presently GREEN and will require further monitoring on subsequent surveys to see if this appears on similar clamps. | | | | | | | | | | | GREEN |
| **Stopper Clamps with possible deterioration:**  No.07 at 153 msw  No.09 at 160 msw  No.16 at 178 msw  Figure 12 - Riser 5 Vertical profile, 2020 C1 vs. HBL Survey | | | | | | | | | | | | |
| **Riser 06** | | | | | | | | | | | | |
| The integrity of Riser 06 is summarized below, grouped by the inspection type. | | | | | | | | | | | | |
| **GVI** | In general, Production Riser 06 is in good condition. 2 minor findings were raised on the riser UCON connector: discolouration of the coating at the 12 o’clock position and protective coatings removed on the mandrel. No signs of corrosion visible and the CP Steel measurement taken in the vicinity of the 12 o’clock position was -1039mV, indicating good protection. | | | | | | | | | | | GREEN |
| **Anode** | **Anode Depletion** – 10 Anode depletion checks were done, representing 21 anodes, on all the ancillary components of the riser and all anodes were found to be <25% depleted, secure and active. The anodes on the Riser Heel Anchor Clamp are buried and could not be assessed and the UCON anodes are inaccessible on Riser 6.  **Continuity wires** were checked on the guide frames, UCON, carrier pipe locking handle, bracelet anodes x 6, and the Riser Heel Clamp. All were in good condition and positively identified except for the RHA holdback clamp, which was buried. | | | | | | | | | | | GREEN |
| **Cathodic Protection Measure-ments** | **CP Anode –** 1 measurement was taken on a Bracelet Anode, during the HBL, at KP 0.2253 (-1072mV).  **CP Steel -** 4 measurements were taken; on an anode clamp at KP 0.225, on the BSLM, the Riser Heel Anchor and the UCON-H-12 and the readings ranged from -1039mV to -1054mV. The Riser Heel Anchor hold back clamp was buried and no CP readings could be taken on it. | | | | | | | | | | | GREEN |
| **Bolted Items** | All bolted flanges were checked at the I-Tube to the BSLM and the end fitting for the UCON connector and all were found to be aligned, secure and intact. | | | | | | | | | | | GREEN |
| **Connector** | The UCON connector was checked on both sides and was found to be aligned, secure and intact.  During the 2020 C1 inspection, a discolouration at the 12 o’clock position, on the collet connector was noted, which was not previously noted. | | | | | | | | | | | GREEN |
| **Displacement** | Possible displacement was noted due to the absence of marine growth in a band at the bottom of the bend stiffener. The band was approximately 25mm, evidenced by the gap in marine growth formation. This could indicate regular riser movement within the bend stiffener. The OEM and TA concluded that this was not an integrity issue.  (IMSA Anomaly 19-0053, Movement of Equipment, Status: Routine Monitoring, no change in 2020). | | | | | | | | | | | GREEN |
| **Span** | Minor spanning was seen either side of a riser support at KP 0.004. The longest span was 6m upstream of the riser support. | | | | | | | | | | | GREEN |
| **Trenching** | Trenching of the seabed was observed near the touch down point at KP 0.338. Trenching should be monitored but is a normal condition and should not be an integrity concern. | | | | | | | | | | | GREEN |
| **Burial** | **The riser static section** in general is buried over 75% and was fully buried at 3 points. From KP0.112 to KP0.188 the riser was buried 50 to 75%.  **The RHA chains to the riser clamp** are buried within 2.0m of the RHA (KP 0.1933) all the way to and including the clamp. | | | | | | | | | | | GREEN |
| **Scour** | **The Riser Heel Anchor Base** was scoured up to 0.15m with all 4 corners being undermined by the scour. Although this does not appear to be an integrity issue, it should be monitored.  The **RHA** **Bullseye** was videoed showing <0.5° Quadrant 1 (0.5 degree to the Northwest). However, this has not been trended by comparing with previous readings. | | | | | | | | | | | GREEN |
| **Lazy Wave Configuration (see** Figure 13 **for overall vertical profile)** | **Figure 13**  shows the overall vertical profile, as presented in DOF Subsea Report 220283-FR-SV-CL-401-0007 (Client Doc # 2000-625-AA-7180-00012).  **Buoyancy** – All 23 buoyancy modules were secured and in their designated positions.  **Ballast Module and Stopper Clamps** – All the Ballast strings appeared to be secure with all of the ballast modules being secured by bandit straps and the stopper clamps having bolted clamps. Stopper clamps 1 through 14 are separated by 3 ballast modules and stopper clamps 15 and 16 are separate by one ballast module each. | | | | | | | | | | | GREEN |
| Figure 13 - Riser 6 Vertical Profile, 2020 C1 vs. HBL Survey | | | | | | | | | | | | |
| **Riser 07** | | | | | | | | | | | | |
| The integrity of Riser 07 is summarized below, grouped by the inspection type. | | | | | | | | | | | | |
| **GVI** | In general, Production Riser 07 is in good condition. 2 findings were raised on the riser and the only one of concern is on an area of abraded marine growth on the mitre bend, approximately 150mm x 150mm, location relative to turret orientation ~135°. It appears to be to bare metal. There are no signs of corrosion visible and the CP Steel measurement taken in the vicinity was -1026mV, indicating good protection (IMSA Anomaly 19-0046, Bare Metal Exposure, Status: Routine Monitoring). | | | | | | | | | | | GREEN |
| **Anode** | **Anode Depletion** – 15 Anode depletion checks were done, representing 21 anodes, on all the ancillary components of the riser and all anodes were found to be <25% depleted, secure and active. Note: the anodes on the UCON are inaccessible for Riser 7.  **Continuity Wires** were checked on the guide frames, UCON, carrier pipe locking handle, bracelet anodes x 6, and the Riser Heel Anchor Clamp. All were in good condition and positively identified except for the RHA clamp, which was buried. | | | | | | | | | | | GREEN |
| **Cathodic Protection Measure-ments** | **CP Anode -** 1 measurement was taken on a Bracelet Anode at KP 0.226, during the HBL survey, and the reading was -1071mV, indicating good protection.  **CP Steel -** 3 measurements were taken: on the BSLM, the Riser Heel Anchor and the UCON-H-12 and the readings ranged from -1019mV to -1054mV, indicating good protection.  The Riser Heel Anchor hold bank clamp was buried and no CP readings could be taken on it. | | | | | | | | | | | GREEN |
| **Bolted Items** | All bolted flanges were checked at the I-Tube to the BSLM and the end fitting for the UCON connector and all were found to be aligned, secure and intact. | | | | | | | | | | | GREEN |
| **Connector** | The UCON connector was checked and found to be aligned, secure and intact with no relative movement apparent. Discolouration was seen on the collet connector at the 12 o’clock position, the cause is unknown. however the CP potential of -1019mV showed good protection against corrosion. | | | | | | | | | | |  |
| **Displacement** | Possible displacement was noted due to the absence of marine growth in a band at the bottom of the bend stiffener. The band was approximately 15mm, evidenced by the gap in marine growth formation. This could indicate regular riser movement within the bend stiffener. The OEM and TA concluded that this was not an integrity issue. No change was seen during the 2020 C1 inspection.  (IMSA Anomaly 19-0053, Movement of Equipment, Status: Closed) | | | | | | | | | | | GREEN |
| **Span** | Minor spanning was seen either side of a riser support at KP 0.004. The longest span was 7m upstream of the riser support. | | | | | | | | | | | GREEN |
| **Trenching** | Trenching of the seabed was noted near the touch down point at KP 0.361. Trenching should be monitored but is a normal condition and should not be an integrity concern. | | | | | | | | | | | GREEN |
| **Burial** | **The riser static section** in general is buried over 75% to 100% and was fully buried at 6 points.  **The RHA chains to the riser clamp** are buried within 2.5m of the RHA (KP 0.204) all the way to and including the clamp. | | | | | | | | | | | GREEN |
| **Scour** | **The Riser Heel Anchor base** was scoured up to 0.1m with all 4 corners being undermined by the scour. Although this does not appear to be an integrity issue, it should be monitored.  The **RHA** **Bullseye** was videoed showing 0.5° Quadrant 2 (1 degree to the Northwest). However, this has not been trended by comparing the previous readings. | | | | | | | | | | | GREEN |
| **Lazy Wave Configuration (see** Figure 14 **for overall vertical profile)** | **Figure 14** shows the overall vertical profile, as presented in DOF Subsea Report 220283-FR-SV-CL-401-0007 (Client Doc # 2000-625-AA-7180-00012).  **Buoyancy** – All 23 buoyancy modules were secured and in their designated positions.  **Ballast Module and Stopper Clamps** – All the Ballast strings appeared to be secure with all of the ballast modules being secured by bandit straps and the stopper clamps having bolted clamps. Stopper clamps 1 through 14 are separated by 3 ballast modules and stopper clamps 15 and 16 are separate by 2 ballast module each.  The differential between the 2020 C1 and the HBL vertical profile is due to a change in the riser content. In 2020, Flowline 03 was found to have a hydrate blockage, and the riser has been flooded with Methyl Ethylene Glycol (MEG) causing the profile to lower by about 20msw compard to the 2019 measured profile. Consequently, the touchdown point has changed as illustrated in Figure 14. Although this profile is explainable and does not appear to be an immediate concern, it is ouside the design envelope for operating condition. Presently the Riser is isolated and unavailable.  (IMSA Anomaly 21-0015, Flow Restriction, Blockage, Status: Routine Monitoring  See also related IMSA Anomaly 20-0027, for Flowline 03 Potential Hydrate Blockage, Status: Open) | | | | | | | | | | | GREEN |
| Figure 14 - Riser 7 Vertical Profile (msw) , 2020 C1 vs. HBL Survey | | | | | | | | | | | | |
| **Riser 08** | | | | | | | | | | | | |
| The integrity of Riser 08 is summarized below, grouped by the inspection type. | | | | | | | | | | | | |
| **GVI** | In general, Production Riser 08 is in good condition. 3 findings were raised on the riser and the only one of concern.  The finding is on the Subsea End Fitting Continuity cable at the 12 o'clock position which is detached from the end fitting (see Continuity Wires entry below). | | | | | | | | | | | GREEN |
| **Anode** | **Anode Depletion** – 15 Anode depletion checks were done, representing 27 anodes, on all the ancillary components of the riser and all inspected anodes were found to be <25% depleted, secure and active. This includes all 6 anodes on the UCON connector. | | | | | | | | | | | GREEN |
| **Continuity Wires** | **Continuity Wires** were checked on the guide frames, UCON, carrier pipe locking handle, bracelet anodes x 6, and the Riser Heel Clamp. All were in good condition and positively identified except for the RHA clamp, which was buried and had one **disconnected continuity wire**, as described below.  The finding is on the Subsea End Fitting Continuity Cable at the 12 o'clock position, which is detached from the end fitting. This is one of 4 continuity cables running between the 6 anode bracelets and the Bend Restrictor Reaction Collar. The second adjacent cable is intact and the CP on the end fitting is -1052mV, indicating good protection.  (IMSA Anomaly 19-0048, CP System Failure, Status: Routine Monitoring). | | | | | | | | | | | YELLOW |
| **Cathodic Protection Measure-ments** | **CP Steel -** 3 measurements were taken: on the BSLM, the Riser Heel Clamp and the UCON-H-12 and the readings ranged from -1034mV to -1053mV, indicating good protection.  The Riser Heel Anchor hold back clamp was buried and no CP readings could be taken on it. | | | | | | | | | | | GREEN |
| **Riser Heel Anchor Chains to the RHA Clamp** | There is a differential tension on the RHA chains to the RHA clamp. This raises a concern as to the possibility of unbalanced forces on the RHA clamp, which could result in torsional forces on the riser. An anomaly was raised on this issue and subsequently closed as the apparent chain tensions have remained the same in 3 successive surveys: February 2018, September 2019 and November 2020.  (IMSA Anomaly 19-0067, Riser 8 Heel Anchor chain to the heel anchor clamp, uneven chain tension, Status: Closed). | | | | | | | | | | | GREEN |
| **Bolted Items** | All bolted flanges were checked at the I-Tube to the BSLM and the end fitting for the UCON connector and all were found to be aligned, secure and intact. | | | | | | | | | | | GREEN |
| **Connector** | The UCON connector was checked and found to be aligned, secure and intact with no relative movement apparent. | | | | | | | | | | |  |
| **Displacement (Bend Stiffener)** | No displacement was noted at the bottom of the bend stiffener as was reported on the other 3 risers.  (IMSA Anomaly 19-0053, Movement of Equipment, Status: Routine Monitoring, no change in 2020). | | | | | | | | | | | GREEN |
| **Span** | Minor spanning was seen either side of a riser support at KP 0.004. The longest span was 7m downstream of the riser support. A 3.5m span was also reported at the approach to the Riser Heel Anchor at KP 0.1985 | | | | | | | | | | | GREEN |
| **Trenching** | Trenching of the seabed was noted near the touch down point at KP 0.332. Trenching should be monitored but is a normal condition and should not be an integrity concern. | | | | | | | | | | | GREEN |
| **Displacement (Riser)** | Previous minor displacements of the static riser section, on the order of 0.2m, were no longer visible and have most likely backfilled. | | | | | | | | | | | GREEN |
| **Burial** | **Burial (Linear) - The riser**, in general is buried over 75% to 100% from the RBM to KP0.332.  **Burial (Structural) - The RHA chains to the riser clamp** are buried within 3m of the RHA (KP 0.1985) all the way to and including the clamp.  **The Riser Heel Anchor Skirts** were reported to be 90% buried to 0.3m with only the top of the beams visible. | | | | | | | | | | | GREEN |
| **Scour** | **The Riser Heel Anchor Base** was scoured up to 0.2m with all 4 corners being undermined by the scour. Although this does not appear to be an integrity issue, it should be monitored.  The **RHA** **Bullseye** was videoed showing 0.5° Quadrant 2 (0.5 degrees to the Northwest). However, this has not been trended by comparing with previous readings. | | | | | | | | | | | GREEN |
| **Lazy Wave Configuration** | Figure 15 shows the overall vertical profile, as presented in DOF Subsea Report 220283-FR-SV-CL-401-0007 (Client Doc # 2000-625-AA-7180-00012).  Note: The Survey data for the cold baseline survey was not available for plotting and the image from page 97 of the “C4A Baseline Survey (Cold) During the CSU Inspection Report” was used as the cold baseline riser profile with the hot baseline survey data overlaid to the correct scale.  **Buoyancy** – All 23 buoyancy modules were secured and in their designated positions.  **Ballast Module and Stopper Clamps** – All the Ballast strings appeared to be secure with all of the ballast modules being secured by bandit straps and the stopper clamps with bolted clamps. Stopper clamps 1 through 14 are separated by 3 ballast modules and stopper clamps 15 and 16 are separate by one ballast module each. | | | | | | | | | | | GREEN |
| Figure 15 - Riser 8 Vertical Profiles, 2020 C1 vs. HBL Survey | | | | | | | | | | | | |
| Flowloop Jumpers | | | | | | | | | | | | |
| Visual inspection of the jumpers was completed during the 2019 Hot Baseline Inspection (HBL) and all data included here is from the HBL with the exception of references to previously raised anomalies.  The following jumpers have been included in this section:  4.2.1.3.1 [Manifold Jumper 01](#_Manifold_Jumper_01) – between Production Manifolds West & East  4.2.1.3.2 [Manifold Jumper 02](#_Manifold_Jumper_02) – between Production Manifolds West & East  4.2.1.3.3 [PM-E Flowline Jumper 01](#_PM_Flowline_Jumper_1) – between PM-East & DC PLET 1  4.2.1.3.4 [PM-E Flowline Jumper 02](#_PM_Flowline_Jumper_2) – between PM-East & DC PLET 2  4.2.1.3.5 [PM-W Flowline Jumper 03](#_PM_Flowline_Jumper_3) – between PM-West & DC PLET 3  4.2.1.3.6 [PM-W Flowline Jumper 04](#_PM_Flowline_Jumper) – between PM-West & DC PLET 4  4.2.1.3.7 [RBM Flowline Jumper 01](#_RBM_Flowline_Jumper_1) – between RBM PLET1 & RBM  4.2.1.3.8 [RBM Flowline Jumper 02](#_RBM_Flowline_Jumper_2) – between RBM PLET2 & RBM  4.2.1.3.9 [RBM Flowline Jumper 03](#_RBM_Flowline_Jumper_3) – between RBM PLET3 & RBM  4.2.1.3.10 [RBM Flowline Jumper 04](#_RBM_Flowline_Jumper) – between RBM PLET4 & RBM | | | | | | | | | | | | |
| **Manifold Jumper 01** | | | | | | | | | | | | |
| Figure 16 - Manifold Jumper 01 with Numbered Horizontal Bends | | | | | | | | | | | | |
| The jumper configuration is as follows:   * UCON-H-12 (PM-W) (Elev.+2.1m) * Horizontal pipe * Vertical 45⁰ Bends 1 & 2 (touchdown) * Horizontal 90⁰ Bends 3, 4, 5 & 6 (on seabed) * Vertical 45⁰ Bends 7 (touchdown) & 8 * Horizontal pipe * UCON-H-12 (PM-E) (Elev. +2.1m) | | | | | | | | | | | | |
| **GVI** | In general, the manifold jumper is in good condition and no findings were raised. | | | | | | | | | | | GREEN |
| **Anode** | UCON-H-12 (PM-E) and UCON-H-12 (PM-W) have 6 sacrificial anodes each. All anodes were found to be active, secure and <25% depleted. | | | | | | | | | | | GREEN |
| **Connector** | UCON-H-12 (PM-E) and UCON-H-12 (PM-W) were aligned and secure and no relative movement was evident. Both of the carrier pipe locking handles were found in the unlocked position (FMC clarified that this is not an integrity issue, no anomaly raised). | | | | | | | | | | | GREEN |
| **Continuity Cables** | UCON-H-12 (PM-E) and UCON-H-12 (PM-W) each have 4 bolted, single continuity cables: Guide Frame N, S & Underside and on the carrier pipe locking handle. All continuity cables were found to be in good condition, attached and visible. | | | | | | | | | | | GREEN |
| **Cathodic Potential** | CP Steel readings, one each on the connectors, showed good cathodic protection.  UCON-H-12 (PM-E) – CP measurement is -1008mV  UCON-H-12 (PM-W) – CP measurement is -982mV | | | | | | | | | | | GREEN |
| **Seabed Condition** | (as per the following table and Figure 16)  The seabed is mainly silt/sand. | | | | | | | | | | | GREEN |
| **Component** | | **Spanning** | | | | **Burial** | | | | **Comment** | | |
| V45⁰ Bend 1 | | Elevation 2.1m | | | | - | | | | Span for 6m | | |
| V45⁰ Bend 2 | | Seabed | | | | 75% to 100% | | | | on seabed | | |
| H 90⁰ Bend 3 | | Seabed | | | | 75% to 100% | | | | Jumper is buried for most of the distance between Bend 3 and Bend 6 | | |
| H 90⁰ Bend 4 | | Seabed | | | | Buried | | | |
| H 90⁰ Bend 5 | | Seabed | | | | Buried | | | |
| H 90⁰ Bend 6 | | Seabed | | | | 75% to 100% | | | |
| V45⁰ Bend 7 | | Seabed | | | | 75% to 100% | | | | on seabed | | |
| V45⁰ Bend 8 | | Elevation 2.1m | | | | - | | | | Span for 4m | | |
| **Manifold Jumper 02** | | | | | | | | | | | | |
| Figure 17 - Manifold Jumper 02 with Numbered Horizontal Bends | | | | | | | | | | | | |
| The jumper configuration is as follows:   * UCON-H-12 (PM-W) (Elev.+2.1m) * Horizontal pipe * Vertical 45⁰ Bends 1 & 2 (touchdown) * Horizontal 90⁰ Bends 3, 4, 5 & 6 (on seabed) * Vertical 45⁰ Bends 7 (touchdown) & 8 * Horizontal pipe * UCON-H-12 (PM-E) (Elev.+2.1m) | | | | | | | | | | | | |
| **GVI** | In general, the manifold jumper is in good condition and one finding was raised on a detached continuity cable, as described below. | | | | | | | | | | | GREEN |
| **Anode** | UCON-H-12 (PM-E) and UCON-H-12 (PM-W) have 6 sacrificial anodes each. All anodes were found to be active, secure and <25% depleted. | | | | | | | | | | | GREEN |
| **Connector** | UCON-H-12 (PM-E) and UCON-H-12 (PM-W) were aligned and secure and no relative movement was evident. Both of the carrier pipe locking handles were found in the unlocked position (FMC clarified that this is not an integrity issue, no anomaly raised). | | | | | | | | | | | GREEN |
| **Continuity Cables** | UCON-H-12 (PM-E) and UCON-H-12 (PM-W) each have 4 bolted, single continuity cables: Guide Frame N, S & Underside and on the Carrier pipe locking handle. All but one of the continuity cables were found to be in good condition, attached and visible.  The PMW UCON Carrier Pipe Locking Handle Continuity Cable was detached from the Guide Frame Assembly. This was previously noted in 2018 during Campaign 4A. No significant change was noted. Discoloration was observed on the Locking Handle Bolt, and a CP reading of -943mV was obtained confirming that the handle is protected from corrosion.  (IMSA Anomaly 18-0005, CP System Failure, STATUS: Closed) | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel, one each on the connectors and one additional CP check, showing good cathodic protection.  UCON-H-12 (PM-E) – CP measurement is -992mV  UCON-H-12 (PM-W) – CP measurement is -1037mV  UCON-H-12 (PM-W) carrier pipe locking handle, CP -943mV | | | | | | | | | | | GREEN |
| **Seabed Condition** | (as per the following table and Figure 17)  The seabed is mainly silt/sand. | | | | | | | | | | | GREEN |
| **Component** | | **Spanning** | | | | **Burial** | | | | **Comment** | | |
| V45⁰ Bend 1 | | Elevation 2.1m | | | | - | | | | Span for 11m | | |
| V45⁰ Bend 2 | | Seabed | | | | 75% to 100% | | | | Partially buried | | |
| H 90⁰ Bend 3 | | Seabed | | | | 75% to 100% | | | | Jumper is buried for most of the distance between Bend 3 and Bend 4 and between Bend 5 and Bend 6 | | |
| H 90⁰ Bend 4 | | Seabed | | | | 75% to 100% | | | |
| H 90⁰ Bend 5 | | Seabed | | | | 75% to 100% | | | |
| H 90⁰ Bend 6 | | Seabed | | | | 75% to 100% | | | |
| V45⁰ Bend 7 | | Seabed | | | | 75% to 100% | | | | on seabed | | |
| V45⁰ Bend 8 | | Elevation 2.1m | | | | - | | | | Span for 5m | | |
| **PM Flowline Jumper 01** | | | | | | | | | | | | |
| Figure 18 - PM Flowline Jumper 01 with Numbered Horizontal Bends | | | | | | | | | | | | |
| The jumper configuration is as follows:   * UCON-H-12 (PM-E) (Elev.+2.1m) * Horizontal pipe * Vertical 45⁰ Bends 1 & 2 (touchdown) * Horizontal 90⁰ Bends 3 & 4 (on seabed) * Horizontal 70⁰ Bends 5 & 6 (on seabed) * Vertical 45⁰ Bends 7 touchdown) & 8 * Horizontal 90⁰ Bend 9 (Elev.+2.1m) * Horizontal pipe * UCON-H-12 (DC PLET 1) (Elev.+2.1m) | | | | | | | | | | | | |
| **GVI** | In general, the flowline jumper is in good condition and no findings were raised on this jumper. | | | | | | | | | | | GREEN |
| **Anode** | UCON-H-12 (PM-E) and UCON-H-12 (DC PLET1) have 6 sacrificial anodes each. All anodes were found to be active, secure and <25% depleted. | | | | | | | | | | | GREEN |
| **Connector** | UCON-H-12 (PM-E) and UCON-H-12 (DC PLET1) were aligned and secure and no relative movement was evident. Both of the carrier pipe locking handles were found in the unlocked position (FMC clarified that this is not an integrity issue, no anomaly raised). | | | | | | | | | | | GREEN |
| **Continuity Cables** | UCON-H-12 (PM-E) and UCON-H-12 (DC PLET1) each have 4 bolted, single continuity cables: Guide Frame N, S & Underside and on the carrier pipe locking handle. All of the continuity cables were found to be in good condition, attached and visible. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel readings, one each on the connectors, showed good cathodic protection.  UCON-H-12 (DC PLET1) – CP measurement is -949mV.  UCON-H-12 (PM-E) – CP measurement is -978mV. | | | | | | | | | | | GREEN |
| **Crossings (over the jumper)** | SFL F/PME is in contact with the jumper, no movement or damage apparent.  DC PLET2 Hold Back Chain, in a sleeve that is supported by 3 buoyancy modules. The sleeve is in contact with the jumper with no signs of abrasion or relative movement. However, it is expected that there will be future relative movement bwtween the jumper and the chain sleeve. | | | | | | | | | | | GREEN |
| **Seabed Condition** | (as per the following table and Figure 18)  The seabed is mainly silt/sand. Due to the movement of the PLET, caused by the thermal expansion/contraction of the flowline, there is evidence of trenching of the seabed on the Northwest side of the jumper from Horizontal Bend 3 to the PLET. This is normal for the expansion spool/jumper. | | | | | | | | | | | GREEN |
| **Component** | | **Spanning** | | | | **Burial** | | | | **Comment** | | |
| V45⁰ Bend 1 | | Elevation 2.1m | | | | - | | | | Span for 5m | | |
| V45⁰ Bend 2 | | Seabed | | | | 75% to 100% | | | | On seabed | | |
| H 90⁰ Bend 3 | | Seabed | | | | 75% to 100% | | | | Jumper is buried for most of the distance between Bend 3 and Bend 4 but, the remaining sections on the seabed show some displacement. | | |
| H 90⁰ Bend 4 | | Seabed | | | | 75% to 100% | | | |
| H 70⁰ Bend 5 | | Seabed | | | | 75% to 100% | | | |
| H 70⁰ Bend 6 | | Seabed | | | | 75% to 100% | | | |
| V45⁰ Bend 7 | | Seabed | | | | 75% to 100% | | | | on seabed | | |
| V45⁰ Bend 8 | | Elevation 2.1m | | | | - | | | | Span for 8m | | |
| H 90⁰ Bend 9 | | Elevation 2.1m | | | | - | | | |  | | |
| **PM Flowline Jumper 02** | | | | | | | | | | | | |
| Figure 19 - PM Flowline Jumper 02 with Numbered Horizontal Bends | | | | | | | | | | | | |
| The jumper configuration is as follows:   * UCON-H-12 (PM-E) (Elev.+2.1m) * Horizontal pipe * Vertical 45⁰ Bends 1 & 2 (touchdown) * Horizontal 90⁰ Bends 3 & 4 (on seabed) * Horizontal 90⁰ Bend 5 & 6 (on seabed) * Vertical 45⁰ Bends 7(touc3hdown) & 8 * Horizontal 90⁰ Bend 9 (Elev.+2.1m) * Horizontal pipe * UCON-H-12 (DC PLET 2) (Elev.+2.1m) | | | | | | | | | | | | |
| **GVI** | In general, the flowline jumper is in good condition and no findings were raised on this jumper. | | | | | | | | | | | GREEN |
| **Anode** | UCON-H-12 (PM-E) and UCON-H-12 (DC PLET2) have 6 sacrificial anodes each. All anodes were found to be active, secure and <25% depleted. | | | | | | | | | | | GREEN |
| **Connector** | UCON-H-12 (PM-E) and UCON-H-12 (DC PLET2) were aligned and secure and no relative movement was evident. Both of the carrier pipe locking handles were found in the unlocked position (FMC clarified that this is not an integrity issue, no anomaly raised). | | | | | | | | | | | GREEN |
| **Continuity Cables** | UCON-H-12 (PM-E) and UCON-H-12 (DC PLET2) each have 4 bolted, single continuity cables: Guide Frame N, S & Underside and on the carrier pipe locking handle. All of the continuity cables were found to be in good condition, attached and visible. However, there was no event logged for the continuity wire at the underside of the Guide Frame assembly. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel, one each on the connectors, showed good cathodic protection.  UCON-H-12 (DC PLET2) - CP measurement is -959mV  UCON-H-12 (PM-E) - CP measurement is -989mV | | | | | | | | | | | GREEN |
| **Crossings (over the jumper)** | SFL F/PME and EFL/EDM-PME (A & B) in contact with the jumper and no movement or abrasion is apparent. All 3 are in a group, within a meter of each other. | | | | | | | | | | |  |
| **Seabed Condition** | (as per the following table and Figure 19)  The seabed is mainly silt/sand. Due to movement caused by the thermal expansion/contraction of the flowline, there is evidence of trenching of the seabed either side of the jumper from Horizontal Bend 3 to the PLET. This is normal for the expansion spool/jumper. | | | | | | | | | | | GREEN |
| **Component** | | **Spanning** | | | | **Burial** | | | | **Comment** | | |
| V45⁰ Bend 1 | | Elevation 2.1m | | | | - | | | | Span for 6m, 1.1m span height | | |
| V45⁰ Bend 2 | | Seabed | | | | 75% to 100% | | | | On seabed | | |
| H 90⁰ Bend 3 | | Seabed | | | | 75% to 100% | | | | Jumper is 100% buried for a 2 m distance between Bend 5 and Bend 6. The remaining sections on the seabed show evidence of displacement caused by thermal expansion/contraction. | | |
| H 90⁰ Bend 4 | | Seabed | | | | 75% to 100% | | | |
| H 90⁰ Bend 5 | | Seabed | | | | 75% to 100% | | | |
| H 90⁰ Bend 6 | | Seabed | | | | 75% to 100% | | | |
| V45⁰ Bend 7 | | Seabed | | | | 75% to 100% | | | | on seabed | | |
| V45⁰ Bend 8 | | Elevation 2.1m | | | | - | | | | Span for 8m, 1.2m span height | | |
| H 90⁰ Bend 9 | | Elevation 2.1m | | | | - | | | |  | | |
| **PM Flowline Jumper 03** | | | | | | | | | | | | |
| Figure 20 - PM Flowline Jumper 03 with Numbered Horizontal Bends | | | | | | | | | | | | |
| The jumper configuration is as follows:   * UCON-H-12 (PM-W) (Elev.+2.1m) * Horizontal pipe * Vertical 45⁰ Bends 1 & 2 (touchdown) * Horizontal 90⁰ Bends 3 & 4 (on seabed) * Horizontal 90⁰ Bends 5 & 6 (on seabed) * Vertical 45⁰ Bends 7(touchdown) & 8 * Horizontal 90⁰ Bend 9 (Elev.+2.1m) * Horizontal pipe * UCON-H-12 (DC PLET 3) (Elev.+2.1m) | | | | | | | | | | | | |
| **GVI** | In general, the flowline jumper is in good condition. 2 findings were raised on this jumper. The one finding that is of interest is included in the Coating-Insulation section below and is a concern regarding coating deterioration on a UCON connector. | | | | | | | | | | | GREEN |
| **Anode** | UCON-H-12 (PM-W) and UCON-H-12 (DC PLET 3) have 6 sacrificial anodes each. All anodes were found to be active, secure and <25% depleted. | | | | | | | | | | | GREEN |
| **Connector** | UCON-H-12 (PM-W) and UCON-H-12 (DC PLET 3) were aligned and secure and no relative movement was evident. Both of the carrier pipe locking handles were found in the unlocked position (FMC clarified that this is not an integrity issue, no anomaly raised). | | | | | | | | | | | GREEN |
| **Continuity Cables** | UCON-H-12 (PM-W) and UCON-H-12 (DC PLET 3) each have 4 bolted, single continuity cables: Guide Frame N, S & Underside and on the carrier pipe locking handle. All of the continuity cables were found to be in good condition, attached and visible. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel readings, one each on the connectors, showed good cathodic protection.  UCON-H-12 (DC PLET 3) – CP measurement is -983mV.  UCON-H-12 (PM-W) – CP measurement is -1051mV. | | | | | | | | | | | GREEN |
| **Coating Insulation Observation** | Degraded coating was found on the UCON-H-12 (PM-W), between 12 and 4 o'clock, approximately 300mm x 30mm. No other damage observed.  (IMSA Anomaly 20-0020, Coating disbondment at the junction between the flowline jumper and the PM-West UCON Connecter, Status: Routine Monitoring). | | | | | | | | | | | GREEN |
| **Crossings (over the jumper)** | EFL/EDM-PMW (A & B) are in contact with the jumper and no movement or abrasion is apparent. | | | | | | | | | | | GREEN |
| **Seabed Condition** | (as per the following table and Figure 20)  The seabed is mainly silt/sand. Due to movement caused by the thermal expansion/contraction of the flowline, there is significant evidence of trenching of the seabed either side of the jumper from Horizontal Bend 3 to the PLET. This is normal for the expansion spool/jumper. | | | | | | | | | | | GREEN |
| **Component** | | **Spanning** | | | | **Burial** | | | | **Comment** | | |
| V45⁰ Bend 1 | | Elevation 2.1m | | | | - | | | | Span for 5m, 1.2m span height | | |
| V45⁰ Bend 2 | | Seabed | | | | 75 - 100% | | | | On seabed | | |
| H 90⁰ Bend 3 | | Seabed | | | | 75 - 100% | | | | The jumper is partially buried throughout. The remaining sections on the seabed show evidence of displacement and minor trenching of the seabed caused by thermal expansion/contraction, most pronounced between Bend 4 and Bend 5. | | |
| H 90⁰ Bend 4 | | Seabed | | | | 75 - 100% | | | |
| H 90⁰ Bend 5 | | Seabed | | | | 75 - 100% | | | |
| H 90⁰ Bend 6 | | Seabed | | | | 75 - 100% | | | |
| V45⁰ Bend 7 | | Seabed | | | | 75 - 100% | | | | on seabed | | |
| V45⁰ Bend 8 | | Elevation 2.1m | | | | - | | | | Span for 4m, 1.54m span height | | |
| H 90⁰ Bend 9 | | Elevation 2.1m | | | | - | | | |  | | |
| **`** | | | | | | | | | | | | |
| Figure 21 - PM Flowline Jumper 04, with Numbered Horizontal Bends | | | | | | | | | | | | |
| The jumper configuration is as follows:   * UCON-H-12 (PM-W) (Elev.+2.1m) * Horizontal pipe * Vertical 45⁰ Bends 1 & 2 (touchdown) * Horizontal 90⁰ Bends 3 & 4 (on seabed) * Horizontal 70⁰ Bends 5 & 6 (on seabed) * Vertical 45⁰ Bends 7(touchdown) & 8 * Horizontal 90⁰ Bend 9 (Elev.+2.1m) * Horizontal pipe * UCON-H-12 (DC PLET 4) (Elev.+2.1m) | | | | | | | | | | | | |
| **GVI** | In general, the flowline jumper is in good condition. 2 findings were raised on this jumper. The one finding that is of interest is included in the Coating-Insulation observation section below and is a concern relating to coating deterioration on a Ucon connector. | | | | | | | | | | | GREEN |
| **Anode** | UCON-H-12 (PM-W) and UCON-H-12 (DC PLET 4) have 6 sacrificial anodes each. 8 of the 12 anodes were checked and found to be active, secure and <25% depleted. | | | | | | | | | | | GREEN |
| **Connector** | UCON-H-12 (PM-W) and UCON-H-12 (DC PLET 4) were aligned and secure and no relative movement was evident. Both of the carrier pipe locking handles were found in the unlocked position (FMC clarified that this is not an integrity issue, no anomaly raised). | | | | | | | | | | | GREEN |
| **Continuity Cables** | UCON-H-12 (PM-W) and UCON-H-12 (DC PLET 4) each have 4 bolted, single continuity cables: Guide Frame N, S & Underside and on the carrier pipe locking handle. All of the continuity cables were found to be in good condition, attached and visible. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel readings, one each on the connectors, showed good cathodic protection potential.  UCON-H-12 (DC PLET 4) – CP measurement is -1071mV.  UCON-H-12 (PM-W) – CP measurement is -979mV. | | | | | | | | | | | GREEN |
| **Coating Insulation Observation** | Degraded coating was found on the UCON-H-12 (DC PLET 4), between 7 and 10 o'clock, approximately 300mm x 40mm. No other damage observed.  (IMSA Anomaly 20-0020, Coating disbondment at the junction between the flowline jumper and the PM-West UCON Connecter, Status: Routine Monitoring). | | | | | | | | | | | GREEN |
| **Crossings (over the jumper)** | DC PLET 3 Hold Back Chain, in a sleeve that is supported by 3 buoyancy modules. The sleeve is in contact with the jumper with no signs of abrasion or relative movement. However, it is expected that there will be future relative movement between the jumper and the chain sleeve. | | | | | | | | | | | GREEN |
| **Seabed Condition** | (as per the following table Figure 21)  The seabed is mainly silt/sand. Due to movement caused by the thermal expansion/contraction of the flowline, there is significant evidence of trenching either side of the jumper from Horizontal Bend 3 to the PLET. This is normal for the expansion spool/jumper. | | | | | | | | | | | GREEN |
| **Component** | | **Spanning** | | | | **Burial** | | | | **Comment** | | |
| V45⁰ Bend 1 | | Elevation 2.1m | | | | - | | | | Span for 8m, 1.69m span height | | |
| V45⁰ Bend 2 | | Seabed | | | | Partial | | | | On seabed | | |
| H 90⁰ Bend 3 | | Seabed | | | | 50% | | | | Bend 4 is in span. There is a 5m 95% burial between Bends 4 and 5, due to a mound near an Xmas Tree W6(P6). There is a 1m long 100% burial between Bends 5 and 6. The remaining sections on the seabed show evidence of displacement caused by thermal expansion /contraction. | | |
| H 90⁰ Bend 4 | | Seabed | | | | Suspended | | | |
| H 70⁰ Bend 5 | | Seabed | | | | 75% | | | |
| H 70⁰ Bend 6 | | Seabed | | | | 75-100% | | | |
| V45⁰ Bend 7 | | Seabed | | | | Partial | | | | on seabed | | |
| V45⁰ Bend 8 | | Elevation 2.1m | | | | - | | | | Span for 8m, 1.8m span height | | |
| H 90⁰ Bend 9 | | Elevation 2.1m | | | | - | | | |  | | |
| **RBM Flowline Jumper 01** | | | | | | | | | | | | |
| Figure 22 - RBM Flowline Jumper 01 with Numbered Horizontal Bends | | | | | | | | | | | | |
| The jumper configuration is as follows:   * UCON-H-12 (RBM PLET 1) (Elev.+2.1m) * Horizontal pipe * Vertical 45⁰ Bends 1 & 2 (touchdown) * Horizontal 90⁰ Bends 3, 4, 5 & 6 (all on seabed) * Vertical 45⁰ Bends 7(touchdown) & 8 * Horizontal pipe * UCON-H-12 (RBM) (Elev.+2.1m) | | | | | | | | | | | | |
| **GVI** | In general, the flowline jumper is in good condition. No findings were raised on this jumper. | | | | | | | | | | | GREEN |
| **Anode** | UCON-H-12 (RBM) and UCON-H-12 (RBM PLET 1) have 6 sacrificial anodes each. All 12 anodes were checked and found to be active, secure and <25% depleted. | | | | | | | | | | | GREEN |
| **Connector** | UCON-H-12 (RBM) and UCON-H-12 (RBM PLET 1) were aligned and secure and no relative movement was evident. No event was raised on the UCON-H-12 (RBM PLET 1) underside guide frame and is assumed to be inaccessible. | | | | | | | | | | | GREEN |
| **Continuity Cables** | UCON-H-12 (RBM) and UCON-H-12 (RBM PLET 1) each have 4 bolted, single continuity cables: Guide Frame N, S & Underside and on the Carrier pipe locking handle. All of the continuity cables were found to be in good condition, attached and visible. No event was raised on the UCON-H-12 (RBM PLET 1) underside guide frame and is assumed to be inaccessible. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel readings, one each on the connectors, showed good cathodic protection.  UCON-H-12 (RBM PLET 1) – CP measurement is -1032mV.  UCON-H-12 (RBM) – CP measurement is -1034mV. | | | | | | | | | | | GREEN |
| **Coating Insulation Observation** | No observations were recorded, assume no defects found on the Novolastic Thermal Insulation on the jumper. Full video coverage was done on the jumper and images are available for all of the bends. | | | | | | | | | | | GREEN |
| **Crossings (over the jumper)** | No crossings logged for this jumper. | | | | | | | | | | | GREEN |
| **Seabed Condition** | (as per the following table and Figure 22)  The seabed is mainly silt/sand. Due to movement caused by the thermal expansion/contraction of the flowline, there is significant evidence of trenching of the seabed either side of the jumper from Horizontal Bend 3 to Bend 4. This is normal for the expansion spool/jumper. | | | | | | | | | | | GREEN |
| **Component** | | **Spanning** | | | | **Burial** | | | | **Comment** | | |
| V45⁰ Bend 1 | | Elevation 2.1m | | | | - | | | | Span for 5.6m, 1. m span height | | |
| V45⁰ Bend 2 | | Seabed | | | | Partial | | | | On seabed | | |
| H 90⁰ Bend 3 | | Seabed | | | | 50% | | | | 3.4m span between Bend 2 and Bend 3, 0.2m gap. Between Bend 4 and Bend 7 the pipeline is >75% buried with intermittent full burial. Movement is evident between Bend 3 and Bend 4 caused by thermal expansion/contraction. | | |
| H 90⁰ Bend 4 | | Seabed | | | | 100% | | | |
| H 90⁰ Bend 5 | | Seabed | | | | 100% | | | |
| H 90⁰ Bend 6 | | Seabed | | | | 100% | | | |
| V45⁰ Bend 7 | | Seabed | | | | Partial | | | | on seabed | | |
| V45⁰ Bend 8 | | Elevation 2.1m | | | | - | | | | Span for 5.6m, 1.0m span height | | |
| **RBM Flowline Jumper 02** | | | | | | | | | | | | |
| Figure 23 - RBM Jumper 02 with Numbered Horizontal Bends | | | | | | | | | | | | |
| The jumper configuration is as follows:   * UCON-H-12 (RBM PLET 2) (Elev.+2.1m) * Horizontal pipe * Vertical 45⁰ Bends 1 & 2 (touchdown) * Horizontal 90⁰ Bends 3, 4, 5 & 6 (all on seabed) * Vertical 45⁰ Bends 7(touchdown) & 8 * Horizontal pipe * UCON-H-12 (RBM) (Elev.+2.1m) | | | | | | | | | | | | |
| **GVI** | In general, the flowline jumper is in good condition. One finding was raised on this jumper concerning a CP measurement out of the acceptable range, however this is not anomalous. | | | | | | | | | | | GREEN |
| **Anode** | UCON-H-12 (RBM) and UCON-H-12 (RBM PLET 2) have 6 sacrificial anodes each. All 6 anodes were checked on UCON-H-12 (RBM PLET 2) and found to be active, secure and <25% depleted. On UCON-H-12 (RBM), only anode AN-01 was checked, with AN-02 to AN-06 having restricted access. AN-01 was found to be active, secure and <25% depleted. A CP measurement of -1055mV confirms that the Ucon connector is well protected from corrosion and implies that the anodes are working well. | | | | | | | | | | | GREEN |
| **Connector** | UCON-H-12 (RBM) and UCON-H-12 (RBM PLET 2) were aligned and secure and no relative movement was evident. However, the inspection was hampered by poor visibility. | | | | | | | | | | | GREEN |
| **Continuity Cables** | UCON-H-12 (RBM) and UCON-H-12 (RBM PLET 2) each have 4 bolted, single continuity cables: Guide Frame N, S & Underside and on the carrier pipe locking handle. All of the continuity cables were found to be in good condition, attached and visible. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel readings, one each on the connectors, showed good cathodic protection.  UCON-H-12 (RBM PLET 2) – CP measurement is -1030mV.  UCON-H-12 (RBM) – CP measurement is -1055mV. | | | | | | | | | | | GREEN |
| **Coating Insulation Observation** | No observations were recorded, assume no defects found on the Novolastic Thermal Insulation on the jumper. Full video coverage was done on the jumper and images are available for all of the bends. | | | | | | | | | | | GREEN |
| **Crossings (over the jumper)** | No crossings logged for this jumper. | | | | | | | | | | | GREEN |
| **Seabed Condition** | (as per the following table and Figure 23)  The seabed is mainly silt/sand. Due to movement caused by the thermal expansion/contraction of the flowline, there is significant evidence of trenching of the seabed either side of the jumper from Horizontal Bend 3 to Bend 6. This is normal for the expansion spool/jumper. | | | | | | | | | | | GREEN |
| **Component** | | **Spanning** | | | | **Burial** | | | **Comment** | | | |
| V45⁰ Bend 1 | | Elevation 2.1m | | | | - | | | Span for 4.9m, 2. m span height | | | |
| V45⁰ Bend 2 | | Seabed | | | | Partial | | | On seabed | | | |
| H 90⁰ Bend 3 | | Seabed | | | | 50-75% | | | Bend 2 to 3, exposed.  Bend 3 to 4, <50% buried with possible trenching caused by expansion /contraction .  Bend 4 to 5 – Northern half is 50-75% buried & Southern half is buried. Bend 5 to 6 is 50-75% buried.  Bend 6 to 7 is >75% buried. | | | |
| H 90⁰ Bend 4 | | Seabed | | | | 50-75% | | |
| H 90⁰ Bend 5 | | Seabed | | | | 75-100% | | |
| H 90⁰ Bend 6 | | Seabed | | | | 75% | | |
| V45⁰ Bend 7 | | Seabed | | | | Partial | | | on seabed | | | |
| V45⁰ Bend 8 | | Elevation 2.1m | | | | - | | | Span for 6.9m, 2m span height | | | |
| **RBM Flowline Jumper 03** | | | | | | | | | | | | |
| Figure 24 - RBM Flowline Jumper 03 with Numbered Horizontal Bends | | | | | | | | | | | | |
| The jumper configuration is as follows:   * UCON-H-12 (RBM PLET 3) (Elev.+2.1m) * Horizontal pipe * Vertical 45⁰ Bends 1 & 2 (touchdown) * Horizontal 90⁰ Bends 3, 4, 5 & 6 (all on seabed) * Vertical 45⁰ Bends 7(touchdown) & 8 * Horizontal pipe * UCON-H-12 (RBM) (Elev.+2.1m) | | | | | | | | | | | | |
| **GVI** | In general, the flowline jumper is in good condition. 1 finding was raised on this jumper concerning a CP measurement out of the acceptable range, however this is not anomalous. | | | | | | | | | | | GREEN |
| **Anode** | UCON-H-12 (RBM) and UCON-H-12 (RBM PLET 3) have 6 sacrificial anodes each. All 6 anodes were checked on UCON-H-12 (RBM PLET 3) and found to be active, secure and <25% depleted. On UCON-H-12 (RBM), only anode AN-01 was checked, with AN-02 to AN-06 having restricted access. AN-01 was found to be active, secure and <25% depleted. A CP measurement of -1056mV confirms that the UCON connector is well protected from corrosion and implies that the anodes are working well. | | | | | | | | | | | GREEN |
| **Connector** | UCON-H-12 (RBM) and UCON-H-12 (RBM PLET 3) were aligned and secure and no relative movement was evident. However, the inspection was hampered by poor visibility. | | | | | | | | | | | GREEN |
| **Continuity Cables** | UCON-H-12 (RBM) and UCON-H-12 (RBM PLET 3) each have 4 bolted, single continuity cables: Guide Frame N, S & underside and on the carrier pipe locking handle. All of the continuity cables were found to be in good condition, attached and visible. However, no event was recorded for the UCON underside for the RBM connector. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel readings, one each on the connectors, showed good cathodic protection.  UCON-H-12 (RBM PLET 3) – CP measurement is -1029mV.  UCON-H-12 (RBM) – CP measurement is -1056mV. | | | | | | | | | | | GREEN |
| **Coating Insulation Observation** | No observations were recorded, assume no defects found on the Novolastic Thermal Insulation on the jumper. Full video coverage was done on the jumper and images are available for all of the bends. | | | | | | | | | | | GREEN |
| **Crossings (over the jumper)** | No crossings logged with this jumper. | | | | | | | | | | | GREEN |
| **Seabed Condition** | (as per the following table and Figure 24)  The seabed is mainly silt/sand. Due to movement caused by the thermal expansion/contraction of the flowline, there is significant evidence of trenching of the seabed either side of the jumper from Horizontal Bend 3 to Bend 7. This is normal for the expansion spool/jumper. | | | | | | | | | | | GREEN |
| **Component** | | **Spanning** | | | | **Burial** | | | **Comment** | | | |
| V45⁰ Bend 1 | | Elevation 2.1m | | | | - | | | Span for 8.1m, 3m span height | | | |
| V45⁰ Bend 2 | | Seabed | | | | Partial | | | On seabed | | | |
| H 90⁰ Bend 3 | | Seabed | | | | 75-100% | | | Bend 2 to 5 – partially buried  Bend 5 to 6 is >75% buried with one 3m section fully buried.  Bend 5 to 7, the jumper is >75% buried. | | | |
| H 90⁰ Bend 4 | | Seabed | | | | 75-100% | | |
| H 90⁰ Bend 5 | | Seabed | | | | 50-75% | | |
| H 90⁰ Bend 6 | | Seabed | | | | 75% | | |
| V45⁰ Bend 7 | | Seabed | | | | Partial | | | On seabed | | | |
| V45⁰ Bend 8 | | Elevation 2.1m | | | | - | | | Span for 8.8m, 2m span height | | | |
| **RBM Flowline Jumper 04** | | | | | | | | | | | | |
| Figure 25 - RBM Flowline Jumper 04 with Numbered Horizontal Bends | | | | | | | | | | | | |
| The jumper configuration is as follows:   * UCON-H-12 (RBM PLET 4) (Elev.+2.1m) * Horizontal pipe * Vertical 45⁰ Bends 1 & 2 (touchdown) * Horizontal 90⁰ Bends 3, 4, 5 & 6 (all on seabed) * Vertical 45⁰ Bends 7(touchdown) & 8 * Horizontal pipe * UCON-H-12 (RBM) (Elev.+2.1m) | | | | | | | | | | | | |
| **GVI** | In general, the flowline jumper is in good condition. No finding was raised on this jumper. | | | | | | | | | | | GREEN |
| **Anode** | UCON-H-12 (RBM) and UCON-H-12 (RBM PLET 4) have 6 sacrificial anodes each. All 12 anodes were checked and found to be active, secure and <25% depleted. | | | | | | | | | | | GREEN |
| **Connector** | UCON-H-12 (RBM) and UCON-H-12 (RBM PLET 4) were aligned and secure and no relative movement was evident. | | | | | | | | | | | GREEN |
| **Continuity Cables** | UCON-H-12 (RBM) and UCON-H-12 (RBM PLET 4) each have 4 bolted, single continuity cables: Guide Frame N, S & Underside and on the carrier pipe locking handle. All of the continuity cables, where clearly visible, were found to be in good condition, attached and visible. Two of the cable were not clearly seen, however photos were taken of the connecting cables. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel readings, one each on the connectors, showed good cathodic protection potential.  UCON-H-12 (RBM PLET 4) – CP measurement is -1021mV.  UCON-H-12 (RBM) – CP measurement is -1048mV. | | | | | | | | | | | GREEN |
| **Coating Insulation Observation** | No observations were recorded, assume no defects found on the Novolastic Thermal Insulation on the jumper. Full video coverage was done on the jumper and pictures are available for all of the bends. | | | | | | | | | | | GREEN |
| **Crossings (over the jumper)** | No crossings logged for this jumper. | | | | | | | | | | | GREEN |
| **Seabed Condition** | (as per the following table and Figure 25).  The seabed is mainly silt/sand. Due to movement caused by the thermal expansion/contraction of the flowline, there is significant evidence of trenching of the seabed either side of the jumper from Horizontal Bend 3 to Bend 4. Some East-West movement was also reported between Bend 6 and Bend 7.  This is normal for the expansion spool/jumper. | | | | | | | | | | | GREEN |
| **Component** | | **Spanning** | | | | **Burial** | | | **Comment** | | | |
| V45⁰ Bend 1 | | Elevation 2.1m | | | | - | | | Span for 5.9m, 2m span height | | | |
| V45⁰ Bend 2 | | Seabed | | | | Partial | | | On seabed | | | |
| H 90⁰ Bend 3 | | Seabed | | | | 50-75% | | | Bend 3 to 4 – active trenching of the seabed noted caused by thermal expansion/contraction.  Bend 4 to 5, >75% buried  Bend 6 to 7, >75% buried | | | |
| H 90⁰ Bend 4 | | Seabed | | | | >75% | | |
| H 90⁰ Bend 5 | | Seabed | | | | 90% | | |
| H 90⁰ Bend 6 | | Seabed | | | | 75% | | |
| V45⁰ Bend 7 | | Seabed | | | | Partial | | | On seabed | | | |
| V45⁰ Bend 8 | | Elevation 2.1m | | | | - | | | Span for 0m, 1.6m span height | | | |
| Flowlines | | | | | | | | | | | | |
| The full visual inspection of the flowlines between the Drill Centre and Riser Base includes the following features:   * VIV Strakes (35m section) at DC PLET end. * EFL/SFL Crossings (Flowline 01 and Flowline 02 only). * 2x Buckle Triggers per Flowline (see Figure 26 for the locations). * 3 to 5 x On Stalk weld joints per Flowline. (*Note: these are joints made up during spooling of flowlines onto installation vessel’s reel at spool base*).   Spans and burial/scour sections were also recorded, with the emphasis on overlength spans exceeding 27m in length. Thermal expansion of the flowlines causes the position of the flowline at the Buckle Triggers, to laterally change to the order of 5m depending on the production status of the flowline.  Following are the integrity details for flowlines [01](#FL1_001), [02](#FL2_001), [03](#FL3_001) and [04](#FL4_001). The inspection findings are taken mainly from the Hot Baseline Inspection (HBL) unless previous findings and anomalies remain relevant. During the 2020 C1 inspection campaign, the work scope was restricted to 2 tasks on each flowline, as follows:   * Task Plan 220283-TP-046 (Buckle Trigger Survey – Critical Spans) * Task Plan 220283-TP-047 (Buckle Trigger Inclination) | | | | | | | | | | | | |
| Figure 26 - Flowline Buckle Trigger Locations and KP Positions | | | | | | | | | | | | |
| **Production Flowline 01** | | | | | | | | | | | | |
| **GVI** | In general, Flowline 01 is in good condition and was fully inspected during the 2019 Hot Baseline Survey. It should be noted that the flowline was not producing during the HBL and 2020 C1 visual inspections, however it was flowing during the MBES survey, which explains the discrepancy in the location of the flowline with respect to the buckle triggers.  The Strakes (35m) at the DC-1 End appeared to be secure. | | | | | | | | | | | GREEN |
| **Field Joints** | 232 field joints were recorded, all appeared to be intact with no signs of displacement or cracking. 5 of the field joints had ‘monkey fist’ rope installation aids. 4 of the joints were On-Stalk joints with two half shell covers secured with bandit material. For the On-Stalk joint locations, refer to IMSA Anomaly 19-0062, Design Issue, Status: Routine Monitoring. | | | | | | | | | | | GREEN |
| **Buckle Trigger BT1-1 (KP1.106)** | Anodes - 9 events were recorded and all anodes were secure, active and <25% depleted.  CP Steel - 1 x CP measurements taken, reading -1042mV, indicating good protection.  Scour/Burial measurements - all faces showed burial of 0.5m up to 90%. Scour on the SW and NE corners was up to 0.35m.  Bullseye- videoed but no comparison made with previous surveys.  Tilt is -0.1⁰ at 335⁰. | | | | | | | | | | | GREEN |
| Buckle Trigger BT1-2 (KP2.119) | Anodes - 6 events were recorded and all anodes were secure, active and <25% depleted.  CP Steel – 1 x CP measurement taken, reading -1042mV, indicating good protection.  Scour/Burial measurements – burial measurements were taken along 3 of the faces, averaging 65% buried up to 0.3m. Scour was a maximum of 0.25m on the 4 corners.  Bullseye - videoed but no comparison made with previous surveys.  Tilt is 0.3⁰ at 340⁰. | | | | | | | | | | | GREEN |
| **Flowline Displacement at the Buckle Triggers** | The maximum westward displacement at the buckle triggers due to movement caused by thermal expansion/contraction was as follows:   * BT1-1 (at KP 1.106) 5.5 m from the post * BT1-2 (at KP 2.119) 4.75m from the post   However, at the time of the inspection, the flowline was resting against the vertical posts (0m). The design displacement is a maximum of 6.5m and the maximum extent of the displacements can be estimated by the travel marks along the top of the skid beam. | | | | | | | | | | | GREEN |
| **Burial/Scour** | 27 burial events were recorded, most indicated burial of >75% and 3 instances of the flowline being covered, which is not anomalous but can prevent full inspection of the flowline if extensive. | | | | | | | | | | | GREEN |
| **Spans** | 4 spans, ranging from 29m to 40 m in length, were over the 27m limit and they were associated with the Buckle Triggers: 2 x BT1-1, 2 x BT1-2. These spans will be assessed by the Pipeline Operations Engineer for further analysis and remedial requirements if any.  (IMSA Anomaly 19-0025, Span, Status: Routine Monitoring). | | | | | | | | | | | YELLOW |
| **Crossings** | 10 EFL and 5 SFL umbilicals crossed over the flowline and were in contact. 10 of the crossings showed sediment & marine growth loss on the top of the flowline indicating relative movement, which could be caused by the displacement of the flowline due to thermal expansion & contraction. | | | | | | | | | | | GREEN |
| **Debris** | 4 x tag lines with ‘monkey fists’, not considered significant. | | | | | | | | | | | GREEN |
| **Production Flowline 02** | | | | | | | | | | | | |
| **GVI** | In general, Flowline 02 is in good condition with overlength spanning being the only significant finding, as described below. It should be noted that the flowline was producing during the visual inspection and the MBES.  The Strakes (35m) at the PM end, appeared to be secure. | | | | | | | | | | | GREEN |
| **Field Joints** | 227 field joints were recorded, all appeared to be intact with no signs of displacement or cracking. 3 of the field joints had ‘monkey fist’ rope installation aids. 3 of the joints were On-Stalk joints with two half shell covers secured with bandit material. For the On-Stalk joint locations, refer to IMSA Anomaly 19-0062, Design Issue, Status: Routine Monitoring. | | | | | | | | | | | GREEN |
| **Buckle Trigger BT2-1 (KP1.133)** | Anodes - 9 events were recorded and all anodes were secure, active and <25% depleted.  CP Steel – 1 x CP measurement taken, reading -1040mV, indicating good protection.  Scour/Burial measurement - the burial measurements along the 4 faces varied from 0.2m to 0.3m up to 90% of the faces. The scour on the NE and SW corners was from 0m to 0.2m.  Bullseye - videoed but no comparison made with previous surveys.  Tilt is 0.41⁰ at 039⁰. | | | | | | | | | | | GREEN |
| **Buckle Trigger BT2-2 (**KP2.068**)** | Anodes - 5 events were recorded and all anodes were secure, active and <25% depleted.  CP Steel – 1 x CP measurement taken, reading -1040mV, indicating good protection.  Scour/Burial measurement - the burial measurements along the 4 faces varied from 0.15m to 0.4m up to 90% of the faces. The scour on the 4 corners was from 0m to 0.2m.  Bullseye - was videoed and appears at TDC, however no comparison made with previous surveys.  Tilt is 0.1⁰ at 329⁰. | | | | | | | | | | | GREEN |
| **Flowline Displacement at the Buckle Triggers** | The maximum westward displacement at the buckle triggers due to movement caused by thermal expansion was as follows:   * BT2-1 (at KP 1.133) 5.0 m from the post * BT2-2 (at KP 2.068) 5.5 m from the post   However, at the time of the 2020 C1 inspection, the flowline was resting against the vertical posts (0m). The design displacement is a maximum of 6.5m and the maximum extent of the displacements can be estimated by the travel marks along the top of the skid beam. | | | | | | | | | | | GREEN |
| **Burial/Scour** | 12 burial events were recorded, most events indicated burial of >75% with 1 instance of the flowline being covered, at KP 0.565, which is not anomalous but can prevent full inspection of the flowline if extensive. Trenching of the seabed was seen either side of the buckle triggers caused by the thermal expansion and contraction of the flowline. | | | | | | | | | | | GREEN |
| **Spans** | Out of 4 spans, ranging from 26m to 33 m in length, 3 were over the 27m limit and they were associated with the Buckle Triggers: 1x BT2-1, 2x BT2-2. These spans will be assessed by the Pipeline Operations Engineer for further analysis and remedial requirements, if any.  (IMSA Anomaly 19-0025, Span, Status: Routine Monitoring). | | | | | | | | | | | YELLOW |
| **Crossings** | 10 EFL and 5 SFL umbilicals crossed over the flowline and all were in contact with the exception of 1 SFL with a clearance of about 20mm. The majority of these had sediment & marine growth loss on the top of the flowline indicating relative movement, which could be caused by the displacement of the flowline due to thermal expansion & contraction. | | | | | | | | | | | GREEN |
| **Debris** | 5 x tag lines with ‘monkey fists’, not considered significant. | | | | | | | | | | | GREEN |
| **Production Flowline 03** | | | | | | | | | | | | |
| **GVI** | In general, Flowline 03 is in good condition with overlength spanning being the only significant finding, as described below. It should be noted that the flowline was not producing during the HBL visual inspection and was producing during the MBES survey.  During the 2020 C1 campaign, Flowline 03 was isolated and unavailable due to a suspected hydrate blockage and is partially filled with Methyl Ethylene Glycol (MEG). This is a Flow Assurance issue not related to the integrity of the Flowline.  The Strakes (35m), at the PM end, appeared to be secure. | | | | | | | | | | | **YELLOW** |
| **Field Joints** | 214 field joints were recorded, all appeared to be intact with no signs of displacement or cracking. 4 of the field joints had ‘monkey fist’ rope installation aids. 3 of the joints were On-Stalk joints with two half shell covers secured with bandit material. For the On-Stalk joint locations, refer to IMSA Anomaly 19-0062, Design Issue, Status: Routine Monitoring. | | | | | | | | | | | GREEN |
| **Buckle Trigger BT3-1 (KP0.932)** | Anodes - 9 events were recorded, representing 12 anodes, and all anodes were secure, active and <25% depleted.  CP Steel – 1 x CP measurement taken, reading -1039mV, indicating good protection.  Scour/Burial measurement - the burial measurements along the 4 faces varied from 0.15m to 0.4m over 70% to 90% of the faces. The scour on the 4 corners was from 0m to 0.4 m.  Bullseye - videoed but no comparison made with previous surveys.  Tilt is 0.1⁰ at 355⁰. | | | | | | | | | | | GREEN |
| **Buckle Trigger BT3-2 (KP1.965)** | Anodes - 6 events were recorded, representing 12 anodes and all anodes were secure and <25% depleted. All anodes were active with the exception of AN-11 & AN-12, which were inactive.  CP Steel – 1 x CP measurement taken, reading -1037mV, indicating good protection.  Scour/Burial measurement - the burial measurements along the 4 faces varied from 0.15m to 0.3m up to 90% of the faces. The scour on the 4 corners was from 0m to 0.3m.  Bullseye - videoed and found to be TDC but no comparison made with previous surveys.  Tilt is 0.2⁰ at 359⁰. | | | | | | | | | | | GREEN |
| **Flowline Displacement at the Buckle Triggers** | The maximum westward displacement at the buckle triggers, caused by thermal expansion, was as follows:   * BT3-1 (at KP 0.932) 5.0 m from the post * BT3-2 (at KP 1.965) 5.5 m from the post   However, at the time of the visual inspection, the flowline was resting against the vertical posts (0m). The design displacement is a maximum of 6.5m and the maximum extent of the displacements can be estimated by the travel marks along the top of the skid beam. | | | | | | | | | | | GREEN |
| **Burial/Scour** | 12 burial events were recorded, all events indicated burial of >75% with 2 instances of the flowline being covered, between KP2.299 and KP2.653, which is not anomalous but can prevent full inspection of the flowline if extensive. Trenching of the seabed was seen either side of the buckle triggers, caused by the thermal expansion and contraction of the flowline. | | | | | | | | | | | GREEN |
| **Spans** | Out of 4 spans, ranging from 25m to 37m in length, 2 were over the 27m limit and they were associated with the Buckle Triggers: 1 x BT3-1, 1 x BT3-2. These spans will be assessed by the Pipeline Operations Engineer for further analysis and remedial requirements, if any.  (IMSA Anomaly 19-0025, Span, Status: Routine Monitoring). | | | | | | | | | | | YELLOW |
| **Crossings** | No crossings were reported across Flowline 03. | | | | | | | | | | | GREEN |
| **Debris** | 6 x tag lines with ‘monkey fists’, not considered significant. | | | | | | | | | | | GREEN |
| **Production Flowline 04** | | | | | | | | | | | | |
| **GVI** | In general, Flowline 04 was in good condition with overlength spanning and one area of coating abrasion being the only significant findings, as described below. It should be noted that the flowline was not producing during the visual inspection and was producing during the MBES survey.  The Strakes (35m), at the PM end, appeared to be secure. | | | | | | | | | | | GREEN |
| **Physical Damage** | An area of abrasion was seen on Flowline 04 at KP 0.011, on the Northeast side of the flowline. The abrasion to the Novolastic thermal coating appears to be superficial over an area of 200mm wide x 300mm in width, noticed mainly because the area has been cleared of marine growth and sediment recently and the black line rotation indicator has also been abraded. This area will need to been cleaned and CVI carried out in order to determine the extent of the damage, if any.  (IMSA Anomaly 20-0021, Abrasion of external coating on Flowline 04 between KP 0.007 and KP 0.011, Status: Routine Monitoring). | | | | | | | | | | | YELLOW |
| **Field Joints** | 234 field joints were recorded, all appeared to be intact with no signs of displacement or cracking. 4 of the field joints had ‘monkey fist’ rope installation aids. 3 of the joints were On-Stalk joints with two half shell covers secured with bandit material. The stalk joint cover, at KP0.796 was thought to be displaced, however this is probably just a slight misalignment. For the On-Stalk joint locations, refer to IMSA Anomaly 19-0062, Design Issue, Status: Routine Monitoring. This anomaly was raised in order to research the stalk joint cover installation and the configuration of the half shells and the method of cementing or physically securing the half shell covers to the joint area. | | | | | | | | | | | GREEN |
| **Buckle Trigger BT4-1 (KP0.987)** | Anodes - 9 events were recorded, representing 12 anodes, and all anodes were secure, active and <25% depleted.  CP Steel – 1 x CP measurement taken, reading -1041mV, indicating good protection.  Scour/Burial measurement - the burial measurements along the 4 faces varied from 0.2m to 0.25m over 70% to 90% of the faces. The scour on the 4 corners was from 0m to 0.45 m.  Bullseye - videoed and appears to be near TDC but no comparison made with previous surveys.  Tilt is 0.2⁰ at 16.3⁰. | | | | | | | | | | | GREEN |
| **Buckle Trigger BT4-2 (KP1.937)** | Anodes - 6 events were recorded representing 11 anodes and all anodes were secure and <25% depleted.  CP Steel - 1 x CP measurement taken, reading -1043mV, indicating good protection.  Scour/Burial measurement - the burial measurements along 3 of the 4 faces varied from 0.05m to 0.3m for 50% to 80% of the faces. The scour on the 4 corners was from 0m to 0.3m.  Bullseye- videoed in poor visibility and no comparison made with previous surveys.  Tilt is 1.3⁰ at 21⁰. | | | | | | | | | | | GREEN |
| **Flowline Displacement at the Buckle Triggers** | The maximum westward displacement at the buckle triggers, caused by thermal expansion, was as follows:   * BT4-1 (at KP0.987) 5.0 m from the post * BT4-2 (at KP1.937) 5.5 m from the post   However, at the time of the visual inspection, the flowline was resting against the vertical posts (0m). The design displacement is a maximum of 6.5m and the maximum extent of the displacements can be estimated by the travel marks along the top of the skid beam. | | | | | | | | | | | GREEN |
| **Burial/Scour** | 34 burial events were recorded, all events indicated burial of >50% with 3 instances of the flowline being covered, near KP1.76, KP1.78 and KP2.6, which is not anomalous but can prevent full inspection of the flowline if extensive. Trenching of the seabed was seen either side of the buckle triggers caused by the thermal expansion and contraction of the flowline. | | | | | | | | | | | GREEN |
| **Spans** | Out of 4 spans, ranging from 26m to 32 m in length, 2 were over the 27m limit and was associated with the Buckle Trigger BT4-1. These spans will be assessed by the Pipeline Operations Engineer for further analysis and remedial requirements, if any.  (IMSA Anomaly 19-0025, Span, Status: Routine Monitoring). | | | | | | | | | | | YELLOW |
| **Crossings** | No crossings were reported across Flowline 04. | | | | | | | | | | | GREEN |
| **Debris** | 6 x tag lines with ‘monkey fists’, not considered significant. | | | | | | | | | | | GREEN |
| Pipeline End Terminations (PLET) | | | | | | | | | | | | |
| Visual inspection of the flowline PLETs was completed during the 2019 Hot Baseline Inspection (HBL) and all data included here is from the HBL with the exception of references to previously raised anomalies.  It should be noted that the PLET Alignment events done during the C4A cold baseline inspection were not repeated during the Hot Baseline Survey. This alignment measurement is meant to locate the position of the sliding rails on the upper PLET configuration, with respect to the PLET base which is designed to remain static. The design parameters for the slide rails are as follows:   * DC PLET is allowed to move towards the flowline up to -0.5m and expand away from the flowline up to +3.0m * RBM PLET is allowed to move towards the flowline -0m (zero allowance) and expand away from the flowline up to +3.5m   Therefore, the alignment arrow on the sliding element should be checked against painted measurement position on the base, during both hot and cold production states, to confirm that the PLETs are moving within the allowed boundary limits. It should be noted that the C4A Cold Baseline survey confirmed that all the PLET’s were in their installed, neutral position at ‘000mm’ at the time.  PLET alignment surveys were done on Flowline 3 and Flowline 4 during the 2019 Q2 P7 Flow Module Campaign, which showed movement caused by the thermal expansion of the flowline up to +0.7m expansion on DC PLET 4. Please refer to sections 4.2.1.5.3 and 4.2.1.5.4 for details.  Each Drill Centre (DC) PLET has the following configuration:   * Pipeline End Termination Assembly   + Anode Skids, East and West on PLET ‘wings’ * Hold Back Chain System   + Jumper Bridge - PLET DC Flowline 1 and 4 only (See PM Flowline Jumpers 1 and 4)   + Chain tensioner assembly * Permanent Flowline Anchor Suction Pile (PFAP)   Each Riser Base Manifold (RBM) PLET has a simpler configuration:   * Pipeline End Termination Assembly   Note: The UCON-H-12 connectors are included with the jumper inspections.  The following flowline PLETs have been included in this section:  4.2.1.5.1 [PLET DC Flowline 1](#_PLET_DC_Flowline_1)  4.2.1.5.2 [PLET DC Flowline 2](#_PLET_DC_Flowline)  4.2.1.5.3 [PLET DC Flowline 3](#_PLET_DC_Flowline_2)  4.2.1.5.4 [PLET DC Flowline 4](#_PLET_DC_Flowline_3)  4.2.1.5.5 [PLET RBM Flowline 1](#_PLET_RBM_Flowline)  4.2.1.5.6 [PLET RBM Flowline 2](#_PLET_RBM_Flowline_1)  4.2.1.5.7 [PLET RBM Flowline 3](#_PLET_RBM_Flowline_2)  4.2.1.5.8 [PLET RBM Flowline 4](#_PLET_RBM_Flowline_3) | | | | | | | | | | | | |
| **PLET DC Flowline 01** | | | | | | | | | | | | |
| **GVI** | In general, PLET DC Flowline 01 is in good condition with 4 findings raised. All 4 findings were not integrity issues and details are included in the Cathodic Potential Measurements and the Corrosion sections below. | | | | | | | | | | | GREEN |
| **Anode** | (Summarized by component)  All anodes were found to be active, secure and <25% depleted.   * PLET Anode Skid West & East * PLET Frame (typical) * Chain Tensioner & Isolation Plate   PFAP (typical) & Vent (4) | | | | | | | | | | | GREEN |
| **Continuity Cables** | Cables are all bolted at one end and clamped at the other end. The cables were partially buried. All clamps were attached.   * PLET Anode Skid West Cable 1 - skid bolt to PLET clamp * PLET Anode Skid West Cable 2 - skid bolt to PLET clamp * PLET Anode Skid East Cable 1 - skid bolt to PLET clamp * PLET Anode Skid East Cable 2 - skid bolt to PLET clamp * PFAP to Chain Tensioner Assembly - both not evented * bolted to chain tensioner and clamped to the PFAP. * bolted to the devil’s claw and bolted to the PFAP   The continuity cables to the chain tensioner should be checked during future inspections, however the CP potential reading taken on the chain tensioner test point was -1038mV, indicating good cathodic protection. | | | | | | | | | | | GREEN |
| **Corrosion** | Green Pin Heavy Duty shackle and Master Link (PLET Side), discoloured (Brown), indications of surface corrosion. Contact CP reading on the shackle -641mV, indicating the shackle and master link are isolated from the PLET.  Chains and shackles are isolated from the cathodic protection system by design. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel, one on each component, showing good cathodic protection potential.   * PLET - CP range -942mV to -1054mV * Anchor Pile - CP -1032mV * Chain Tensioner - CP -1038mV * Chain Isolation Plate (w/ 2 anodes) -1076mV * Anchor Chain - CP range -641mV to -646mV\*   \* CP readings on chain indicate non-protected steel, which is normal for chain assemblies. | | | | | | | | | | | GREEN |
| **Debris** | Two items of debris were noted on the anode skids:   * PLET Anode Skid West - 4 x installation, wire rope slings   PLET Anode Skid East - 4 x installation, wire rope slings  The wire rope slings are not a hazard to the ROV and are not an integrity threat. | | | | | | | | | | | GREEN |
| **PLET DC Alignment on Flowline 01** | Measurements were taken during the C4A Baseline Survey (Cold) on 8 Feb 2018. No check was done during the Hot Baseline Survey, August 2019.   * PLET DC Northeast – 0m (Range -0.5m / +3.0m) * PLET DC Southwest – 0m (Range -0.5m / +3.0m)   The flowline was non-producing (cold) during the survey. | | | | | | | | | | | GREEN |
| **Status Check** | The status of the following items was checked and videoed during the survey and there were no associated findings.   * PLET Frame Bullseye - 1.5° Quadrant 1 (SW). * PFAP Bullseye - 0.25° Quadrant 1 (SW). * PFAP Chain Devil’s Claw Setting - 1.2 on the scale.   PLET Isolation Valve 031-FIV-011 - in the OPEN position. | | | | | | | | | | | GREEN |
| **Seabed Condition** | The seabed is mainly silt/sand and from the MBES survey the PLET Frame and wings appear to be buried and ‘scoured out’ around the components that protrude above the PLET base frame. Although the status is currently GREEN, the scour and burial of the PLETs should be trended over successive surveys. MBES surveys will give the best overview and the ROV surveys can add the required detailed observations. | | | | | | | | | | | GREEN |
| **Burial (Structural)** | The video survey of the PLET Mudmat Wings confirmed the MBES survey results, both mudmats are buried.   * PLET East Mudmat Wing - 100% buried to an estimated depth of 0.25m * PLET West Mudmat Wing – 100% buried to an estimated depth of 0.1m | | | | | | | | | | | GREEN |
| **Burial (Hold Back Chain)** | With the exception of the connections to the PFAP chain tensioner and the PLET, the chain appears to be fully buried and not under significant tension. | | | | | | | | | | | GREEN |
| **Scour** | A scour survey was carried out on all 8 corners of the East & West mudmats and no scour was seen. All 8 corners were buried.  The seabed level on the sides of the PFAP suction anchor pile is as follows (Acceptance Criteria is 12.5m to 13.5m):   * Anchor Pile, North side - 12.8m * Anchor Pile, Southwest side - 12.7m * Anchor Pile, Southeast side - 12.6m   No scour was evident around the anchor pile. | | | | | | | | | | | GREEN |
| **PLET DC Flowline 02** | | | | | | | | | | | | |
| **GVI** | In general, PLET DC Flowline 02 is in good condition with 1 findings raised. The finding could be integrity issues and the details are included in the Cathodic Potential Measurements section below. | | | | | | | | | | | YELLOW |
| **Anode** | (Summarized by component)  All anodes were found to be active, secure and <25% depleted.   * PLET Anode Skid West & East * PLET Frame (typical) * Chain Tensioner * PFAP (typical) & Vent (4) * Jumper Bridge Buoyancy Modules 2 Upper & 2 Lower   Only one anode could not be surveyed due to burial:   * Chain Isolation Plate (PLET end) - buried   PLET Anode Skid West was installed such that the skid is only approximately half supported by the West mudmat wing. This appears to still be aligned horizontally but it should be monitored for lack of support from the mud wing.  (IMSA Anomaly 18-0003, West Anode Skid displaced from Design Location, Status: Routine Monitoring). | | | | | | | | | | | GREEN |
| **Continuity Cables** | Cables are all bolted at one end and clamped at the other end (with one exception - see below). The cables were partially buried. All clamps were attached.   * PLET Anode Skid West Cable 1 – skid bolt to PLET clamp * PLET Anode Skid West Cable 2 – skid bolt to PLET clamp * PLET Anode Skid East Cable 1 – skid clamp\* to PLET clamp * PLET Anode Skid East Cable 2 – skid bolt to PLET clamp * PFAP to Chain Tensioner Assembly – both not evented: * bolted to chain tensioner and clamped to the PFAP * bolted to the devil’s claw and bolted to the PFAP   The continuity cable to the chain tensioner should be checked during future inspections, however the CP potential reading taken on the chain tensioner test point was -1017mV, indicating good cathodic protection.  \* Most likely a replacement cable, clamped at both ends. | | | | | | | | | | | GREEN |
| **Corrosion** | No corrosion events were logged.  Green Pin Heavy Duty shackle buried on this chain, so a corrosion check could not be done. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel, one on each component, showing good cathodic protection potential.   * PLET - CP range -942mV to -1026mV * Anchor Pile - CP -1060mV * Chain Tensioner - CP -1017mV * Chain Isolation Plate (w/ 2 anodes) **-1126mV**\*\* * Chain shackle adjacent Isolation Plate, PLET side -1019mV * Anchor Chain - CP range – none taken\*\*   \* Non-protected steel, which is normal for chains. Measurement not required.  \*\* The reading of **-1126mV** on the chain isolation point is very negative and should be checked again. The measurement is well outside the stated acceptable range of -850mV to -1100mV and is considered likely to be erroneous.  IMSA Anomaly 20-0022 Chain Isolation Plate, CP out of Range, Status: Routine Monitoring. | | | | | | | | | | | YELLOW |
| **Crossing** | The Jumper Bridge 1 is a protection sleeve around Hold Back Chain No.2 where it crosses over the PM Flowline Jumper 1. The chain at the sleeve location is buoyed up by 3 buoyancy modules. The sleeve and jumper are in contact, however there is no apparent abrasion or evidence of relative movement between the two components. The MBES plot of the PM Flowline Jumper 1 clearly shows a trench made by N-S lateral movement of the jumper, which indicates that there is relative movement during the thermal expansion and contraction of the jumper. | | | | | | | | | | | GREEN |
| **Debris** | Two items of debris were noted on the anode skids:   * PLET Anode Skid West - 4 x installation, wire rope slings * PLET Anode Skid East - 4 x installation, wire rope slings   The wire rope slings are not a hazard to the ROV and are not an integrity threat. | | | | | | | | | | | GREEN |
| **PLET DC Alignment on Flowline 02** | Measurements were taken during the C4A Baseline Survey (Cold) on 8 Feb 2018. No check was done during the Hot Baseline Survey, August 2019.   * PLET DC Northeast - 0m (Range -0.5m / +3.0m) * PLET DC Southwest - 0m (Range -0.5m / +3.0m)   The flowline was not producing (cold) during the survey. | | | | | | | | | | | GREEN |
| **Status Check** | The status of the following items was checked and videoed during the survey and there were no associated findings.   * PLET Frame Bullseye - 1° between Quadrant 1 & 2 (N). * PFAP Bullseye - 0. 5° Quadrant 3 (NE). * PFAP Chain Devil’s Claw Setting - 1.43 on the scale. * PLET Isolation Valve 031-FIV-021 - in the OPEN position | | | | | | | | | | | GREEN |
| **Seabed Condition** | The seabed is mainly silt/sand and from the MBES survey, the PLET Frame and wings appear to be buried and ‘scoured out’ around the components that protrude above the PLET base frame. Although the status is currently GREEN, the scour and burial of the PLETs should be trended over successive surveys. MBES surveys will give the best overview and the ROV surveys can add the required detailed observations. | | | | | | | | | | | GREEN |
| **Burial (Structural)** | The video survey of the PLET Mudmat Wings confirmed the MBES survey results, both mudmats are buried.   * PLET East Mudmat Wing - 100% buried t o an estimated depth of 0.15m * PLET West Mudmat Wing - 100% buried to an estimated depth of 0.15m | | | | | | | | | | | GREEN |
| **Burial (Hold Back Chain)** | With the exception of the connections to the PFAP chain tensioner and the PLET, the chain appears to be fully buried and not under significant tension. In addition, the chain is exposed either side of the Jumper Bridge 1 crossing.  An additional comment was made in Burial (Linear) Event 9, “Anchor Side: Green Pin Heavy Duty Shackle, Green Pin Bow Shackle and the Enlarged End Link 100% buried. Isolation Plate 80% buried.” | | | | | | | | | | | GREEN |
| **Scour** | A scour survey was carried out on all 8 corners of the East & West mudmats and no scour was seen. All 8 corners were buried.  The seabed level on the sides of the PFAP suction anchor pile is as follows (Acceptance Criteria is 12.5m to 13.5m):   * Anchor Pile, North side - 13m * Anchor Pile, Southwest side - 12.7m * Anchor Pile, Southeast side - 12.6m   No scour was evident around the anchor pile. | | | | | | | | | | | GREEN |
| **PLET DC Flowline 03** | | | | | | | | | | | | |
| **GVI** | In general, PLET DC Flowline 03 is in good condition with no findings raised. | | | | | | | | | | | GREEN |
| **Anode** | (Summarized by component)  All anodes were found to be active, secure and <25% depleted.   * PLET Anode Skid West & East * PLET Frame (typical) * Chain Tensioner * PFAP (typical) & Vent (4) * Jumper Bridge Buoyancy Modules 2 Upper & 2 Lower   Only one anode could not be surveyed due to burial:   * Chain Isolation Plate (PLET end) - buried | | | | | | | | | | | GREEN |
| **Continuity Cables** | Cables are all bolted at one end and clamped at the other end. The cables were partially buried. All clamps were attached.   * PLET Anode Skid West Cable 1 – skid bolt to PLET clamp * PLET Anode Skid West Cable 2 – skid bolt to PLET clamp * PLET Anode Skid East Cable 1 – skid bolt to PLET clamp * PLET Anode Skid East Cable 2 – skid bolt to PLET clamp * PFAP to Chain Tensioner Assembly – both not evented: * bolted to chain tensioner and clamped to the PFAP * bolted to the devil’s claw and bolted to the PFAP   The continuity cable to the chain tensioner should be checked during future inspections, however the CP potential reading taken on the chain tensioner test point was -1035mV, indicating good cathodic protection. | | | | | | | | | | | GREEN |
| **Corrosion** | No corrosion events were logged. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel, one each on the component, showing good cathodic protection potential.   * PLET - CP range -940mV to -1039mV * Anchor Pile - CP -1034mV * Chain Tensioner - CP -1035mV * Chain Isolation Plate (w/ 2 anodes) -1001mV * Chain shackle adjacent Isolation Plate, PLET side -710mV\* * Chain shackle adjacent Isolation Plate, Anchor side -647mV\* * Anchor Chain - CP range –none taken\*\*   \* CP’s on chain indicate non-protected steel, which is normal for chains.  \*\* Measurement not required. | | | | | | | | | | | GREEN |
| **Crossing** | The Jumper Bridge 4 is a protection sleeve around Hold Back Chain No.3 where it crosses over the PM Flowline Jumper 4. The chain at the sleeve location, is buoyed up by 3 buoyancy modules. The sleeve and jumper are in contact, however there is no apparent abrasion or evidence of relative movement between the two components. The MBES plot of the PM Flowline Jumper 4 clearly shows a trench made by N-S lateral movement of the jumper, which indicates that there is relative movement during the thermal expansion and contraction of the jumper. | | | | | | | | | | | GREEN |
| **Debris** | Two items of debris were noted on the anode skids:   * PLET Anode Skid West - 4 x installation, wire rope slings * PLET Anode Skid East - 4 x installation, wire rope slings   The wire rope slings are not a hazard to the ROV and are not an integrity threat. | | | | | | | | | | | GREEN |
| **PLET DC Alignment on Flowline 03** | Measurements were taken during the C4A Baseline Survey (Cold) on 8 Feb 2018 as follows:   * PLET DC Northeast - 0m (Range -0.5m / +3.0m) * PLET DC Southwest - 0m (Range -0.5m / +3.0m)   The flowline was non-producing (cold) during the survey.  Measurements were also taken during the 2019 Q2 P7 Flow Module Campaign on 15 May 2019, as follows:   * PLET DC Southwest - +0.1m (Range -0.5m / +3.0m)   The flowline was assumed to be non-producing (cold) during the survey. | | | | | | | | | | | GREEN |
| **Status Check** | The status of the following items was checked and videoed during the survey and there were no associated findings.   * PLET Frame Bullseye - 1° between Quadrant 1 (NW). * PFAP Bullseye - 0°. * PFAP Chain Devil’s Claw Setting - 0.9 on the scale. * PLET Isolation Valve 032-FIV-031 - in the OPEN position. | | | | | | | | | | | GREEN |
| **Seabed Condition** | The seabed is mainly silt/sand and from the MBES survey, the PLET Frame and wings appear to be buried and ‘scoured out’ around the components that protrude above the PLET base frame. Although the status is currently GREEN, the scour and burial of the PLETs should be trended over successive surveys. MBES surveys will give the best overview and the ROV surveys can add the required detailed observations. | | | | | | | | | | | GREEN |
| **Burial (Structural)** | The video survey of the PLET Mudmat Wings confirmed the MBES survey results, both mudmats are buried.   * PLET East Mudmat Wing - 100% buried to an estimated depth of 0.15m * PLET West Mudmat Wing – 100% buried to an estimated depth of 0.2m | | | | | | | | | | | GREEN |
| **Burial (Hold Back Chain)** | With the exception of the connections to the PFAP chain tensioner and the PLET, the chain appears to be fully buried and not under significant tension. In addition, the chain is exposed either side of the Jumper Bridge 4 crossing. | | | | | | | | | | | GREEN |
| **Scour** | A scour survey was done on all 8 corners of the East & West mudmats and no scour was seen. All 8 corners were buried.  The seabed level on the sides of the PFAP suction anchor pile is as follows (Acceptance Criteria is 12.5m to 13.5m):   * Anchor Pile, North side - 12.6m * Anchor Pile, Southwest side - 12.5m * Anchor Pile, Southeast side - 12.6m   No scour was evident around the anchor pile. | | | | | | | | | | | GREEN |
| **PLET DC Flowline 04** | | | | | | | | | | | | |
| **GVI** | In general, the PLET DC Flowline 04 is in good condition with 3 findings raised. All 3 findings were not integrity issues and details are included in the Cathodic Potential Measurements and the Status Check sections below. | | | | | | | | | | | GREEN |
| **Anode** | (Summarized by component)  All anodes were found to be active, secure and <25% depleted.   * PLET Anode Skid West & East * PLET Frame (typical) * Chain Tensioner & Isolation Plate * PFAP (typical) & Vent (4) | | | | | | | | | | | GREEN |
| **Continuity Cables** | Cables are all bolted at one end and clamped at the other end. The cables were partially buried. All clamps were attached.   * PLET Anode Skid West Cable 1 - skid bolt to PLET clamp * PLET Anode Skid West Cable 2 - skid bolt to PLET clamp * PLET Anode Skid East Cable 1 - skid bolt to PLET clamp * PLET Anode Skid East Cable 2 - skid bolt to PLET clamp * PFAP to Chain Tensioner Assembly - both not evented * bolted to chain tensioner and clamped to the PFAP. * bolted to the devil’s claw and bolted to the PFAP.   The continuity cable to the chain tensioner should be checked during future inspections, however the CP potential reading taken on the chain tensioner test point was -1038mV, indicating good cathodic protection. | | | | | | | | | | | GREEN |
| **Corrosion** | No corrosion related events were raised. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel readings, one on each component, showing good cathodic protection potential.   * PLET - CP range -923mV to -1033mV * Anchor Pile - CP -1022mV * Chain Tensioner - CP -1038mV * Chain Isolation Plate (w/ 2 anodes) -1058mV * Anchor Chain, either side of the isolation plate - CP range -640mV to -659mV\* * \* CP’s on chain indicate non-protected steel, which is normal for chain assemblies. | | | | | | | | | | | GREEN |
| **Debris** | Two items of debris were noted on the anode skids.   * PLET Anode Skid West - 4 x installation, wire rope slings * PLET Anode Skid East - 4 x installation, wire rope slings   The wire rope slings are not a hazard to the ROV and are not an integrity threat. | | | | | | | | | | | GREEN |
| **PLET DC Alignment on Flowline 04** | Measurements were taken during the C4A Baseline Survey (Cold) on 8 Feb 2018. No check was done during the Hot Baseline Survey, August 2019.   * PLET DC Northeast – 0m (Range -0.5m / +3.0m) * PLET DC Southwest – 0m (Range -0.5m / +3.0m)   The flowline was non-producing (cold) during the survey  Measurements were also taken during the 2019 Q2 P7 Flow Module Campaign on 15 May 2019, as follows:   * PLET DC Southwest – +0.7m (Range -0.5m / +3.0m)   The flowline was producing during the survey. | | | | | | | | | | | GREEN |
| **Status Check** | The status of the following items was checked and videoed during the survey and there were no associated findings.   * PLET Frame Bullseye - 1.5° Quadrant 1 (SW) * PFAP Bullseye - 0.25° Quadrant 1 (SW) * PFAP Chain Devil’s Claw Setting - 1.2 on the scale * PLET Isolation Valve 031-FIV-011 - in the OPEN position   PFAP Vent 03 including Cover: East locking clamp open, no change in condition from 2018. The TA advised that the locking clamps were redundant after installation (IMSA Anomaly 18-0001, Status: Closed) | | | | | | | | | | | GREEN |
| **Seabed Condition** | The seabed is mainly silt/sand and from the MBES survey, the PLET Frame and wings appear to be buried and ‘scoured out’ around the components that protrude above the PLET base frame. One isolated spot on the Southeast corner of the mudmat has 0.1m scour. Although the status is currently GREEN, the scour and burial of the PLETs should be trended over successive surveys. MBES surveys will give the best overview and the ROV surveys can add the required detailed observations. | | | | | | | | | | | GREEN |
| **Burial (Structural)** | The video survey of the PLET Mudmat Wings confirmed the MBES survey results, both mudmats are buried.   * PLET East Mudmat Wing - 100% buried to an estimated depth of 0.1m * PLET West Mudmat Wing – 100% buried to an estimated depth of 0.25m | | | | | | | | | | | GREEN |
| **Burial (Hold Back Chain)** | With the exception of the connections to the PFAP chain tensioner and the PLET, the chain appears to be fully buried and not under significant tension. | | | | | | | | | | | GREEN |
| **Scour** | A scour survey was carried out on all 8 corners of the East & West mudmats and no scour was seen. All 8 corners were buried with the exception of one isolated point of scour, at the Southeast corner, 0.1m deep.  The seabed level on the sides of the PFAP suction anchor pile is as follows (Acceptance Criteria is 12.5m to 13.5m):   * Anchor Pile, North side - 12.5m * Anchor Pile, Southwest side - 12.5m * Anchor Pile, Southeast side - 13m   No scour was evident around the anchor pile. | | | | | | | | | | | GREEN |
| **PLET RBM Flowline 01** | | | | | | | | | | | | |
| **GVI** | In general, the PLET RBM Flowline 01 is in good condition with no findings raised. | | | | | | | | | | | GREEN |
| **Anode** | (Summarized by component)  All anodes were found to be active, secure and <25% depleted.   * PLET Anode Skid West & East * PLET Frame (typical) | | | | | | | | | | | GREEN |
| **Continuity Cables** | Cables are all bolted to the anode skid and clamped to the PLET frame. The cables were partially buried. All clamps were attached and visible on this PLET.   * PLET Anode Skid West Cable 1 – skid bolt to PLET clamp * PLET Anode Skid West Cable 2 – skid bolt to PLET clamp * PLET Anode Skid East Cable 1 – skid bolt to PLET clamp * PLET Anode Skid East Cable 2 – skid bolt to PLET clamp | | | | | | | | | | | GREEN |
| **Corrosion** | No corrosion events were logged on this PLET. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel - all readings showing good cathodic protection potential.   * PLET ROV Panel -1025mV * PLET Mudmat Post, Northwest -1031mV * PLET Mudmat Post, Northeast -1031mV | | | | | | | | | | | GREEN |
| **Debris** | Two items of debris were noted on the anode skids.   * PLET Anode Skid West - 4 x installation, wire rope slings * PLET Anode Skid East - 4 x installation, wire rope slings   The wire rope slings are not a hazard to the ROV and are not an integrity threat. | | | | | | | | | | | GREEN |
| **PLET RBM Alignment on Flowline 01** | Measurements were taken during the C4A Baseline Survey (Cold) on 10 Feb 2018. No check was done during the Hot Baseline Survey, August 2019.   * PLET RBM East - 0m (Range -0.0m / +3.5m) * PLET RBM West - 0m (Range -0.0m / +3.5m)   The flowline was non-producing (cold) during the survey. | | | | | | | | | | | GREEN |
| **Status Check** | The status of the following items was checked and videoed during the survey and there were no associated findings.   * PLET Frame Bullseye - 1.5° Quadrant 2 (S) * PLET Isolation Valve 031-FIV-012 - in the OPEN position | | | | | | | | | | | GREEN |
| **Seabed Condition** | The seabed is mainly silt/sand and from the MBES survey, the PLET Frame and wings appear to be buried and ‘scoured out’ around the components that protrude above the PLET base frame. Although the status is currently GREEN, the scour and burial of the PLETs should be trended over successive surveys. MBES surveys will give the best overview and the ROV surveys can add the required detailed observations. | | | | | | | | | | | GREEN |
| **Burial (Structural)** | The video survey of the PLET Mudmat Wings confirmed the MBES survey results, both mudmats are buried.   * PLET East Mudmat Wing - 90% buried to an estimated depth of 0.1m * PLET West Mudmat Wing - 100% buried to an estimated depth of 0.1m | | | | | | | | | | | GREEN |
| **Scour** | A scour survey was carried out on all 8 corners of the East & West mudmats & mudmat wings and minor scour was seen. 6 corners were buried and the other 2 showed scouring as listed below:   * RBM PLET Mudmat Northwest corner – scoured 0.1m * RBM PLET Mudmat Northeast corner – scoured 0.2m | | | | | | | | | | | GREEN |
| **PLET RBM Flowline 02** | | | | | | | | | | | | |
| **GVI** | In general, the PLET RBM Flowline 02 is in good condition with no findings raised. | | | | | | | | | | | GREEN |
| **Anode** | (Summarized by component)  All anodes were found to be active, secure and <25% depleted.   * PLET Anode Skid West & East * PLET Frame (typical) | | | | | | | | | | | GREEN |
| **Continuity Cables** | Cables are all bolted to the anode skid and clamped to the PLET frame. The cables were partially buried. All clamps were attached and visible on this PLET.   * PLET Anode Skid West Cable 1 - skid bolt to PLET clamp * PLET Anode Skid West Cable 2 - skid bolt to PLET clamp * PLET Anode Skid East Cable 1 - skid bolt to PLET clamp * PLET Anode Skid East Cable 2 - skid bolt to PLET clamp | | | | | | | | | | | GREEN |
| **Corrosion** | No corrosion events were logged on this PLET. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel - all readings showing good cathodic protection potential.   * PLET ROV Panel -1025mV * PLET Mudmat Post, Northwest -1032mV * PLET Mudmat Post, Northeast -1033mV | | | | | | | | | | | GREEN |
| **Debris** | Two items of debris were noted on the anode skids.   * PLET Anode Skid West - 4 x installation, wire rope slings * PLET Anode Skid East - 4 x installation, wire rope slings   The wire rope slings are not a hazard to the ROV and are not an integrity threat. | | | | | | | | | | | GREEN |
| **PLET RBM Alignment on Flowline 02** | Measurements were taken during the C4A Baseline Survey (Cold) on 10 Feb 2018. No check was done during the Hot Baseline Survey, August 2019.   * PLET RBM East – 0m (Range -0.0m / +3.5m) * PLET RBM West – 0m (Range -0.0m / +3.5m)   The flowline was non-producing (cold) during the survey. | | | | | | | | | | | GREEN |
| **Status Check** | The status of the following items was checked and videoed during the survey and there were no associated findings.   * PLET Frame Bullseye - 2° Quadrant 1 (S) * PLET Isolation Valve 031-FIV-022 - in the OPEN position | | | | | | | | | | | GREEN |
| **Seabed Condition** | The seabed is mainly silt/sand and from the MBES survey, the PLET Frame and wings appear to be buried and ‘scoured out’ around the components that protrude above the PLET base frame. Although the status is currently GREEN, the scour and burial of the PLETs should be trended over successive surveys. MBES surveys will give the best overview and the ROV surveys can add the required detailed observations. | | | | | | | | | | | GREEN |
| **Burial (Structural)** | The video survey of the PLET Mudmat Wings confirmed the MBES survey results, both mudmats are buried.   * PLET East Mudmat Wing - 70% buried to an estimated depth of 0.05m * PLET West Mudmat Wing - 90% buried to an estimated depth of 0.1m | | | | | | | | | | | GREEN |
| **Scour** | A scour survey was carried out on all 8 corners of the East & West mudmats & mudmat wings and minor scour was seen. 6 corners were buried and the other 2 showed scouring as listed below.   * RBM PLET Mudmat Northwest corner – scoured 0.1m * RBM PLET Mudmat Northeast corner – scoured 0.25m | | | | | | | | | | | GREEN |
| **PLET RBM Flowline 03** | | | | | | | | | | | | |
| **GVI** | In general, the PLET RBM Flowline 03 is in good condition with 2 findings raised. The findings are related to Debris and Corrosion and the details can be found in the corresponding section below. | | | | | | | | | | | GREEN |
| **Anode** | (Summarized by component)  All anodes were found to be active, secure and <25% depleted.   * PLET Anode Skid West & East * PLET Frame (typical) | | | | | | | | | | | GREEN |
| **Continuity Cables** | Cables are all bolted to the anode skid and clamped to the PLET frame. The cables and bolted attachment points were partially buried. All clamps were attached and visible on this PLET.   * PLET Anode Skid West Cable 1 - skid bolt to PLET clamp * PLET Anode Skid West Cable 2 - skid bolt to PLET clamp * PLET Anode Skid East Cable 1 - skid bolt to PLET clamp * PLET Anode Skid East Cable 2 - skid bolt to PLET clamp | | | | | | | | | | | GREEN |
| **Corrosion** | An isolated spot of corrosion (with possible blistering) was noted on the Southwest Strut Tower. The diameter of the area is estimated to be 70mm and needs to be water jetted cleaned in order to determine if there is any pitting corrosion. This is not currently an integrity issue but should be monitored with CVI and CP. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel - all readings showing good cathodic protection potential.   * PLET ROV Panel -1024mV * PLET Mudmat Post, Northwest -1040mV * PLET Mudmat Post, Northeast -1035mV | | | | | | | | | | | GREEN |
| **Debris** | Two items of debris were noted on the anode skids.   * PLET Anode Skid West - 4 x installation, wire rope slings * PLET Anode Skid East - 4 x installation, wire rope slings   PLET - 2 x Soft rope attached to mudmat wings, up to 3m in length. This is not integrity related but, should be removed as an ROV hazard.  The wire rope slings are not a hazard to the ROV and are not an integrity threat. | | | | | | | | | | | GREEN |
| **PLET RBM Alignment on Flowline 03** | Measurements were taken during the C4A Baseline Survey (Cold) on 10 Feb 2018. No check was done during the Hot Baseline Survey, August 2019.   * PLET RBM East – 0m (Range -0.0m / +3.5m) * PLET RBM West – 0m (Range -0.0m / +3.5m)   The flowline was non-producing (cold) during the survey.  Measurements were also taken during the 2019 Q2 P7 Flow Module Campaign on 15 May 2019, as follows:   * PLET RBM West - +0.2m (Range -0.0m / +3.5m)   The flowline was assumed to be non-producing during the survey. | | | | | | | | | | | GREEN |
| **Status Check** | The status of the following items was checked and videoed during the survey and there were no associated findings.   * PLET Frame Bullseye - 2° Quadrant 1 (Southeast) * PLET Isolation Valve 032-FIV-032 - in the OPEN position   The Northeast mudmat wing strut locking sleeve was checked and found to be not in place, allowing the strut to bend at the centre hinge joint. This unlocked strut is not considered a threat to the effectiveness of the mudmat, and it has already fully settled into the seabed (IMSA Anomaly 18-0013, Clearance /Alignment, Status: Closed. | | | | | | | | | | | GREEN |
| **Seabed Condition** | The seabed is mainly silt/sand and from the MBES survey, the PLET Frame and wings appear to be buried and ‘scoured out’ around the components that protrude above the PLET base frame. Although the status is currently GREEN, the scour and burial of the PLETs should be trended over successive surveys. MBES surveys will give the best overview and the ROV surveys can add the required detailed observations. | | | | | | | | | | | GREEN |
| **Burial (Structural)** | The video survey of the PLET Mudmat Wings confirmed the MBES survey results, both mudmats are mostly buried.   * PLET East Mudmat Wing - 80% buried to an estimated depth of 0.1m * PLET West Mudmat Wing – 90% buried to an estimated depth of 0.1m | | | | | | | | | | | GREEN |
| **Scour** | A scour survey was done on all 8 corners of the East & West mudmats & mudmat wings and minor scour was seen. 6 corners were buried and the other 2 showed scouring as listed below.   * RBM PLET Mudmat Northwest corner - scoured 0.15m * RBM PLET Mudmat Northeast corner - scoured 0.25m | | | | | | | | | | | GREEN |
| **PLET RBM Flowline 04** | | | | | | | | | | | | |
| **GVI** | In general, the PLET RBM Flowline 04 is in good condition with no findings raised. | | | | | | | | | | | GREEN |
| **Anode** | (Summarized by component)  All anodes were found to be active, secure and <25% depleted.   * PLET Anode Skid West & East * PLET Frame (typical) | | | | | | | | | | | GREEN |
| **Continuity Cables** | Cables are all bolted to the anode skid and clamped to the PLET frame. The cables and bolted attachment points were partially buried on the East anode skid. All clamps were attached and visible on this PLET. The bolted ends of the cable should be confirmed intact during the next inspection.   * PLET Anode Skid West Cable 1 - skid bolt to PLET clamp * PLET Anode Skid West Cable 2 - skid bolt to PLET clamp * PLET Anode Skid East Cable 1 - skid bolt to PLET clamp * PLET Anode Skid East Cable 2 - skid bolt to PLET clamp   There is no positive way of confirming the continuity of the cable connections without the use of a tool such as a Swain Clamp meter for measuring current flow through the wire. However CP readings indicate good protection. | | | | | | | | | | | GREEN |
| **Corrosion** | No corrosion events were logged for this PLET. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel - all readings showing good cathodic protection potential.   * PLET ROV Panel -1025mV * PLET Mudmat Post, Northwest -1039mV * PLET Mudmat Post, Northeast -1040mV | | | | | | | | | | | GREEN |
| **Debris** | Two items of debris were noted on the anode skids.   * PLET Anode Skid West - 4 x installation, wire rope slings * PLET Anode Skid East - 4 x installation, wire rope slings   PLET – 2 x Soft rope attached to mudmat wings. This is not integrity related, however this debris should be removed as an ROV hazard.  The wire rope slings are not a hazard to the ROV and are not an integrity threat. | | | | | | | | | | | GREEN |
| **PLET RBM Alignment on Flowline 04** | Measurements were taken during the C4A Baseline Survey (Cold) on 10 Feb 2018. No check was done during the Hot Baseline Survey, August 2019.   * PLET RBM East - 0m (Range -0.0m / +3.5m) * PLET RBM West - 0m (Range -0.0m / +3.5m)   The flowline was non-producing (cold) during the survey.  Measurements were also taken during the 2019 Q2 P7 Flow Module Campaign on 15 May 2019, as follows:   * PLET RBM West - +0.6m (Range -0.0m / +3.5m)   The flowline was producing during the survey. | | | | | | | | | | | GREEN |
| **Status Check** | The status of the following items was checked and videoed during the survey and there were no associated findings.   * PLET Frame Bullseye - 1.75° between Quadrant 1 & 2 (South) * PLET Isolation Valve 032-FIV-042 - in the OPEN position | | | | | | | | | | | GREEN |
| **Seabed Condition** | The seabed is mainly silt/sand and from the MBES survey, the PLET Frame and wings appear to be buried and ‘scoured out’ around the components that protrude above the PLET base frame. Although the status is currently GREEN, the scour and burial of the PLETs should be trended over successive surveys. MBES surveys will give the best overview and the ROV surveys can add the required detailed observations. | | | | | | | | | | | GREEN |
| **Burial (Structural)** | The video survey of the PLET Mudmat Wings confirmed the MBES survey results, both mudmats are mostly buried.   * PLET East Mudmat Wing - 90% buried to an estimated depth of 0.1m * PLET West Mudmat Wing - 80% buried to an estimated depth of 0.15m | | | | | | | | | | | GREEN |
| **Scour** | A scour survey was done on all 8 corners of the East & West mudmats & mudmat wings and minor scour was seen. 6 corners were buried and the other 2 showed scouring as listed below.   * RBM PLET Mudmat Northwest corner - scoured 0.05m * RBM PLET Mudmat Northeast corner - scoured 0.2m | | | | | | | | | | | GREEN |
| Manifolds | | | | | | | | | | | | |
| The two production manifolds were partially surveyed during the 2020C1 campaign, with the Production Manifold West receiving the highest priority. The riser base manifold was fully inspected during the HBL and was not revisited during the 2020 C1 Campaign.  Three manifolds are detailed in this section:   * 4.2.1.6.1 [Production Manifold East Assembly (PME)](#_Production_Manifold_East) * 4.2.1.6.2 [Production Manifold West Assembly (PMW)](#_Production_Manifold_West) * 4.2.1.6.3 [Riser Base Manifold Assembly (RBM)](#_Riser_Base_Manifold) | | | | | | | | | | | | |
| **Production Manifold East Assembly (PM-E)** | | | | | | | | | | | | |
| The majority of the PM-E assembly was inspected during the 2019 Hot Baseline Inspection (HBL). However, limited visibility prevented the visual survey of the internal components.  The inspection scope completed during the 2020 C1 campaign was as follows:   * **HP Caps (x3),** debris covers removed to allow GVI, continuity cable and GVI for deposits/corrosion * **CP survey** on HP Caps and the adjacent manifold * **GVI** of the internal aspects of the manifold * **Mumat survey** for scour / burial * Check on previously raised anomalies   Where appropriate, data has been included from earlier inspection and previous anomaly reports. | | | | | | | | | | | | |
| **GVI** | In general, the PM-E assembly appeared to be in good condition with all open anomalies addressed during the 2020C1 campaign.  The previously identified missing Debris/MG Caps on valves receptacles were rectified and are included in the following list:   * AU.PRL.011-VV-CIM1 - PM-E (Top) MG Cap Replaced * AU.PRL.011-VV-CIM2 - PM-E (Top) MG Cap Replaced but doesn’t fit corrrectly * AU.PRL.011-MV1A-001 - PM-E (Top) Debris Cap Replaced * AU.PRL.011-MV3A-001 - PM-E (Top) Debris Cap present * AU.PRL.011-MV4A-001 - PM-E (Top) Debris Cap present * AU.PRL.011-MV6A-001 - PM-E (Top) Debris Cap present   As a general recommendation for the Debris/MG Caps, an assortment of all sizes of caps should be kept onbaord the support vessel and replaced on an opportunity basis. (IMSA Anomaly 19-0055, Missing Equipment, Status: Routine Monitoring).  The GVI of the internal aspects of the manifold was hampered by poor visiblilty and was limited in its success. | | | | | | | | | | | GREEN |
| **Anode** | During the HBL campaign, a representative sample of anodes (5) was chosen to estimate the condition of the anodes on the Front (SW), Back (NE) and Left (NW) side of the PM-E. All the stand-off anodes were found to be active, secure and depleted <25%. | | | | | | | | | | | GREEN |
| **Connectors** | During the HBL, the EFL-001 Valve Position Indicator (VPI) connectors were checked at the SCM and Manifold ends and were found to be secure and aligned.  During the C4A Baseline Survey (Cold), 25 Jan 2018, the SFL-001, F/PME-PME at HDM1 and PME was checked and found secure.  It is not clear if the remaining connectors were checked, however there are events raised on the flying leads, separate from the connectors. | | | | | | | | | | | GREEN |
| **Continuity Cables** | Mudmat Locks - All 4 mudmats locks were previously checked and their cables were securely bolted at each end.  Hub Debris/Marine Growth Caps - The cables for Hub E2, E5 and E6 were checked and the manifold side of the cables is securely bolted. The HP cap ends of the cables were seen, although it was difficult to visual confirm the security of the cables. However, the CP measurements confirmed that continuity was established between the manifold and the HP Caps.  (IMSA Anomaly 20-0004, Confirm Cathodic Protection Potentials of the HO Caps by removing the protective covers, Status: Closed) | | | | | | | | | | | GREEN |
| **Corrosion & Deposits** | The following 3 HP marine growth covers were removed to check for black deposits on the HP Caps and check the continuity wires:  Hub E6 – Deposits found and removed, continuity wires intact and no associated corrosion was apparent  Hub E5 (P9) – Deposits found and removed, continuity wires intact and no associated corrosion was apparent  Hub E2 (F4) – Deposits found and removed, continuity wires intact and no associated corrosion was apparent  (Refer IMSA Anomaly 17-0002, Black Deposits on PM HP Caps, Status: Routine Monitoring)  D:\220283_413-IN-CL-014-0002\2020 C1\Stills\Production_Flowloop_System\Production_Manifolds\PM_E\0467 - GVI 37_E2 (F4) HP Cap PostClean-Standoff.jpg  HP Hub E2 (F4) - This is a typical post-cleaning inspection photo of an HP Hub. Note, the continuity wire is leading in from the left side of the picture.  CP measurements were also taken on the HP hubs to confirm that the continuity wires were intact (Refer IMSA Anomaly 20-0004, Black Deposits on PM HP Caps, Status: Closed).  3 minor corrosion events were logged for PM-E.   * E2 (F4) Hub Debris/MG cover dummy stab handle had signs of surface corrosion. * Both the E5 (P9) and E6 Hub Debris/MG covers show sign of possible corrosion staining around the base of the covers.   In all 3 cases, these are not integrity issues and all items can be retrieved to the surface for remedial action, if required.  (IMSA Anomaly 20-0044, Localized external corrosion, Status: Routine monitoring). | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | During the 2020 C1 campaign, CP measurements were taken on the HP hubs and on the adjacent manifold top deck. All measurements were within an acceptable range, typically between -1011mV to -1024mV, with one outlier CP reading taken on Hub E5 (P9), which was -980mV. The CP measurement of -980mV on Hub E5 (P9) is still well within the acceptable range, however is disimilar to the other HP Hub readings.  (IMSA Anomaly 20-0004, Confirm HP Cap Cathodic Protection Potentials, Status: Routine monitoring).  During the HBL survey, CP measurements (5) were taken on the top and the 4 sides of PM-E and ranged from -988mV to -1014mV, all within range and showing good levels of cathodic protection.  In 2017, CP readings were taken on PM-E test points, East & West and both were -1003mV. | | | | | | | | | | | GREEN |
| **Status Check** | One valve position check was noted during the 202 C1 campaign.   * AU.PRL.011-VV-CIM2 - Chemical Injection Valve 2 Manifold - CLOSED   All other valve sites were visited during the HBL Inspection; however, the manifold branch valve indicators were not checked as per instruction in MOC 220283-MOC-QA-CL-202-0059.  **HBL - Seabed Assets Inspection Scope 16,28/09/2019:**   * AU.PRL.011-FIV-001 - Flowline Isolation Valve 1 - OPEN * AU.PRL.011-FIV-002 - Flowline Isolation Valve 2 - OPEN * AU.PRL.011-HIV-8001 - Header Isolation Valve 1 - Override As Left: NEUTRAL * AU.PRL.011-HIV-8001 - Header Isolation Valve 1 - OPEN * AU.PRL.011-HIV-8002 - Header Isolation Valve 2 - Override As Left: NEUTRAL * AU.PRL.011-HIV-8002 - Header Isolation Valve 2 - PM-E - OPEN * AU.PRL.011-VV-CIM1 - Chemical Injection Valve 1 Manifold (MG CAP Installed) * AU.PRL.011-VV-CIM1 - Chemical Injection Valve 1 Manifold - CLOSED * AU.PRL.011-VV-CIM2 - Chemical Injection Valve 2 Manifold - CLOSED * AU.PRL.011-VV-ST1A - PM-E (Right) Seal Test Valve 1A - CLOSED * AU.PRL.011-VV-ST1B - PM-E (Right) Seal Test Valve 1B - CLOSED * AU.PRL.011-VV-ST2A - PM-E (Left) Seal Test Valve 2A - CLOSED * AU.PRL.011-VV-ST2B - PM-E (Left) Seal Test Valve 2B – CLOSED   **HBL Status checks, indicators not inspected, as per MOC 220283-MOC-QA-CL-202-0059 - 28/09/2019**  **‘As Left’ Survey C4A - Commissioning and Start Up Support, 16/01/2018, after valve cycling test on 15/01/2018.**   * AU.PRL.011-MV1A-001 - PM-E (Top) Manifold Branch Valve 1A Passive * AU.PRL.011-MV1B-001 - PM-E (Top) Manifold Branch Valve 1B Passive * AU.PRL.011-MV2A-001 - PM-E (Top) Manifold Branch Valve 2A MCLOT * AU.PRL.011-MV2B-001 - PM-E (Top) Manifold Branch Valve 2B Passive * AU.PRL.011-MV3A-001 - PM-E (Top) Manifold Branch Valve 3A Passive * AU.PRL.011-MV3B-001 - PM-E (Top) Manifold Branch Valve 3B Passive * AU.PRL.011-MV4A-001 - PM-E (Top) Manifold Branch Valve 4A Passive * AU.PRL.011-MV4B-001 - PM-E (Top) Manifold Branch Valve 4B Passive * AU.PRL.011-MV5A-001 - PM-E (Top) Manifold Branch Valve 5A Passive * AU.PRL.011-MV5B-001 - PM-E (Top) Manifold Branch Valve 5B MCLOT * AU.PRL.011-MV6A-001 - PM-E (Top) Manifold Branch Valve 6A Passive * AU.PRL.011-MV6B-001 - PM-E (Top) Manifold Branch Valve 6B MCLOT   **HBL - Seabed Assets Inspection Scope 16,28/09/2019**   * PM-E / Back NE Mudmat Lock LOCKED * PM-E / Back NW Mudmat Lock LOCKED * PM-E / Front SE Mudmat Lock PARTIAL LOCK\* * PM-E / Front SW Mudmat Lock LOCKED   \*Note: The manifold is a gravity structure and the mudmat locks are not required after installation. This is not an integrity issue. | | | | | | | | | | | GREEN |
| **Flying Leads** | Previously, it was noted that 2 of the flying leads appeared to have fairly sharp bends where they contact the top deck of the PM-W. The flying leads involved are as follows:   * AU.PRL.11-EFL-001A – Electrical Flying Lead F/EDM-PM-E * AU.PRL.11-EFL-001B – Electrical Flying Lead F/EDM-PM-E   The minimum bend radius for the flying leads is 127mm.  These leads were water jetted, at the minimum radius points and checked during the 2020C1 campaign. The flying leads did not appear to be kinked and the leads did not exhibit any relative movement to the manifold.  (IMSA Anomaly 19-0056, Minimum Bending Radius, Status: Routine Monitoring). | | | | | | | | | | | GREEN |
| **Damage** | Minor damage to the dummy hot stabs on Hub Debris/MG covers was recorded:   * E6 Hub Protection Cover, dummy stab handle is bent * E5 (P9) Hub Protection Cover, dummy stab T-bar handle is broken   (IMSA Anomaly 21-0018, Physical Damage, Status: Routine Monitoring). | | | | | | | | | | | GREEN |
| **Mudmat & Seabed Condition** | The seabed is composed of silty sand and apparently the visibility was poor enough that it prevented the ROV from visually estimating burial and scour levels for the PM-E mudmat, with the exception of one measurement taken at the NorthEast corner of the mudmat. This was recorded as ‘0’m scour.  Due to the poor visibility, the bullseye inclination was not recorded.  The MBES survey over the PM-E provides a very well defined pattern of burial that encompasses a band from the Northwest quadrant through to the Southeast quadrant. The mudmat structure is visible in the Northeast and the Southwest quadrants showing isolated scouring in Northeast and Southwest corners. | | | | | | | | | | | GREEN |
| **Production Manifold West Assembly (PM-W)** | | | | | | | | | | | | |
| The majority of the PM-W assembly was inspected during the Hot Baseline Inspection (HBL). However, limited visibility prevented the visual survey of the internal components. During the 2020 C1 campaign the remaining work scope was completed, as per the 2019 recommendations:   * **Mudmat** * GVI * Anode assessment x 1 * Bullseye status check x 2, N & S * CP Steel reading x 1 * Scour measurement * **Manifold Right Face (West), Back Face (South), Left Face (East), Front Face (North)** * GVI of faces and internal components * Anode assessment x 4 * CP Steel reading x 8 * Marine Growth assessment x 3   In addition to the recommendations above, the W2 and W5 HP Caps were inspected by removing the Debris/MG covers, vidually inspected and CP measurements taken.  Where appropriate data has been added from earlier inspection and previous anomaly reports. | | | | | | | | | | | | |
| **GVI** | In general, the PM-W assembly appeared to be in good condition and no new concerns were raised during the 2020 C1 campaign.  The workscope on the PM-W was completed, as planned. The only outstanding item appears to be a comprehensive survey of all the EFL’s and SFL’s and their respective connectors.  Minor issues with the MG Caps are not considered an immediate integrity threat and the assessment is currently GREEN pending corrective action. The TA/Discipline Engineer recommended Cap replacement at the next available opportunity and that an assortment of all cap types are kept onboard for correct replacement of missing items.  (IMSA Anomaly 19-0055, Missing Equipment, Status: Open) | | | | | | | | | | | GREEN |
| **Sacrificial Anodes** | Anode depletion checks were completed on 5 representative anodes; one on the mudmat and 4 on the manifold structure.  All anodes exhibited minimal depletion, in the range of 0% to 25%,  The CP measurements indicate good levels of cathodic protection potentials, which implies that the anodes are active. | | | | | | | | | | | GREEN |
| **Connectors** | Three flying lead connectors to the PM-W SCM were checked during the 2020 C1 campaign, as follows:   * AU.PRL.12-EFL-001 - Electrical Flying Lead F/PM-PM-W * AU.PRL.12-EFL-001A - Electrical Flying Lead F/EDM-PM-W * AU.PRL.12EFL-001B - Electrical Flying Lead F/EDM-PM-W   There has been only one Connector event logged in IMSA and that was during the C4A - Baseline Survey (Cold) During CSU, 25/01/2018:   * AU.PRL.12-SFL-001A - Steel Flying Lead F/PM-PM - the SFL PM-W MQC at HDM1\_PM-W was found to be aligned and secure.   All connectors and flying leads need a comprehensive survey during the next planned inspection. | | | | | | | | | | | YELLOW |
| **Continuity Cables** | Hub Debris/Marine Growth Caps - The cables for Hub W2 and W5 were checked and the manifold side of the cables is securely bolted. The HP cap ends of the cables were seen, although it was difficult to visual confirm the security of the cables. However, the CP measurements confirmed that continuity was established between the manifold and the HP Caps.  (IMSA Anomaly 20-0004, Confirm Cathodic Protection Potentials of the HO Caps by removing the protective covers, Status: Closed) | | | | | | | | | | | GREEN |
| **Corrosion & Deposits** | The following 2 HP marine growth covers were removed to check for the black deposits on the HP Caps and check the continuity wires:  Hub W2 (F2) – Deposits found and removed, continuity wires intact and no associated corrosion was apparent.  Hub W5 (F3) – Minor staining found, water jetted, continuity wires intact and no associated corrosion was apparent.  (Refer IMSA Anomaly 17-0002, Black Deposits on PM HP Caps, Status: Routine Monitoring)    HP Hub W2 (F2) - This is a typical post-cleaning inspection photo of an HP Hub.  CP measurements were also taken on the HP hubs to confirm that the continuity wires were intact (Refer IMSA Anomaly 20-0004, Black Deposits on PM HP Caps, Status: Closed) | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | During the 2020 C1 campaign, 9 CP Steel measurements were taken: 1x CP on the mudmat, 6x CP’s on the manifold structure and 2 CP measurements on HP Caps (W2 and W5).   * Mudmat, East Face CP: -1036mV * PM-W (West) CP Range: -1014mV to -1052mV * HP Cap CP Range: -1013mV to -1015mV   All of the 2020 C1 campaign CP measurements showed a good level of cathodic protection potential.  Previously recorded CP measurements are as follows:  One CP event, HBL inspection, PM-W (West) CP -973mV  One CP event, C3 Campaign, PM-W (West) CP -996mV  The CP’s taken show an adequate level of cathodic protection potential and appear to be stabilizing at a more negative CP range than previously indicated. | | | | | | | | | | | GREEN |
| **Status Check** | Valve position checks were done on the 4 seal test valves during the 2020C1 inspection:   * AU.PRL.012-VV-ST1A- Seal Test Valve 1A Closed * AU.PRL.012-VV-ST1B- Seal Test Valve 1B Closed * AU.PRL.012-VV-ST2A- Seal Test Valve 2A Closed * AU.PRL.012-VV-ST2B- Seal Test Valve 2B Closed   In addition, it was confirmed that the MG Cap is not in place for AU.PRL.012-VV-CIM2 - Chemical Injection Valve 2 Manifold. An MG Cap was place on CIM2 but, it did not fit correctly. It was advised by the CSR to leave the cap in place.  Valve position checks were done on 8 valves during the HBL inspection:   * AU.PRL.012-VV-CIM1- Chemical Injection Valve 1 Manifold N/I * AU.PRL.012-VV-CIM2- Chemical Injection Valve 2 Manifold CLOSED * AU.PRL.012-FIV-001 - Flowline Isolation Valve 3 OPEN * AU.PRL.012-FIV-002 - Flowline Isolation Valve 4 OPEN * AU.PRL.012-HIV-8001 - Header Isolation Valve 3 Override NEUTRAL * AU.PRL.012-HIV-8001 - Header Isolation Valve 3 OPEN * AU.PRL.012-HIV-8002 - Header Isolation Valve 4 Override NEUTRAL * AU.PRL.012-HIV-8002 - Header Isolation Valve 4 CLOSED   The Manifold Branch Valves marked ‘N/I’ had no inspection on the valve indicator as per instruction in MOC 220283-MOC-QA-CL-202-0059. The manifold branch valves went through extensive valve cycling operation on 16/01/2018. During the 2020 C1 campaign, 9 of the 12 manifold branch valves were checked for debris caps. MV3B, MV 4B and MV 5B were not checked:   * AU.PRL.012-MV1A-001-PM-W (Top) Manifold Branch Valve 1A – Debris Cap In Place * AU.PRL.012-MV1B-001-PM-W (Top) Manifold Branch Valve 1B – Debris Cap In Place * AU.PRL.012-MV2A-001-PM-W (Top) Manifold Branch Valve 2A MCLOT in place * AU.PRL.012-MV2B-001-PM-W (Top) Manifold Branch Valve 2B – Debris Cap In Place * AU.PRL.012-MV3A-001-PM-W (Top) Manifold Branch Valve 3A – Debris Cap In Place * AU.PRL.012-MV3B-001-PM-W (Top) Manifold Branch Valve 3B N/I * AU.PRL.012-MV4A-001-PM-W (Top) Manifold Branch Valve 4A – Debris Cap In Place * AU.PRL.012-MV4B-001-PM-W (Top) Manifold Branch Valve 4B N/I * AU.PRL.012-MV5A-001-PM-W (Top) Manifold Branch Valve 5A – Debris Cap In Place * AU.PRL.012-MV5B-001-PM-W (Top) Manifold Branch Valve 5B MCLOT in place * AU.PRL.012-MV6A-001-PM-W (Top) Manifold Branch Valve 6A – Debris Cap In Place, correctly seated * AU.PRL.012-MV6B-001-PM-W (Top) Manifold Branch Valve 6B – Debris Cap In Place | | | | | | | | | | | GREEN |
| **Flying Leads** | It was noted that 3 of the flying leads to the SCM appeared to have fairly sharp bends where they contact the top deck of the PM-W. The minimum bend radius for the flying leads is 127mm. Since the flying leads did not look kinked and the bend radius could not be measured, this was not considered an integrity issue. These leads were checked during 2020 C1 campaign, as per the photo below, which shows the bend radius of the three flying leads to be acceptable.  The flying leads involved are as follows:   * AU.PRL.12-EFL-001 – Electrical Flying Lead F/PM-PM-W * AU.PRL.12-EFL-001A – Electrical Flying Lead F/EDM-PM-W * AU.PRL.12EFL-001B – Electrical Flying Lead F/EDM-PM-W   D:\220283_413-IN-CL-014-0002\2020 C1\Stills\Production_Flowloop_System\Production_Manifolds\PM_W\0522 - GVI 112_SCM Top.jpg  (IMSA Anomaly 19-0056, Minimum Bending Radius, Status: Routine Monitoring). | | | | | | | | | | | GREEN |
| **Seabed Condition**  **& Leveling** | Scour measurements were taken at all 4 corners of the mudmat and the seabed level agreed with previous comments. The silty sand seabed, according to the MBES seabed map, shows the North to Northwest section of the PW-W mudmat buried. The only scour reported was isolated to the Northeast corner, where the seabed is level with the base of the mudmat. The remaining sections of the mudmat appear to be partially buried and the mudmat framing is still discernable.  The Northern and Southern Bulleye level gauges were photographed and showed the West side lower by 1 to 1.5 degerees. | | | | | | | | | | | GREEN |
| **Riser Base Manifold (RBM)** | | | | | | | | | | | | |
| Visual inspection of the Riser Base Manifold was partially completed during the Hot Baseline Inspection (HBL) and the majority of the data included here is from the HBL with the exception of references to previously raised anomalies and additional data from the following inspections:   * C4A - Baseline Survey (Cold) During CSU, March 2018, GVI * Prelude C3, April 2018, CP Steel measurements   As Stated in the DOF Subsea HBL Report, “*Poor visibility was experienced throughout the inspection of the Riser Base Manifold (RBM). Inspection of the faces was completed; however, assessment of condition of pipework, CRA tubing, actuator bottles and overall internal aspects of the manifold was limited. Internal aspects of the Left (East) Face are considered incomplete.*”  Note: All UCON-H012 Connectors have been inspected as part of their respective jumpers. | | | | | | | | | | | | |
| **GVI** | In general, the RBM assembly is in good condition with 8 findings raised. The findings are related to Debris and Corrosion and the details can be found in the corresponding sections below. | | | | | | | | | | | GREEN |
| **Anode** | All anodes were found to be active, secure and <25% depleted. The anodes on the mudmat, in general, were 50 to 100% buried.   * RBM all 4 sides * RBM Mudmat   (RBM top side has no anodes) | | | | | | | | | | | GREEN |
| **Connectors** | All connectors appeared to be in good condition, aligned, secure and intact, with no apparent movement.  Connectors checked during the HBL Inspection were on the valve position indicator electrical flying leads:   * EFL-001 F/RBM VPI - RBM, RBM end * EFL-001 F/RBM VPI – RBM, SCM end * EFL-002 F/RBM VPI - RBM, RBM end * EFL-002 F/RBM VPI - RBM, SCM end   The connectors that were checked during the C4A – Baseline Survey (Cold) During CSU are as follows:   * EFL-001A F/EDM – ESFL A * EFL-001B F/EDM – ESFL B * EFL-002A F/ESFL - RBM A, SCM end * EFL-002A F/ESFL - RBM A, ESFL end * EFL-002B F/ESFL - RBM B, SCM end   EFL-002B F/ESFL - RBM B, ESFL end | | | | | | | | | | | GREEN |
| **Continuity Cables** | The only continuity cables observed were those at the 4 mudmat locking pins. The cables are bolted at each end with single cables.  All appeared to be in place, however the NE pin was not clearly visible during the HBL inspection, although all were clearly visible during the C4A inspection. | | | | | | | | | | | GREEN |
| **Cathodic Potential Measure-ments** | All CP steel measurements taken showed good protection. These readings were consistent for both the HBL and the C3 inspections, as listed below:   * RBM Back HBL-1053mV * RBM Front HBL-1053mV * RBM Left HBL-1054mV * RBM Right HBL-1055mV * RBM Top HBL-1053mV * RBM Mudmat HBL-1053mV   For the Prelude C3 Campaign in April 2018, the readings were as follows:  RBM Sides (x6) ranging from -1048mV to -1059mV  RBM Mudmat measurement was -1059mV. | | | | | | | | | | | GREEN |
| **Debris** | The only significant debris reported is a historically known guide post (2.5m x 0.25m x 0.25m) positioned diagonally within the NW Corner of the RBM frame. The nose is resting on the bolt for a vertical protection panel on the Right (West) Face, the bottom of the guide post is positioned behind the Riser 08 UCON hub on the Back (North) Face. The guide post passes under a small bore CRA tube, with possible deformation noted. No change to the location, position or orientation has been noted during this campaign.  During the 2020 C1 inspection this was checked and there is no integrity concern with regards to this debris item, however it should be monitored during the next inspection to check for any change in status.  (IMSA Anomaly 18-0015, Debris (External) Status: Routine Monitoring) | | | | | | | | | | | GREEN |
| **Status Check** | During the Hot Baseline Inspection, all the main valves were checked, summarized below.   * FCRBV 1, 2, 3 & 4 were all found in the OPEN position * FCRBV Overrides 1, 2, 3 & 4 were all found in the NEUTRAL position * XOV-012 & XOV-034 were found in the OPEN position   The SCM was LOCKED  The Bullseyes were found as follows:   * NE Bullseye: 0.5° SW * SW Bullseye: 0.5° SW   The Mudmat Locks on the NW, SE and SW sides were found to be LOCKED  The Mudmat Lock on the Northeast side is UNLOCKED and this has previously been logged as an anomaly. However, the RBM was designed as a gravity structure and does not require locking pins to secure it to the mudmat. Accordingly, the TAs have closed this anomaly (see IMSA Anomaly 18-0014, Lack of Integrity Status: Closed). | | | | | | | | | | | GREEN |
| **Seabed Condition** | The seabed is mainly silt/sand and from the MBES survey, the RBM mudmat appears to be partially buried with the anodes reportedly buried 50% to 100%. MBES survey gives a good overview showing the extent of burial. | | | | | | | | | | | GREEN |
| **Burial (Structural)** | During the Hot Baseline Survey, the 4 sides of the mudmat were reported to be 90% buried to a depth of 0.2m. | | | | | | | | | | | GREEN |
| **Scour** | A scour survey was done on all 4 corners of the mudmat and isolated scour was observed, as listed below:   * Mudmat Northeast corner scoured by 0.05m * Mudmat Southeast corner showed no significant scour * Mudmat Southwest corner scoured by 0.2m * Mudmat Northwest corner scoured no significant scour | | | | | | | | | | | GREEN |

### Subsea Tree & Well System

The 2020C1 campaign focussed solely on EVDT E3 (P8) and the inspection history for all other trees remain as per the 2019 Annual Integrity Report.

In addition to the E3 (P8) inspection, Flow Module (FM) change outs were carried out on E1 (P1), in January 2020 and W6 (P6), in August 2020.

The subsea trees were generally in good condition, however the Hot Baseline Inspection was limited on all well trees due to the following reasons:

* Poor visibility was experienced throughout the inspection of the all Xmas Trees and Wellheads.
* For E1, inspection of the EVDT was completed, and inspection of the Flow Module was partially completed concurrently.
* For W6, inspection of the EVDT was partially completed, and inspection of the Flow Module was partially completed concurrently.
* For E4, W1, W3 & W4 inspection was only completed on the EVDT Top.
* E3 was not inspected.

Although no or minimal inspection was performed on E3 (P8) and E4 (P3), both of the Xmas Trees had Flow Module Recovery and Replacements carried out, 3 to 6 August 2019 and 6 to 13 September 2019, respectively.

Table 6 summarizes the inspection progress on the well trees during the 2020 C1 camapaign and the Hot Baseline Inspection, as indicated by DOF Subsea, showing the percentage of inspection outstanding on the specific event types, compared with the total number of events in the work scope for each Xmas Tree.

Table 6 - Hot Baseline Survey, Xmas Trees & Wellheads 2019 & 2020, % of Inspection Not Completed

| **Hot Baseline Survey, Xmas Trees and Wellheads 2019 & 2020, % of Inspection Not Completed** | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Task Considered Outstanding () | E1(P1)  (40%) | E3(P8)  (0%) | E4(P3) (93%) | W1(P5) (40%) | W3(P4) (90%) | W4(P7)  (90%) | W6(P6)  (46%) |
| Enhanced Vertical Deepwater Tree (EVDT) | | | | | | | |
| o GVI | Completed | Completed |  |  |  |  | Completed |
| o Anode assessment | Completed | Completed |  |  |  |  |  Back |
| o CP Steel reading | Completed | Completed |  |  |  |  | Completed |
| o Marine growth assessment | Completed | Completed |  |  |  |  | Completed |
| o Valve status check | Completed | Completed |  |  |  |  |  Front XOV |
| Flow Module (FM) | | | | | | | |
| o GVI | Completed | Completed |  |  |  |  | Completed |
| o Anode assessment | Completed | Completed |  |  |  |  | Completed |
| o CP Steel reading | Completed | Completed |  |  |  |  | Completed |
| o FM EFL overall |  | Completed |  |  |  |  |  |
| o Marine growth assessment | Completed | Completed |  |  |  |  | Completed |
| o Valve status check |  | Completed |  |  |  |  | Completed |
| Subsea Control Module (SCM) | | | | | | | |
| o GVI |  | Completed |  |  |  |  |  |
| Tubing Head (TH) | | | | | | | |
| o GVI |  | Completed |  |  |  |  |  |
| o Anode assessment |  | Completed |  |  |  |  |  |
| o CP Steel reading |  | Completed |  |  |  |  |  |
| o Marine growth assessment |  | Completed |  |  |  |  |  |
| o Valve status check |  | Completed |  |  |  |  |  |
| Wellhead | | | | | | | |
| o GVI |  | Completed |  |  |  |  |  |
| o Anode assessment |  | Completed |  |  |  |  |  |
| Total Inspection Events Recorded | 31 | - | 4 | 35 | 6 | 7 | 35 |
| Flow Module Replacement | Yes  2020  (P1) | Yes  2019  (P8) | Yes 2019 (P3) | Yes 2019 (P5) | - | Yes 2019 (P7) | Yes  2020  (P6) |

The integrity summaries for the well trees are dependent on the previous inspection and previous anomalies raised.

|  |  |  |
| --- | --- | --- |
| Well Slot East Position 1 (P1) | | |
| The specific findings are summarized below for the P1 EVDT (Slot E1). | | |
| **GVI** | Although the HBL GVI was limited, the EVDT inspection was completed and the flow module was 60% completed. Apart from minor coating damage, a marine growth cover was found missing on tronic plug E4, on the front side of the EVDT (IMSA Anomaly 19-0057, Variation from Specification, Status: Open).  The EFL connector to the Flow Module was found to be aligned and secure. | GREEN |
| **Valve Status** | A status check was carried out on each of the valves, on the EVDT and Flow Module, and the Vx Compensator rod during the Hot Baseline survey.  The PSV was found to be midway between Open and Shut. Previously, as recorded in IMSA Anomaly 17-0020, the AVV, CIT-1, PSV and AAV valve indicators were found to be faulty in May 2017. As an interim measure, the valve positions are to be checked by the FLNG Control Room and logged in their Valve Matrix.  (IMSA Anomaly 17-0020. Variation from Specification, Status: Closed)  The ASV position indicator appeared to be bent and it was recommended that the valve position is to be monitored by the FLNG Control Room and logged in their Valve Matrix.  (IMSA Anomaly 19-0015, Physical Damage, Status: Closed). | GREEN |
| **Anodes** | All anodes on the EVDT (9) and the Flow Module (1) are active and secure and depleted less than 25%. | GREEN |
| **Cathodic Protection** | CP measurements taken on the EVDT (5) and the Flow Module (1) were all within an acceptable range from -967mV to -1002mV. | GREEN |
| **Corrosion** | No signs of corrosion were noted. | GREEN |
| **Coating Damage** | Minor blistering of the coating seen with a few small areas of the protective coating flaking and exposing bare metal.  (IMSA Anomaly 19-0045, Coating Damage with Bare Metal Exposure Status: Routine Monitoring). | GREEN |
| Well Slot East Position 3 (P8) | | |
| No inspection events were logged during the Hot Baseline Inspection and was therefore assigned a full inspection work scope for the 2020 C1 campaign, which was carried out in its entirety.  For intervention work carried out on the E3 Well Tree see document 220283\_398-ENCL-403-0002 P8(E3) Flow Module Replacement Summary Report, carried between 3 to 6 August 2019.  Previous inspection results are detailed below, where applicable. | | |
| **GVI** | In November 2020, during the C1 campaign, a complete GVI was done on the Well Tree, Flow Module, SCM, Tubing Head and Wellhead.  No anomalies were found during the GVI other than the valve issues previously identified and subsequently intervened. | GREEN |
| **Valve Status** | During the 2020 C1 campaign, valve status checks totalled 25 and were completed on the Well Tree, the SCM, the Flow Module and the Tubing Head. The results of the status checks are listed in the table below.    Table 7 – Subsea Tree E3 (P8) Valve Status, 25 Nov 2020   |  |  | | --- | --- | | **Subsea Tree E3 (P8) Valves** | Valve Status as of 25 Nov 2020 | | AU.PRL.011-AMV-8301 - XMAS Tree (Front) E3 Annulus Master Valve | AMV Open | | AU.PRL.011-ASV-8301 - XMAS Tree (Front) E3 Annulus Swab Valve | ASV Closed, Indicator broken, as previously reported. | | AU.PRL.011-AVV-8301 - Annulus Vent Valve E3 | AVV Closed | | AU.PRL.011-AWV-8301 - XMAS Tree (Front) E3 Annulus Wing Valve | AWV Closed | | AU.PRL.011-CIT1-8301 - XMAS Tree (Left) E3 Chemical Injection Valve 1 | CIT1 Shut | | AU.PRL.011-CIT2-8301 - XMAS Tree (Left) E3 Chemical Injection Valve 2 | CIT2 Shut | | AU.PRL.011-CIT3-8301 - XMAS Tree (Left) E3 Chemical Injection Valve 3 | CIT3 Shut | | AU.PRL.011-FM-301-VV-CULV - Flow Module E3 Connector Unlock Valve | CULV Closed | | AU.PRL.011-FM-301-VV-SLRV - Flow Module E3 Soft Land Retract Valve | SLRV Open | | AU.PRL.011-PCV-301 - Production Choke Valve E3 | PCV 10% Open | | AU.PRL.011-PMV-8301 - Production Master Valve E3 | PMV Open | | AU.PRL.011-PSDV-8301 - Production Shutdown Valve E3 | PSDV Shut | | AU.PRL.011-PSV-8301 - XMAS Tree (Front) E3 Production Swab Valve | PSV Open | | AU.PRL.011-PWV-8301 - Production Wing Valve E3 | PWV Shut | | AU.PRL.011-SCSSV-8301A - Surface Controlled Subsurface Safety Valve 1 E3 | SV1 Open | | AU.PRL.011-SCSSV-8301B - Surface Controlled Subsurface Safety Valve 2 E3 | SV2 Shut | | AU.PRL.011-T-301 - XMAS Tree E3 | VX Compensator Rod Retracted | | AU.PRL.011-TCT-8301 - XMAS Tree (Front) E3 Tree Connector Test Valve | TCT Unknown | | AU.PRL.011-THD-301 - Tubing Head E3 | VX Compensator Rod Retracted | | AU.PRL.011-THD-301-VV-AAV - Tubing Head E3 Annulus Access Valve | AAV Open | | AU.PRL.011-THD-301-VV-THTV - Tubing Head E3 Tubing Head VX Test Valve | THTV Unknown | | AU.PRL.011-THD-301-VV-THVX - Tubing Head E3 Tubing Head VX Gasket Retainer Valve | THVX Closed | | AU.PRL.011-THD-301-VV-VXC - Tubing Head E3 VX Compensator Valve | VXC Unknown | | AU.PRL.011-VXC-8301 - XMAS Tree (Front) E3 VX Compensator Valve | VXC Unknown | | AU.PRL.011-VXP-8301 - XMAS Tree (Front) E3 VX Gasket Release Valve | VXP Shut | | AU.PRL.011-XOV-8301 - XMAS Tree (Front) E3 Crossover Valve | XOV Shut |   Historical Valve status checks: (C4B - Opportunistic Scopes November 2018)  Valve checks totalled 23 and were completed on the Well Tree, the SCM, the Flow Module and the Tubing Head. Two findings were noted:  1) the Production Swab was broken and should be in the shut position.  2) the VX compensator rod position appears to be fully retracted.  Historically, 3 valve indicators were not working (CIT-1, PSV and SV-1) and are to be tracked in the valve matrix sheet issued from the FLNG Control Room.  (IMSA Anomaly 17-0027, Design Issue/Variation to Specification, Status: Closed) | GREEN |
| **Anodes** | During the 2020 C1 campaign, 4 representative welded stand off anodes were chosen, on the tree, tubing head and wellhead. All anodes were estimated depleted <25%, secure and active. | GREEN |
| **Cathodic Protection** | A total of 9 CP measurements were taken during the 2020 C1 campaign and ranged from -993mV to -1028mV, all indicating adequate cathodic protection potential on the Tree, the Tubing Head and the Flow Module.  Continuity testing for the last Flow Module changeout, 18 Dec 2019 was not completed. In situ CP measurements on the FM ranged from -996mV to -1001mV, confirming that there is no apparent continuity issue. For details, see IMSA Anomaly 20-003, Status: Closed.  (Historical CP Baseline & Pre LWI CP Surveys, 2014 to 2016)  7 CP steel measurements were taken on the well tree, with a range of -923mV to -1044mV.  2 CP Anode measurements were taken on the well tree that showed a potential range of -1050mV to -1067mV, indicating a good level of protection. | GREEN |
| **Corrosion** | No corrosion events or anomalies have been recorded against EVDT P8 (E3). | GREEN |
| **Coating Damage** | 9 coating events were logged concerning protective coating disbondment, blistering and mechanical damage. Isolated areas of coating blistering, up to 10mm in diameter and protective coating disbondment to bare steel, less than 20mm x 20mm were reported. Minor mechanical damage is often found associated with the ROV panels, caused mainly by the ROV manipulators.  (IMSA Anomaly 19-0016, Insulation Damage, Status: Routine Monitoring) | GREEN |
| **Insulation Damage** | No insulation damage has been report in 2020 as the P8 (E3) Flow Module was replaced on 3 to 6 August 2019.  Refer to IMSA Anomaly 19-0031, Insulation Damage, Status: Closed. | GREEN |
| **Loss of Communica-tions** | All DHG pressure and temperature sensors are not returning data to the DCS. Trouble shooting is ongoing by Haliburton. Refer to section 4.4.1 for downhole gauge issues.  (IMSA Anomaly 19-0029, Loss of Communication, Status: Open, **for information only** as this is not part of the Subsea equipment scope) | N/A |
| Well Slot East Position 4 (P3) | | |
| A total of 4 inspection events was logged during the Hot Baseline Inspection on EVDT P3 (slot E4).  For intervention work carried out on the E4 Well Tree see document 220283\_398-ENCL-403-0003 P3(E4) Flow Module Replacement Summary Report, carried between 6 to 13 September 2019.  The specific findings, including previous inspections, are summarized below for the E4 well tree. | | |
| **GVI** | During the Hot Baseline Inspection, the Well Tree and ASVD, including the harness, were visually inspected. The ROV Tree Cap was confirmed to be in place.  (C4A - Baseline Survey (Cold) During CSU, February 2018):  During February 2018, a full visual survey was done on the well tree, tubing head, flowline module and SCM. All EFL and SFL connectors and the ASVD harness were checked. The EVDT assembly was found to be in good condition. | GREEN |
| **Valve Status** | During the Hot Baseline Inspection, the VX Compensator Rod was found to be in the fully retracted position. The PSDV ID plate is not visible due to MG and silt covering it.  (C4A - Baseline Survey (Cold) During CSU, February 2018):  26 Valve Status Checks were completed on the Well Tree, Tubing Head and the Flow Module. The Chemical Injection Valve 2 (CIT-2) indicator was found to be not functioning. This anomaly has been added to the list of non-functioning indicators on the E4 Well Tree, which includes the AVV, CIT-1 and SV-1 indicators. These valves have been added to the Valve Matrix sheet issued by the FLNG Control room.  (IMSA Anomaly 17-0028, Design Issue/Variation to Specification, Status: Closed). | GREEN |
| **Status of Production Choke Valve** | On 02 November 2019, the PCV failed to close further than 55 steps. There is an offset of 27 steps. Stopping of movement at 53 steps indicates a potential blockage of the first row of ports. Attempts will be made to reverse flow the well to clear the blockage. See the following anomalies relating to the history of the PCV:  (IMSA Anomaly 19-0039, Valve Issue - Potential Choke Blockage, Status: Closed)  [*Please be aware that blockage was subsequently successfully cleared in 2020 (ref TWI-315) and no further events of PCV failing to close upon demand have been observed since.*]  (IMSA Anomaly 19-0022, Valve Issue PCV Failure & Replacement, Status: Closed, as per DOF Subsea report 220283 398 - ENCL-403-0003 P3 (E4) Flow Module Replacement Summary Report See DOF Subsea). | GREEN |
| **Loss of Communica-tions** | The downhole gauges are not returning any information to the Control System. Note that this equipment is not part of the Subsea equipment scope and this IMSA entry is for tracking and information only.  (IMSA Anomaly 17-0026, Loss of Communications, Status: Closed, **for information only** as this is not part of the Subsea equipment scope). | N/A |
| **Anodes** | (C4A - Baseline Survey (Cold) During CSU, February 2018)  General comments were made on the overall condition of the anodes on the well tree and the tubing head. The general comments described all of the anodes as being 25% depleted.  No anode events were included in the Hot baseline Inspection of E4. | GREEN |
| **Cathodic Protection** | During the Hot Baseline Inspection, one CP steel measurements was taken on the Well Tree SE Corner, which was an acceptable value of -963mV.  (Prelude C3 Campaign):  One CP Steel taken on the well tree with a reading of -1000mV  (Baseline & Pre LWI CP Surveys, 2014 to 2016):  3 CP Steel measurements were taken on the well tree ranging from -962mV to -1000mV.  4 CP anode measurements were taken on the well tree anodes between -983mV and -1010mV. | GREEN |
| **Corrosion** | No anomalies or reports of corrosion on E4 (P3) Tree. | GREEN |
| **Coating Damage** | No anomalies or reports of coating damage on E4 (P3) Tree. | GREEN |
| Well Slot West Position 1 (P5) | | |
| The specific findings are summarized below for the W1 well tree: | | |
| **GVI** | The visual inspection was limited to the well tree (all 4 sides) and the top and the tree cap. However, no comments were made concerning the tubing head, the FM, the SCM or the wellhead. A more comprehensive survey is recommended. | GREEN |
| **Valve Status** | A status check was done on 16 valves, on the EVDT and Flow Module (1), and the Vx Compensator rod during the Hot Baseline survey.  The PCV position indicator was obscured by sediment, however it appeared to be in the Closed position.  3 valve indicators are not functioning: CIT-1, CIT-2 and the PSV. All 3 were reported malfunctioning 11 June 2017. The status of these valves is recorded in the Valve Matrix issued by the FLNG Control Room.  (IMSA Anomaly 17-0025 Design Issue/Variation to Specification, Status: Closed). | GREEN |
| **Anodes** | All anodes on the EVDT (12) are active and secure and depleted less than 25%. No further anode events have been recorded during the previous surveys. As a result, it is recommended that the anodes on the tubing head and wellhead be check during the next planned inspection. | GREEN |
| **Cathodic Protection** | During the Hot Baseline Survey, CP measurements taken on the EVDT (6) were all within an acceptable range from -959mV to -992mV.  (CP’s Baseline, Pre LWI and C2 CP Surveys, 2014 to 2016):  15 CP Steel measurement were taken during previous surveys on the tree and wellhead, all within a range of -824mV to -1036mV. The 2 measurements of -824mV have most likely been superseded by the Hot Baseline measurements, which are all within an acceptable potential range.  4 CP Anode measurements were taken in May to July 2015 and all measurements were within an acceptable range of -1045mV to -1067mV. | GREEN |
| **Corrosion** | No signs of corrosion were noted on W1 (P5) Tree. | GREEN |
| **Coating Damage** | No coating damage was noted on W1 (P5) Tree. | GREEN |
| Well Slot West Position 3 (P4) | | |
| The specific findings are summarized below for the W3 well tree. | | |
| **GVI** | During the Hot Baseline Inspection, the GVI was only completed on the top of the EVDT.  (C4A - Baseline Survey (Cold) During CSU February 2018):  The last full GVI survey of W3 was done in February 2018 covering the well tree, wellhead, the tubing head, the SCM, the flow module and the ASVD c/w Harness. The only reported finding is described under Corrosion below. | GREEN |
| **Valve Status** | During the Hot Baseline Inspection, the PSDV was found to be ‘Active’ and the VX Compensator Rod was fully retracted. No other valve status checks were done.  (C4A - Baseline Survey (Cold) During CSU February 2018):  During the C4B campaign, 27 valve status checks were recorded on the well tree, the flow module and the tubing head. The PMV valve indicator was rotated but still attached.  Valve indicator malfunctions were reported in July 2017 on the following EDVT valves: PMV, CIT-2, AVV, ASV, SV-1, SV-2 AAV. The status of these valves is maintained on the Valve Matrix by the FLNG Control Room.  (IMSA Anomaly 17-0024 Design Issue/Variation from Specification, Status: Closed). | GREEN |
| **Anodes** | During the C4A - Baseline Survey (Cold) During CSU, February 2018, 5 anode events were recorded covering a sampling of the anodes from the EVDT assembly. All anodes surveyed were reported to be <25% depleted, secure and active.  No anodes events have been recorded since February 2018. | GREEN |
| **Cathodic Protection** | During the Hot Baseline survey, 2 CP Steel measurement were taken on the well tree, ranging from -949mV to -962mV, indicating a good level of protection.  (CP’s Baseline, Pre LWI, C2 and C3 CP Surveys, 2014 to 2017)  Historical CP measurements were taken prior to November 2017:  The 13 CP Steel measurements ranged from -926mV to -1013mV.  The 4 CP Anode measurements ranged from -1032mV to -1054mV. | GREEN |
| **Corrosion** | (C4B – Opportunistic Scopes November 2018 and C4A - Commissioning and Startup Support):  During the C4B Campaign, The Data EC x 4 receptacles on the W3 (P6) EVDT ROV Panel, had corrosion on the hex bolts. Although this is deemed to not be an immediate integrity threat, TFMC advised that in could eventually lead to the loss of communications with the downhole gauges.  (IMSA Anomalies 18-0021 & 19-0017 General External Corrosion, Status: Routine Monitoring). | GREEN |
| **Coating Damage** | During the Hot Baseline survey, bare metal exposure and blistering on the Tree Cap Parking was seen on one corner. Blistering approx. 2% of the affected area and blisters are approximately 5mm diameter. Bare metal is intermittent on several areas approx. 30mm x 30mm. A CP reading of -949mV showed adequate cathodic protection against corrosion.  (IMSA Anomaly 19-0045, Coating Damage with Bare Metal Exposure Status: Routine Monitoring). | GREEN |
| Well Slot West Position 4 (P7) | | |
| The specific findings are summarized below for EVDT P7 (Slot W4). | | |
| **GVI** | During the Hot Baseline Inspection, the GVI was only completed on the top of the EVDT.  (C4B Campaign – Cold Baseline (Nov 2018 to Dec 2018)):  The last full GVI survey of W4 was done in November 2019 covering the well tree, wellhead, the tubing head, the SCM, the flow module and the ASVD C/W Harness, with 27 events.  No findings were reported during these GVIs. | GREEN |
| **Valve Status** | During the Hot Baseline Inspection, the PSDV was found to be ‘Active’ and the VX Compensator Rod was fully retracted. No other valve status checks were done.  (C4B Campaign – Cold Baseline Nov 2018):  During the C4B campaign, 23 valve status checks were recorded, on the well tree, the flow module, SCM and the tubing head. The AAV and AVV valve indicators were found to be stuck, as per the FMC Engineer’s confirmation.  Valve indicator malfunctions were reported in July 2017 on the following EDVT valves: CIT-2, CIT-1, AVV, SV-1 and AAV. These were re-checked in July 2018. The status of these valves will be maintained on the Valve Matrix by the FLNG Control Room.  (IMSA Anomaly 17-0023 Design Issue/Variation from Specification, Status: Closed).  The ASV indicator rod was found to be bent. The status of this valve will be maintained on the Valve Matrix by the FLNG Control Room.  (IMSA Anomaly 19-0015 Physical Damage, Status: Closed). | GREEN |
| **Loss of Communica-tions** | All DHG Pressure and Temperature sensors are not communicating with the DCS. Trouble shooting is ongoing with Haliburton. Note that this equipment is not part of the Subsea equipment scope and this IMSA entry is for tracking and information only (IMSA Anomaly 19-0028, Loss of Communication, Status: Open). | N/A |
| **Anodes** | During the C4B Campaign - Cold Baseline November 2018, 5 anode events were recorded covering a representative sample of the anodes on the Xmas Tree assembly. All anodes surveyed were reported to be <25%, secure and active.  No anode events have been recorded since November 2018. | GREEN |
| **Cathodic Protection** | During the Hot Baseline survey, 2 CP Steel measurement were taken on the EVDT top and the SCM, ranging from -944mV to -960mV, indicating a good level of protection.  (CP’s Baseline, Pre LWI, C2 and C3 CP Surveys, 2014 to 2017):  Historical CP measurements were taken prior to November 2017.  The 13 CP Steel measurements ranged from -854mV to -1016mV.  The 4 CP Anode measurements ranged from -1002mV to -1051mV. | GREEN |
| **Corrosion** | No corrosion events have been recorded during the various inspections and no anomalies have been raised for corrosion on the W4 (P7) EVDT. | GREEN |
| **Coating Damage** | During the Hot Baseline survey, Bare metal exposure (approx. 100mm x 10mm) and blistering on approximately 5% of the affected area with blisters approximately 5mm diameter) on Tree Cap Parking.  (IMSA Anomaly 19-0045, Coating Damage with Bare Metal Exposure Status: Routine Monitoring). | GREEN |
| Well Slot West Position 6 (P6) | | |
| The specific findings are summarized below for EVDT P6 (Slot W6): | | |
| **GVI** | Although the GVI was incomplete, the EVDT inspection and the flow module were subjected to a substantial visual inspection. Apart from minor coating damage, corrosion staining and a broken lanyard on an MG cap, the tree and wellhead appear to be generally in good condition.  The SCM was last GVI’d in November 2018 with no findings.  No GVI events have been recorded on the tubing head and the wellhead. | GREEN |
| **Valve Status** | A status check was done on 16 valves on the EVDT, 4 valves on the Flow Module and the Vx Compensator rod during the 2019 Hot Baseline survey.  The Vx Compensator rod was found to be fully retracted.  The PCV indicator label was fully obscured by sediment and the position was approximated at 35%. The marine growth cap was in place.  (C4A - Baseline Survey (Cold) During CSU, January 2018):  The Chemical Injection Valve 2 (CIT-2) indicator was found to be not functioning. This anomaly has been added to the list of non-functioning indicators on the W6 Well Tree, which includes the AVV, CIT-1, PSV and ASV indicators. These valves have been added to the Valve Matrix sheet issued by the FLNG Control room.  (IMSA Anomaly 17-0026, Design Issue/Variation to Specification, Status: CLOSED). | GREEN |
| **Loss of Communica-tions** | One of the 3 DHG’s is not working. DG (1) is not returning the bore pressure and temperature. Note that this equipment is not part of the Subsea equipment scope and this IMSA entry is for tracking and information only.  (IMSA Anomaly 19-0027, Loss of Communication, Status: Open) | N/A |
| **Anodes** | All anodes on the EVDT (9) and the Flow Module (1) are active and secure and depleted less than 25%. Note: No anodes were seen on the SE Face. | GREEN |
| **Cathodic Protection** | CP Steel measurements taken on the EVDT (6) and the Flow Module (1) were all within an acceptable with a range from -951mV to -1004mV.  CP Anode measurements were taken during the Baseline & Pre LWI CP Surveys, (2014 to 2016) on 3 anodes: -1022 mV to -1045 mV. | GREEN |
| **Corrosion** | Corrosion staining was noted on a vertical member on the EVDT, adjacent to the Flow Module. The corroded area was very localized and a CP taken adjacent to the area was -951mV, indicating sufficient cathodic protection potential in the area.  (IMSA Anomaly 19-0051, Localized External Corrosion, Status: Routine Monitoring).  A historical anomaly on the Data EC receptacle S/S hex bolts was not revisited and requires routine monitoring in future.  (IMSA Anomaly 19-0017, General External Corrosion, Status: Routine Monitoring). | GREEN |
| **Coating Damage** | Minor blistering of the coating seen, on less than 10% of the surface area, with a few small areas of the protective coating flaking and exposing bare metal.  (IMSA Anomaly 19-0045, Coating Damage with Bare Metal Exposure Status: Routine Monitoring). | GREEN |
| **Physical Damage** | A broken lanyard was found no longer connected to Marine Growth Cap of the Production Shut Down Valve. This is not an integrity issue and can be replaced at the next opportunity. | GREEN |
| Well Jumpers | | |
| The well jumpers were generally in good condition and all exhibited the same findings described below: | | |
| **Banding Straps for the CRA Tubing** | Banding straps for the CRA tubing corroding and deteriorating or missing between the manifold end Torus connector and the ROV control panel. The straps appear to be temporary installation supports, which probably serve no purpose after installation. The Discipline Engineer states there are no issues with the missing or deteriorating banding as the existing system have multiple tubes still held together by the mounting rail and tubing clamps at intervals of about 500-600mm. Routine checks are required on the CRA tubing and the tubing fittings.  (IMSA Anomaly 19-0033, Non-standard Equipment/Variation from Specification, Status: Routine Monitoring). | GREEN |
| **Strake Banding Straps** | The strake banding straps appear to be incomplete, missing intermediate straps on each strake section, totalling 12 to 15 straps per well jumper. This is as per design and is not an integrity concern unless the straps break and allow the strakes to separate from the jumpers. Routine monitoring is required.  (IMSA Anomaly 18-0009, Missing Equipment, Status: Routine Monitoring). | GREEN |
| **CP Test Plates** | Historically, 4 out of the 7 jumpers, indicated insufficient cathodic protection potential at the Tree ends. The problem was caused by electrical isolation of the CP test points from the jumpers. These anomalies were rectified by installing continuity cables from the jumper ROV panel to the CP test point plate in January 2018.  (IMSA Anomaly 17-0001, Low CP Potential on Well Jumper Test Points on P1, P6, P7and P8, Xmas Tree end, Status Closed). | GREEN |
| The specific findings are summarized below for the well jumpers, with further details on the exceptions for particular well jumpers where required. | | |
| **GVI** | The general visual inspection indicates the overall integrity of the jumpers, the Novolastic thermal insulation, the Torus III Connectors and the bolted clamps are in acceptable condition for all well jumpers. | GREEN |
| **Anodes** | All anodes on the EFL Panels, the ASVD mounting brackets and lifting clamps were depleted <25%, secure and most were stated as being active. | GREEN |
| **Cathodic Protection** | CP steel measurements were taken on all Torus III Connector ROV panel CP test points and the readings range from -933mV to -963mV, indicating an adequate level of protection. | GREEN |
| One CP Anode reading was taken on an inactive anode on **the W3 EFL panel** that showed a potential of -1088mV, which is within the allowable range. | GREEN |
| **Corrosion** | On **well jumper W4**, there is surface corrosion on an EFL Panel bolt, which may indicate that a steel component is isolated from the cathodic protection system. Routine monitoring required.  (IMSA Anomaly 19-049, Localized External Corrosion, Routine Monitoring).  On **well jumper E4**, discoloration or corrosion was noted around the CP Test points. This is thought to have been caused by previous isolation of the CP Test Points from the CP system. This has been rectified by the placement of continuity cables and will be monitored.  (IMSA Anomaly 18-0018, Localized External Corrosion, Status: Routine Monitoring). | GREEN |
| **Coating Damage** | Historically known damage to the Novolastic thermal insulation was checked on **Jumpers E4 (1 area) and W4 (2 areas)**. No additional damage or signs of corrosion products was noted. Routine monitoring is recommended.  (IMSA Anomaly 17-004, External Coating Damage/Missing, Routine Monitoring). | GREEN |
| **GAP – Jumper to Seabed** | Seabed gap measurements were taken at the jumper bends at the ends of the main horizontal section. The gaps ranged from a minimum of 0.37m on well jumper W4 to 1.9m on well jumper W1. | GREEN |
| **Physical Damage** | On well jumper W1, the Erosion Detector (ED) is known to be permanently damaged. A workaround has been established by MMI. (IMSA Anomaly 18-0026, Electrical Failure/Issue, Status: Closed). | GREEN |
| Wet Parked Frames and Mandrel | | |
| **Wet Parking Frames (removed)**: During the field installation stage, 2 wet park frames were deployed at the DC-1 area. No inspection history can be found on either of the frames apart from CP measurements. The Prelude Operating (POP) shows only one frame, East of the Drill Centre. However, it is most likely that both of these frames have since been removed.  **P2 Wet Parking Mandrel** (Tag - FLOP.AU.PRL.P2, E535,327.83 N8472548.26). The P2 Wet Parking Mandrel is not captured in IMSA and there is no inspection logged on this asset. P2 is described as a high pressure wellhead, which is cemented and abandoned. As this appears to be a permanent fixture, this shall be included in the IMSA Asset Register/Hierarchy. Inspection of P2 is a NOPSEMA requirement and is planned in 2021. | | |

### Subsea Distribution System

The Subsea Distribution system has been only partially inspected during the HBL and requires further inspection of UTA-2, UTA-3 and a full survey of the flying leads to complete the baseline.

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| FLNG Turret – Subsea Related Piping & Valves for the Umbilical | | |
| Subsea responsibility for integrity includes topside piping and valves upstream of the Risers Chokes.  These piping and associated valves are inspected and maintained by the MMI Department.  The visual inspection of the FLNG Turret, subsea related piping and valves was done 30 November 2020 under work orders 610999090, 1, 2 & 3. The results are summarised below and further details can be found in the referenced IMSA anomalies. | | |
| **Small Bore Piping and Valves** | All of the small bore piping, at the UTH, was photographed and all found to be in good condition, secure and no leaks or weeping apparent. | GREEN |
| **Hang Off Assemblies** | Minor areas of coating breakdown were noted on the hang off flange with surface corrosion evident where the coating was removed.  (IMSA Anomaly 21-0019, External Coating Damage/missing, Status: Open) | GREEN |
| **Umbilical Movement Above the Water Line** | The main concern with the umbilical, above water, is the positioning of the umbilical with respect to the I-tube sections at the Mid-Turret Installation deck and Installation deck. These areas are to be monitored for relative movement during poor Metcoean conditions.  Measurements were taken between the I-Tube (I.D.920mm) and the umbilcal (O.D. 229mm) and will be repeated on an annual basis as a SAP routine maintenance plan.  There was no obvious damage to the umbilical due to contact with the I-Tubes.  (IMSA Anomaly 21-0011, Movement of Equpment, Status: Closed) | GREEN |
| Umbilical | | |
| The HBL inspection of the umbilical included a single pass visual inspection of the static section as well as a vertical profile of the Lazy Wave section showing the depth of the Hog and the Sag bends and the positions of all the ballast and buoyancy modules.  During the 2020 C1 inspection campaign, only the vertical profile of the Lazy Wave section was done, showing the depth of the Hog and the Sag bends and the positions of all the ballast and buoyancy modules, as well as, the touchdown point on the seabed.  The Umbilical comprises:   * Subsea End Fitting * Bend Limiter (5.3m L x 0.37m Dia) * Bracelet anodes * Buoyancy Section (x32 Modules) * Ballast Section (x44 ballast modules and x23 stopper clamps) * Bend Stiffener (9.25m L x 1.02m Dia) * Bend Stiffener Latching Mechanism (BSLM) via turret I Tube & hang-off collar   The vertical profile of the umbilical was recorded by 46 location fixes along the dynamic section of the umbilical with additional XYZ points taken on each major component, including each buoyancy module and each ballast module. Figure 27 shows the comparison of the vertical profiles for the HBL and the 2020 C1 campaigns, which match relatively closely. The list below summarizes 7 main points along the umbilical that define the profile of the Lazy Wave bend. No limits for the acceptable depth profile have been provided. However, the profile of the umbilical appears not to have any kinks or sharp bends and vessel keel clearance at the hog bend and seabed clearance at the sag bend appear to be adequate. | | |
| **GVI** | In general, the umbilical appeared to be in good condition but the inspection of the static sections was marginal due to poor visibility and is considered incomplete. In contrast, the dynamic section of the umbilical was clearly visible and the inspection was completed up to the BSLM.  6 findings were raised, 3 relating to coating damage and 3 to debris, details of which can be found in their respective sections below. | GREEN |
| List of the Main Datum Points recorded during the 2020C1 Campaign Inspection   * Umbilcal Dynamic Section Touchdown of Seabed Fix 01 KP0.628 248msw * Umbilcal Dynamic Section Hog Bend Fix 16 KP0.476 109msw * Umbilcal Dynamic Section Sag Bend Fix 27 KP0.372 201msw * Stopper Clamp No.1 for the Ballast Modules Feature 209 KP0.328 157msw * Stopper Clamp No.23 for the Ballast Modules Feature 188 KP0.346 187msw * Buoyancy Modules No.1 Feature 187 KP0.448 134msw * Buoyancy Modules No.32 Feature 156 KP0.542 171msw | | |
| Figure 27 - Umbilical Vertical profile Taken During the 2020 C1Inspection and the Hot Baseline Survey | | |
| **Anode** | 13 Anode depletion checks were done on the end fittings including: the subsea end fitting, the bend limiter, the bend stiffener and the BSLM. All anodes were flush mounted and found to be <25% depleted, secure and active.  IMSA Anomaly 18-0016 (Status: Closed) was raised concerning the inactivity of the anodes on the BSLM. These anodes were checked during the HBL inspection and appeared to be slightly active but mainly covered with marine growth. The CP measurements on the BSLM showed good cathodic potential and there does not appear to be an integrity issue. | GREEN |
| **Continuity Wires** | 3 continuity wires were checked between section 1 and section 2 of the Subsea End Fitting. The cables were found to be in good condition, securely bolted at both ends. | GREEN |
| **Cathodic Potential Measure-ments** | CP Steel were taken on 4 end components, as follows:   * Subsea End Fitting CP -1033mV * Bend Limiter Element CP -1088mV * Bend Limiter Restrictor Collar CP -1089mV * BSLM CP -1036mV   The cathodic potentials indicate a good level of protection. | GREEN |
| **Coatings** | It was noted that, at the termination of the bend stiffener, there was a gap of approcimately 30mm between the bend stiffener and the umbilcal outer surface. This is not considered an anomaly but will be monitored during future inspections.  2 coating loss events were raised on the Subsea End Fittings. This appears to be mechanical coating removal. No anomaly was raised and these should be monitored during the next schedule inspection of the umbilical or UTA-1. | GREEN |
| **Bolted Items** | All bolted flanges were checked at the I-tube to the BSLM and the Subsea End Fitting and all were found to be aligned, secure and intact. | GREEN |
| **Crossing** | One EFL, possibly the Fibre Optic cable, was seen running over the top of the umbilical, in contact but with no relative movement apparent. | GREEN |
| **Debris** | All 6 debris events logged related to soft line installation aids and a possible Chinese finger lock. It was agreed to leave the Chinese finger lock in place, even though it is heavily corroded. All items are not integrity issues although they may pose a hazard to the ROV. | GREEN |
| **Span** | Minor spanning was seen and 18 spans were reported, 0.7m to 5.1m in length, 0.5m in height. These are not significant and pose no integrity threat to the umbilical. | GREEN |
| **Burial** | In general, the umbilical is more than 75% buried and was reported to be fully buried in half the events recorded, up to 50m in length along the static segment on the seabed. Burial along with the poor visibility experienced along the umbilical static section made inspection very difficult and lowers the confidence level for finding defects. | GREEN |
| **Lazy Wave Configuration** | (see Figure 27 for the overall vertical profile)  **Buoyancy** – All 32 buoyancy modules were secure and in their designated positions.  **Ballast Module and Stopper Clamps** - With the exception of one of the securing straps on Stopper Clamp no.12, all the ballast strings appeared to be secure with all of the ballast modules being secured by bandit straps and the stopper clamps having bolted clamps. Stopper clamps 1 through 23 are separated by 2 ballast modules totalling 44 ballast modules. All the modules and clamps appeared to be in their installed positions with clamp bolts tight and aligned, were seen.  IMSA Anomaly No. 20-0033 (Missing Equipment, Status: Routine Monitoring) has been been raised on the broken securing strap on Stopper Clamp No.12, top of 4 straps, at 158msw, for future monitoring. | GREEN |
| Steel Flying Leads | | |
| No inspection has been done specifically on the Steel Flying Leads apart from the connectors. | | |
| Electrical Flying Leads | | |
| No inspection has been done specifically on the Electrical Flying Leads apart from the connectors. | | |
| Umbilical Termination Assemblies & Jumpers | | |
| Three Umbilical Termination Assemblies are detailed in the following sections:   * 4.2.3.5.1 [Umbilical Term Assembly 1 (UTA-1, UTH-1 & HDM-1)](#_Umbilical_Termination_Assembly) * 4.2.3.5.2 [UTA-2 Hydraulic Distribution Manifold 2 (**UTA-2/**HDM-2)](#_UTA-2_Hydraulic_Distribution) * 4.2.3.5.3 [UTA-3 Electrical Distribution Manifold 1 (UTA-3/EDM-1)](#_UTA-3_Electrical_Distribution) | | |
| **Umbilical Termination Assembly UTA-1 [UTA-1, UTH-1, HDM-1, UTAJ-1 & 2]** | | |
| The majority of the Umbilical Termination Assembly 1 was inspected during the Hot Baseline Inspection (HBL). Where the HBL survey was incomplete, data has been added from earlier inspections and previous anomaly reports. | | |
| **GVI** | In general, the UTA-1 assembly appeared to be in good condition with 6 findings raised during the Hot Baseline Inspection (HBL). All 6 findings were related to debris and are not considered an integrity issue.  The UTH-1 was landed and installed at an angle, however a TA review found the installed angles to be within tolerance.  (IMSA Anomaly 17-0013, UTH Landed out at an angle, Status: Closed). | GREEN |
| **Anode** | Anodes on the mudmat, both horizontal and vertical, were checked for security and depletion status. 13 anode events were recorded representing 15 anodes. All the welded stand-off anodes were found to be active, secure and depleted <25%. | GREEN |
| **Connectors HDM-1** | During the HBL HDM-1 inspection, Logic Caps HLC-001 through HLC-007 were surveyed and images were captured in the inspection report. All appeared to be in good condition.  During the C4A Baseline Survey (Cold) During CSU campaign all the Logic Caps were inspected as well as GVI of the following connectors:   * EFL F/UTH – EDM (1) UTH Connector to touch down, fully seated. * EFL F/UTH – EDM (2) UTH Connector to touch down, fully seated. * EFL F/UTH – EDM (3) UTH Connector to touch down, fully seated. * EFL F/UTH – EDM (4) UTH Connector to touch down, fully seated. * EFL F/EDM - ESFL (A) ESFL Connector to HDM-1 Connector Connectors fully seated. * EFL F/EDM - ESFL (B) ESFL Connector to HDM-1 Connector Connectors fully seated. * ESFL HDM-1 MQC to touch down, fully seated. * FL F/UTH – CTA (1) UTH Wetmate to touch down, fully seated. * SFL F/HDM1 – HDM2 HDM-1 MQC to touch down, fully seated. * SFL F/HDM1 – XT E4 HDM-1 MQC to touch down, fully seated. * SFL F/HDM1 – XT W1 HDM-1 MQC to touch down, fully seated. * SFL F/HDM1 – XT W3 HDM-1 MQC to touch down, fully seated. No indication of damage observed. * SFL F/PM-E HDM-1 MQC to touch down, fully seated. * SFL F/PM-W HDM-1 MQC to touch down, fully seated. * SFL F/UTH – HDM2 (A) HDM-1 MQC to touch down, fully seated.   No damage was found to any of the connectors listed above.   * SFL F/UTH – HDM2 (B) HDM-1 MQC to touch down Connector fully seated. No indication of damage observed.   A dummy hot stab, on the back of the UTH, was found not properly seated and it was deemed not an integrity issue. This was found during the C4A - Baseline Survey (Cold) During CSU - GVI and Connectors 25/01/2018. (IMSA Anomaly 18-0008, Missing Equipment, Status: Closed).  During the C4A-UTA-1 Continuity Cable Installation, 17/01/2018, a continuity clamp was dropped into the UTH at CP test Point No.3. This is not an integrity issue. (IMSA Anomaly 18-0017, Flange or Connector Integrity, Status: Closed). | GREEN |
| **Continuity Cables** | Continuity cables for the mudmat to the UTA-1 and the clamps were checked. The majority of the 5 cables were checked at both ends for either a bolted or a clamped connection. All connections that weren’t obscured by marine growth appeared to be secure and the CP measurements, detailed below, indicate a good distribution of the cathodic protection potential. For further detail, refer to the C4A-UTA-1 Continuity Cables Installation (Jan-Feb 2018), where a hydraulic wire brush was used to remove sections of paint prior to installing the 4 clamps.  (IMSA anomaly 18-008, Missing Equipment, Status: Closed). | GREEN |
| **Cathodic Potential Measure-ments** | CP measurements were taken on the HDM-1, the UTH and the mudmat over 5 or more surveys, prior to and after the installation of continuity cables in January 2018. All 20 measurements were in the acceptable potential range and were between -990mV and -1040mV. | GREEN |
| **Umbilical Terminal Assembly Jumpers 1 & 2**  **(UTH to HDM-1)** | The jumpers were visually inspected during the HBL and found to be secure and intact with no signs of leakage. These jumpers were also inspected during the following campaigns:  C4A - Baseline Survey (Cold) During CSU - GVI and Connectors 25/01/2018:  C4B - Opportunistic Scopes – GVI - 22/11/2018:  Missing marine growth caps on UTAJ-001 and UTAJ-002 were deemed to not be integrity issues (IMSA Anomaly 18-0007, Missing Equipment, Status: Closed). | GREEN |
| **Seabed Condition** | The silty sand seabed has covered the entire mudmat and the 5 burial events logged all put the depth of burial between 0.25m and 0.3m. The anodes are still well clear of the seabed. There is no scour on the corners of the mudmat, as seen on other seabed structures in the area. | GREEN |
| **UTA-2 Hydraulic Distribution Manifold 2 (UTA-2/HDM-2)** | | |
| The hydraulic distribution manifold UTA-2 was not surveyed during the Hot Baseline Inspection. However, Cathodic Potential measurements have been taken on previous campaigns, logged in IMSA, all showing acceptable cathodic protection potential. See Table 8 below for the CP listing. No anomalies have been raised against UTA-2. | | |
| Table 8 - UTA-2 CP Steel Potential Measurements from Previous Surveys | | |
| **Umbilical TERM Assembly Jumper (UTH to HDM-2)** | The jumper was visually inspected and found to be secure and intact with no signs of leakage. This jumper was also inspected during the following campaigns:  C4A - Baseline Survey (Cold) During CSU - GVI and Connectors 25/01/2018  C4B - Opportunistic Scopes – GVI - 22/11/2018  A missing marine growth cap on UTA-J2 and was deemed to not be an integrity issue  (IMSA Anomaly 18-0007, Missing Equipment, Status: Closed) | GREEN |
| **UTA-3 Electrical Distribution Manifold 3 (UTA-3/EDM-1)** | | |
| The hydraulic distribution manifold UTA-3 was not surveyed during the Hot Baseline Inspection. However, Cathodic Potential measurements have been taken on previous campaigns and logged in IMSA, all showing acceptable cathodic protection potential. No anomalies have been raised against UTA-3.  The electrical distribution manifold at UTA-3 was not surveyed during the Hot Baseline Inspection. However, Cathodic Potential measurements have been taken on previous campaigns, logged in IMSA, all measurements in Table 9 below, are showing potentials more negative than the allowable range of -850mv to -1050mV. These ‘high’ readings do not pose an integrity threat, however they should be monitored in the near future. No anomalies have been raised against UTA-3.  Due to insufficient inspection, this manifold should be given a high priority for the next planned inspection. | | |
| Table 9 - UTA-3 CP Steel Potential Measurements from Previous Surveys | | |
| Fibre Optic System | | |
| Full survey of connectors, CTA Module and Mudmat, connectors, anodes & CP was carried out during the  C4A Baseline Survey (Cold) During CSU. 09 & 25 Feb 2018. The Fibre Optic lead (approximately 170m in length) was only inspected at the termination at the Fibre Optic Termination Assembly and the UTA-1 UTH. No Anomalies Raised during the inspections. | | |
| **GVI** | In general, the Fibre Optic Cable Termination Assembly appeared to be in good condition and no findings were raised during the C4A Baseline Survey. Full video and photographic coverage were carried out on the full assembly. | GREEN |
| **Anode** | Anodes on the CTA module and CTA mudmat, were checked for security and depletion status. 5 anode events were recorded representing 14 anodes. All the flush anodes were found to be active, secure and depleted <25%. | GREEN |
| **Cathodic Potential Measure-ments** | CP measurements were taken on the CTA module during the Prelude C3 Campaign, 13/04/2018. Both measurements were in the acceptable potential range and were between -1018mV and -1025mV. | GREEN |
| **Connectors HDM-1** | The 3 main connectors associated with the Fibre Optic System were checked:   * Main Fibre Optic Tie-in End Fitting * Optic Fibre Jumper Lead – FO Termination end * Optic Fibre Jumper Lead – UTH end, UTH\_F01   All 3 connectors appeared to be properly installed, secure and intact. The Optic Fibre Jumper Lead was not surveyed during the C4A Baseline Survey. | GREEN |
| **Status Check** | The 4 locking mechanisms that lock the CTA module to the CTA base were all confirmed to be rotated anti-clockwise to the “L” locked position. | GREEN |
| **Seabed Condition** | The CTA mudmat’s perimeter was buried up to 50% of the base frame members’ height. The corners appeared to slightly scoured out and the Northeast corner was scoured by an estimated 200mm, but the base of the frame was still not exposed. At the time of the survey there was no silt buildup on the mudmat’s internal framework. | GREEN |
| Electrical Steel Flying Lead (ESFL) UTA-1 (HDM-1) to RBM | | |
| The Electric Steel Flying Lead (ESFL) is installed between HDM-1 and the RBM and is approximately 3.3km in length. The ESFL was surveyed over its entire length during the Prelude C3 Campaign (Jan 2017), followed by detailed inspection of the connection assemblies during the C4A - Baseline Survey (Cold) During CSU. No inspection was logged for the ESFL during the Hot Baseline Survey.  No Anomalies were raised during the inspections. | | |
| **GVI** | In general, the ESFL appeared to be in good condition and no findings were raised during the Surveys. However, the inspection details logged for the flying lead survey are minimal giving a lower confidence level for integrity. This could most likely be remedied by reviewing the historical survey data and documentation for the ESFL. | YELLOW |
| **Anode** | Anodes were checked on the connectors at both ends of the ESFL:   * ESFL MQC at the HDM-1 * ESFL MQC at the RBM   All the flush anodes were found to be active, secure and depleted <25%. | GREEN |
| **Cathodic Potential Measure-ments** | CP measurements were taken on the connectors at both ends of the ESFL during the Prelude C3 Campaign, 13/04/2018. Both measurements were in the acceptable potential range and were between -1018mV and -1025mV. | GREEN |
| **Connectors HDM-1 & RBM** | The end connectors associated with the ESFL were checked:   * ESFL MQC at the HDM-1 * ESFL MQC at the RBM   Each assembly has a buoyancy module and a bend restrictor. At the HDM-1 connector, stabilization grout bags have been placed either side of the bend restrictor adjacent to the mud mat. Both connector assemblies appear to be aligned and secure. | GREEN |
| **ESFL Flying Lead Survey** | The flying lead survey done during the Prelude C3 Campaign provides minimal details and is not yet fully documented in IMSA.  **Burial**: 8 burial events are recorded in IMSA, although no coordinates or KP’s are provided.  **Spans**: 4 spans were recorded over the 3.3km length of the ESFL. The spans ranged from 2 to 5 m in length.  No Anomalies or damage was reported for this survey. | GREEN |
| Marine Growth Estimated Coverage and Thickness | | |
| The marine growth coverage and thickness has been summarized below in three categories: the subsea structures, flowlines and jumpers and risers & umbilical. These figures are taken from the DOF Subsea inspection marine growth events taken during the Hot Baseline survey and partially updated from the 2020 C1 inspection results.  **Seabed Structures** (230 to 245msw):  The soft growth coverage on the seabed structures averages 45% and is not evenly distributed. The distribution is affected by the geometry of the structures and the settlement of silt on the flat surfaces. The maximum thickness of the soft growth is 200mm with an average thickness between 100mm and 150mm. The hard growth coverage is approximately 20% with average thicknesses less than 20mm.  It should be noted that there has been a problem with some modules being cemented together by calcareous deposits, which may involve the hard growth types such as, barnacles and tubeworms. It has been proposed that in situ studies should be carried to better understand this ‘cementing’ phenomenon. (IMSA Anomaly 19-0066, Excessive Marine Growth or Calcareous Deposits, Status: Open).  **Flowlines & Jumpers** (232 to 245msw):  The well jumpers are proud of the seabed, have strakes over the central horizontal section and typically have more extensive growth than the production jumpers and flowlines. The soft growth coverage is typically 30 to 40% with a maximum thickness of 200mm and average thickness of 50mm. The hard growth coverage is approximately 5% with an average thickness of 10mm.  The production jumpers and flowlines are typically more than 50% buried which limits the growth coverage. On the exposed surfaces, the soft growth coverage averages 20% with the average thickness being <50mm. The hard growth on the exposed surfaces, has a coverage of 10% and an average thickness of 10mm.  **Risers and Umbilicals, by section** (25 to 245msw):   * The static section (245msw) of the flowlines and umbilical are predominately more than 75% buried so they have marine growth only on the top surface averaging less than 10% coverage and maximum thickness of less than 20mm, for both hard and soft growth. * Between Buoyancy Section and Touch Down - (245 to 215msw) The growth is predominantly soft growth, averaging 30% and up to 50mm thickness with an average thickness of 20mm. The hard growth coverage averages 10% with an average thickness of 11mm. * The Sag bend and Hog bend section (130m to 190m) have similar marine growth coverage of 30% soft growth, 30mm average thickness, and <10% hard growth, averaging 15mm thickness. * Below the bend stiffener at 25msw), the soft marine growth coverage averages 80%, with average thicknesses of <30mm. The hard growth coverage is estimated to be <20% with an average thickness of <15mm. | | |

## Subsea Surveillance Issues

Note, only issues either resolved in 2020 or current as of 31-Dec-2020 are listed. For historical issues prior to 2020, reference can be made to IMSA Anomaly records.

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| Subsea Surveillance Issues Topside | IMSA Ref | YELLOW |
| Riser ASD Cut Out as High Temperature Riser ASDs cut out at high temperatures. Only rated for 60 degrees C. A plan is in place to upgrade the units with sensors suitable for higher temperatures. | 19-0073 | YELLOW |
| EPU-B (Subsea electrical cabinet, SPCU-B) EPU-B (Subsea electrical cabinet) indicated voltage/current spiketrends on DCS sine Dec-2019. Power supplies were changed in early 2020, TPU instability has continued but is believed to be linked to TPU/VIM communication issues under investigation (see 4.3.1.4 below). | 19-0037  19-0078 | GREEN |
| EPU-A (SPCU-A) Line 5A & 6A Insulation Resistance Deteriorating Trend First reported 27-Mar-2020. Issue was not resolved as of 31-Dec-2020 . | 20-0017 | GREEN |
| Loss of Subsea Communication – TPU Issue Subsea comes were lost 7-Oct-2020. After investigation, root cause of TPU hang was traced to incorrect communication between VIMNet Explorer and TPUs (from different OEMs). Issue resolved with software update in Nov-2020.  Other communication issues in Aug-2020 and Nov-2019 are believed to be related to te same root cause. | 20-0026  20-0024  19-0064 | GREEN |
| Trees and Well Jumpers Surveillance Issues |  | YELLOW |
| EVDT Choke Failures Choke failures have occurred on EVDT P3, P7, P5 and P8. P3 Flow Module was changed out in Mar/Apr-2019, P7 in May-2019, P8 in Jul/Aug-2019 (all like for like). Subsequently P3 was then changed in Sep-2019 and P5, Oct-2019, P8 in Dec-2019, P1 in Jan-2020 and P6 in Aug-2020 with 4-Port Choke Inserts changed out for 12-Port models.  On inspection of failed 4-Port choke inserts, physical damage was discovered. To date there have be no failures of the retrofitted 12-Port chokes. | 19-0018  19-0022  19-0039  20-0005  20-0006  20-0007  20-0009  20-0010 | GREEN |
| Choke Offset on P5 Flow reading is observed to have a constant 8 steps choke position difference when referenced to the flow table. Guidance from Masterflo to perform full closure to correct.  Awaiting opportunity to cycle the choke and flow the well for a sustained period to confirm if there is a persisting issue. | 20-0001 | YELLOW |
| P5 Production Master Valve (012-PMV-8101) Fault PMV control fault originally reported 16-Dec-2020. To rectify, the valve needs to cycled (awaiting opportunity). | 20-0013 | GREEN |
| Riser Surveillance Issues |  | GREEN |
| SCE Limit switch issue on 086UZV-7507 Riser #7 SCE Limit switch failure on 086UZV-7507 Riser #7 ESDV. RCA was carried out and the issue has been resolved by replacement of limit switches for ESDVs on Riser 5 (Oct-2019), Riser 6 (2019), Riser 7 (Oct-2019) and Riser 8 (Mar-2020). | 19-0020  19-0074 | GREEN |
| Riser FCRBV closing times reported more than defined in SAP PM Riser FCRBV closing times reported more than those defined in SAP PM (Performance Standard compliance issue). Plan in place to revise closure time criteria in Performance Standard.  The issue has been resolved as follows:  Completed process safety time calculations to justify a revision of the valve closure time performance standard for the fail close riser base valves (FCRBV) from 45 seconds to 180sec. NOPSEMA action ( # 1049725, 1990-02) in this regard if CLOSED also Performance standard (No. 2000-112-HX-7180-00003 & OPS\_PRE\_001505) revised accordingly with new closure times. | 19-0021 | GREEN |
| Sand production exceeded the target limits Sand production exceeded the target limits of 0.1 lb/MMscf and 0.4 lb/MMscf for Riser 5, Riser 6, Riser 7 and Riser 8. Based upon the analysis on sand production available from specialist contractor Aquip, Shell confirmed that there is no concern regarding erosion of the subsea jumpers / flowlines / risers from an integrity management perspective. Sand production and erosion rates are well within the allowed/predicted levels.  It should be noted that these values of calculated sand production rates are not actual sand production rates. These calculated values are not calibrated. There is context required for exceedance with respect to erosion, namely the duration of exceedance.  Some brief upset conditions were seen upon choke failure, however these are also not an integrity concern due to the short durations.  Sand monitoring ongoing. | 21-0004 | GREEN |
| Damage to Access Fitting - Polymer Coupon for Riser 8 Access fitting and device installed in the turret location SPM-086053 (Riser 8) was found to be damaged. The polymer degradation assessment will be assessed using results from the other three riser polymer coupons. There is a plan to install a new access fitting at next available opportunity. Online retrieval currently prohibited for this fitting. | 18-0028  20-0016 | GREEN |
| Riser Pressurization/Depressurization Rates went above/below the allowable limit Riser Pressurization/Depressurization Rates went above/ below the allowable limit of +/-10 bar/min. This has been investigated and found not to be an integrity threat since it is well below theoretical design limits of +/-50 bar/min. These events were related to choke failures or sudden shutdowns.  There were several false exceedances due to the calculation approach taken which is not effective when there is a shut-in and pressure sensors used for rate of change measurement become isolated. Plan is to review calculation formula to identify a solution if any. If there were to be any continuous or persistent exceedance reported, then a study is to be performed for any potential integrity threat. | 21-0012 | GREEN |
| Riser flowrates have exceeded the bore flowrate limit Riser flowrates have exceeded the bore flowrate limit of 200 MMscfd on at least 2 occasions related to choke failures. This has been investigated and MMI department confirmed that there is no concern regarding erosion of the subsea jumpers/ flowlines/risers from an integrity perspective.  Flowrates in all four risers/flowlines exceeded the limit of 200 MMSCFD in Q4 2019, following implementation of CASCADE Mode on Riser RCV. Risers 6 and 8 also exceeded the limit in Jan-2020.  It is worth noting that the quoted design limit of 200 MMSCFD applies to the turret; the flowlines/risers have a limit of 400 MMSCFD with FLNG operating at HP Mode.  Flowrate monitoring ongoing. | 21-0005 | GREEN |
| CO2 Concentration Exceeded Limit CO2 concentration regularly exceeds the limit. The value of 8.9 mol% received from separator 2 in Apr-2019 (100QP-1052B) for CO2 concentration exceed the limit of 8.77 mol% in gaseous phase. GE (riser OEM) have confirmed that there is no integrity issue at these marginal exceedance values. Trend to be monitored. | 21-0013 | GREEN |
| Production Riser Annulus Pressure Buildup Annulus pressure buildup was not recorded after 6 months’ operation. OEM investigated and performed gas permeation calculations and predicted gas flow after 6-8 months. By October 2019 all the riser’s annuli experienced pressure build up. Riser 8 annulus pressure exceeded the recommended limit of 0.5 barg in October 2019, reaching the value of 1.143 barg.  Annulus pressure monitoring ongoing. | 21-0006 | GREEN |
| Production Riser Annulus Flowrate Exceeded the Limit Annulus flowrate exceeded the limit of 100 l/h for the entire month of Jun-2019. This is related to the operation of the VGMS with GRVs in place (the data is recorded by VGMS but it is ineffectual due to GRVs in place). Plan to remove GRVs under MoC for proper functioning of VGMS. | 20-0011  21-0008  21-0014 | GREEN |
| Riser velocity for all the risers exceeded the allowable limit Riser velocity for all the risers exceeded the allowable limit of 30 m/s in Jan-2020 and for individual risers at other times in 2019 and 2020. Shell confirmed that there is no issue with riser velocity in these particular events.  There were several false exceedances due to the calculation approach taken which is not effective when there is a shut in and pressure sensors used for measurement become isolated. The plan is to review calculation formula to identify a solution to avoid spurious alarms.  Reference should be made to Wood integrity dashboard – issue is closed-out. | 21-0010 | GREEN |
| Riser Displacement The oveall riser displacements indicated during calm Metocean conditions suggest that movement during poor Metocean conditions would cause an unexpected clash with the steel I-Tube interface and riser jackets. Excessive wear on the flexible riser outer jacket may cause a rupture in the annular space of the flexible riser.  Monitoring during annual inspection is covered by SAP routine. | 21-0011 | GREEN |
| Riser VGMS - PI Dashboard - Readings unavailable The VGMS dashboard (03 December 2020) readings reported as not communicating and it seemed power supply was lost.  The issue was resolved with live data communicating in Jan-2021. | 20-0045 | GREEN |
| Flowline Surveillance Issues |  | GREEN |
| Flowline No 3 Hydrate Blockage Following a loss of hydraulic supply pressure to Production Swivel 1 on 04 September 2020, unable to depressuruse the subsea system as per normal hydrate management procedure, and instead MEG was dosed into Flowline/ Riser system.  A blockage (hydrate or mixture of wax and hydrate) was detected from 26/9/20 pressure trend, and has since been confirmed. A hydrate remediation plan is in place to clear the blockage.  Although this is not an integrity issues, Flowline 3 and Riser 7 remain unavailable.  Riser 7 profile has been observed to be significantly changed from the previous inspection which is expected under these conditions. | 20-0027  21-0015 | N/A |
| Manifold Surveillance Issues |  | GREEN |
| High SEM Voltage on PME/PMW Issue was resolved in Apr-2020 by calibration. | 19-0069 | GREEN |

## General Information Issues

The following issues relate to equipment that is not under Subsea responsibility for integrity, however may affect Subsea and hence are included here for information.

|  |  |  |
| --- | --- | --- |
| Issues | IMSA Ref | Status |
| Downhole Gauge Issues Downhole gauge issue – undergoing investigation  Downhole gauge issues have developed on E1(P1), E3(P8), E4(P3), W3(P4), W4(P7), and W6(P6). Some DHG sensors are confirmed failed, investigation still ongoing on others. | 18-0024  19-0026  19-0027  19-0028  19-0029  19-0071 | N/A |
| Repeat Issues with MEG Line Low Pressure to P1, P3, P5 and P7 Repeat issues with MEG line low pressure to P1, P3, P5 and P7 due to leaks, high dP and faulty FCV (P1) topside. dP issue has been resolved by changing filters.  Please refer to MTO Item 115334 as the long term mitigation for low pressure in these lines.  Regarding the repeat issues with high dP topside, this is not an integrity issue. This is a standard operational action to change filters. Concern relates more to the time delay between high dP and maintenance execution to change the filters (upwards of 3 months), coupled with the quality of execution. |  | N/A |

# MANAGEMENT OF CHANGE

4 x eMOCs were raised in 2019 relating to change from 4-port to 12-port PCV nozzles, as per the following description.

Description of Change:

The subsea choke currently has a 4-port nozzle as part of its design. There have been multiple failures which have resulted in a damaged choke nozzle. The subsea IMR team initiated the Prelude Subsea Choke Repair Project which has concluded that a new nozzle design is required; the Multi-Port Multi Metal (MPMM) nozzle has been selected to replace the current 4-port tungsten carbide nozzle.

|  |  |  |  |
| --- | --- | --- | --- |
| **FLOC Description & (MOC Id)** | **Created Date** | **Proposed Startup Date** | **Work Flow Status** |
| Flow Module E4, Well P3 (76512) | August 27, 2019 | September 12, 2019 | Closed |
| Flow Module W1, Well P5 (77967) | September 27, 2019 | October 21, 2019 | Closed |
| Flow Module W4, Well P7 (79092) | October 21, 2019 | February 29,2019 | Approved |
| Flow Module E3, Well P8 (79674) | November 01, 2019 | December 10, 2019 | Closed |

DOF Subsea quoted one MOC with respect to the valve status checks, “**HBL Status checks, indicators not inspected, as per MOC 220283-MOC-QA-CL-202-0059 - 28/09/2019”**

# DEVIATIONS

No deviations relevant to the subsea asset inspection were raised in 2019,.

# Appendix A – Description of Facilities

**Facilities Overview**

| **Subsea Facility** | **Description** |
| --- | --- |
| Wells | * Drilled from a single drill centre * 7 highly deviated/sub-horizontal (85deg) wells * Each well can deliver up to 200 MMscf/d (Note: Dry (water free) gas flow rates) * SCSSV installed in each well |
| Subsea Xmas Tree and Well Jumpers | * 690bar (10,000psi) 7” Enhanced Vertical Deepwater Tree (EVDT), consisting of the following:   + Production choke valve (PCV).   + Subsea venturi flowmeter (VFM).   + Subsea control module (SCM).   + Pressure and temperature sensors.   + Chemical injection ports (for MEG and SI/PPD. * Well Jumpers connecting EVDTs to Production Manifolds |
| Flowline Jumpers, Flowlines & Production Manifolds | * Two 6-slot production manifolds provide tie-in for up to 12 gas production wells (five spare slots) * Manifolds have dual headers   + Flow from each well can be directed to either header * Dedicated SCM on each production manifold * Each manifold is connected to two flowlines (approx. 3km in length) and the manifolds are connected via the manifold jumpers together to provide dual looped flow paths. * Each Flowline is fitted with 2 Buckle Triggers at approximately 1km intervals. * Each Flowline terminates at a PLET at each end. * Flowline Jumpers connect each PLET to the respective Manifold |
| Riser Base Manifold (RBM) | * Flowlines are connected to the four 12” flexible production risers to the FLNG facility via the RBM * Fail Close Riser Base Valve (FCRBV) installed at the RBM for each of the risers * Dedicated SCM on the RBM |
| Production Risers | * Prelude FLNG process modules are connected to the subsea facilities via four flexible risers connected to the turret * Design pressure of 400 barg and temperature of -20 / 128°C * Material for the critical pressure sheath layer (i.e. PVDF) is capable of handling Prelude fluid and design temperature * Installed in a lazy wave configuration with allowance for excursions around the Datum * End connections of the risers are fitted with bend stiffener (turret end) and bend restrictor (subsea end) to prevent damage to the riser’s structure from over bending * Flexible risers anchored at FLNG with a bolted split-flange hang-off of the riser end fitting immediately below the Riser ESDV * A Riser Emergency Shutdown Valve (RESDV) is installed at the top of each riser in the FLNG turret * Riser vent gas monitoring is provided to monitor diffusion of gas through the pressure sheath into the flexible pipe annulus |
| Umbilical and Subsea Distribution | * A dynamic control umbilical with a lazy wave dynamic section and a static seabed section links Prelude FLNG to the subsea system providing hydraulic, electrical and chemical services, and signal and power control communications to the subsea system. * Designed to support eight production wells. * Turret end connection is fitted with a bend stiffener to prevent damage to the umbilical structure from over-bending beyond the MBR. |

**Description of Facilities**

| **Facility** | **Description** |
| --- | --- |
| Xmas Trees | The flow of gas from the wells is controlled by the subsea xmas tree that comprises valves, choke, pressure and temperature monitors, which enable the wells to be safely operated and controlled. The design provides insulation to retain heat and Mono-Ethylene Glycol (MEG) injection at injection points upstream or downstream of the production choke to protect against hydrates during shutdown and start-up of the well.  The material selected for all internal wetted flow paths is carbon steel overlaid with 625 cladding hence no corrosion inhibitors is required. The subsea xmas trees include a coating plus a sacrificial anode cathodic protection system for external corrosion protection. Novolastic™ thermal insulation is applied on top of the coating. |
| Well Jumpers | The well jumpers (nominal 8”) are made of X-70 high strength carbon steel with 3.5 mm alloy 625 cladding. Outside Diameter is 245.9mm (9.681") and wall thickness is 25.4mm (1.0"), Inside Diameter is 188.1mm (7.406”). The WJs are coated and insulated with Novolastic. Maximum design pressure of the WJs is 445 Barg and maximum design temperature is 135°C, and the minimum is -40°C.  Each well jumper is equipped with an Acoustic Sand Vibration Detector (ASVD) and Intrusive Erosion Detector (IED) probe for sand and vibration monitoring.  Well Jumpers are fitted with Vortex Induced Vibration (VIV) strakes to mitigate against fatigue damage due to vibration from the external environment. |
| Production Manifolds | There are two 6-slot Production Manifolds (PM), PM East and PM West which are similar designs. Each PM has 2 headers and well tied to the manifolds can be directed to either header. Each manifold has an SCM installed and two pressure/temperature sensors on each header. |
| Production Manifold Jumpers | The two Production Manifolds are connected by two 12” NB PM Jumpers, allowing for sweeping of the looped flowline pairs through the East and West systems. Material of construction is Carbon Steel cladded with alloy 625. External coating/insulation is 5LPP. Jumpers are connected at each end using the UCON-H horizontal connector system. |
| Production Manifold Flowline Jumpers | Each of the four flowline DC PLETs is connected to one of the Production Manifolds by a 12” NB Jumper. Flowline 1 and 2 DC PLETs are connected to the PM-East and Flowline 3 and 4 DC PLETs are connected to the PM-West. This provides together with the Production Manifold Jumpers dual looped flowpaths allowing for dry gas sweeping from FLNG and round trip pigging capability. Jumper material is Carbon Steel cladded with alloy 625. External coating/insulation is 5LPP.  Jumpers are connected at each end using the UCON-H horizontal connector system. |
| Flowline Production Manifold (DC) Pipeline End Termination | The upstream end of each Flowline terminates at a Pipeline End Termination (PLET), which is connected to the corresponding PM Flowline Jumper using a UCON-H connector. Each PLET is equipped with a 14” OD Ball Valve rated at 517 Bar.  Cathodic protection is provided by 6 sacrificial anodes with a design utilisation factor of 0.9.  The PLET piping is made of carbon steel with 625 clad and is insulated with Novolastic™.  The DC PLETs have a -500/+3000mm sliding capacity for axial expansion/axial contraction (2 sliding pads per PLET). |
| Flowline Pipeline End Termination Suction Anchor Piles | Each Production Flowline Production Manifold (DC) PLET is anchored permanently to a Suction Anchor Pile, connected with an anchor chain.  PLET Suction Piles are approximately 12m diameter by 13.5m high and weighing approximately 300 Te.  The suction piles provide an overall 200 Te holdback capacity (design load) and are designed for an Axial tension of 1685 kN and a bending moment of 64kNm (full shutdown load case). |
| Production Flowlines | There are four 12” NB Production Flowlines, approximately 3km in length from the DC-1 area to the Riser Base Manifold (RBM). Flowline Nos 1 & 2 are connected to Production Manifold East and Flowline Nos 3 & 4 are connected to Production Manifold West. Overall Flowline OD including coatings is 477.7mm. The Production Flowlines have a bending stiffness of 46.76 MNm2.  Maximum design pressure for the Production Flowlines is 327 Barg, maximum design temperature is 130°C, and the minimum is -20°C. Typical normal flowline operating pressures are 174.7 bar (inlet) and 155.9 bar (outlet). Typical normal operating temperatures are 122.3°C (inlet) and 116.8°C (outlet).  The flowlines are constructed as seam welded clad pipe, with carbon steel backing pipe and 316L stainless steel internal cladding. The external coating/insulation system is 5LPP, with 3LPP (FBE + adhesive + PP) external corrosion coating forming part of the 5LPP overall coating/insulation system.  The 316L flowlines have been qualified for up to 8,400 ppm Chlorides content (although SCC testing was completed for 12,400 ppm), up to 29 bara ppCO2, up to 6.54 millibar ppH2S. The flowlines have no corrosion allowance being of stainless steel.  Cathodic protection is provided by sacrificial anodes with a design utilisation factor of 0.9 on the PLETs at each end of each flowline. The design anode current capacity is 1540 A-Hours per Kilogram with a design current density of 91.3 mA/m2 based on ISO DIS 15589.  The design provides for an allowable flowline lateral movement of up to 6.5m. The allowable span length (operating condition) is 77m near all PLETs, 27m in the vicinity of the Buckle Triggers and 16m in other areas. The flowlines were installed with a residual lay tension of 400kN.  VIV Strakes (16D x 0,25D type) are installed over a 35m section at the upstream (DC-1) end of each flowline. |
| Flowline Buckle Triggers | Two Buckle Triggers (BT) are installed at approximately 1 km intervals on each flowline.  The BTs are fabricated from Carbon Steel and coated with Marine Paint.  The function of the Buckle Triggers is to allow the flowline to freely expand/contract with thermal cycles while supported by the Buckle Trigger rail and restricted by the Buckle Trigger post.  Each BT is approximately 16m long, 12m wide and 2.2m high (overall height of Buckle Trigger structure without mudmat). Weight in air is 45 Te and submerged weight is 40.2 Te per BT.  Cathodic protection is provided by sacrificial anodes with a design utilisation factor of 0.9. The design anode current capacity is 1540 A-Hours per Kilogram with a design current density of 91.3 mA/m2 based on ISO DIS 15589. |
| Flowline Riser Base Manifold Pipeline End Terminations | The downstream end of each Flowline terminates at a Pipeline End Termination (PLET), which is connected to the corresponding RBM Flowline Jumper using a UCON-H connector. Each PLET is equipped with a 14” OD Ball Valve rated at 517 Bar.  Maximum design pressure for the RBM PLETs is 327 Barg, maximum design temperature is 130° C, and the minimum is -29° C.  Cathodic protection is provided by 6 sacrificial anodes with a design utilisation factor of 0.9.  The PLET piping is made of carbon steel with 625 CRA cladding, has no internal corrosion allowance and is insulated with Novolastic.  The RBM PLETs have a -0/+3500mm sliding capacity for axial expansion/axial contraction (2 sliding pads per PLET). |
| Riser Base Manifold Flowline Jumpers | Each of the four flowlines is connected to the Riser Base Manifold by a 12” NB Jumper.  Maximum design temperature of the RBM Jumpers is 130° C, and the minimum is -29°C. Maximum operating temperature is 120°C.  Jumper material is 316L SS clad Carbon Steel. External coating/insulation is 5LPP.  Jumpers are connected at each end using the UCON-H horizontal connector system. |
| Riser Base Manifold | The 8-slot Riser Base Manifold (RBM) is connected to the Flowline Jumpers and Riser end fittings with UCON-H horizontal connectors. The RBM is equipped with one pressure/temperature sensors for each of its 4 headers. RBM design pressure and temperature are is 327 Barg and 120°C (in accordance with flowline design) respectively. The manifold is equipped with a dedicated SCM for control of valve operation and processing of RBM sensor data. Manifold piping material is CS with alloy 625 CRA clad has no internal corrosion allowance, and is externally coated and insulated with Novolastic™.  The RBM is equipped with four Fail Closed Riser Base Valve (FCRBV), one on each header, one for each riser.  Cathodic protection is provided by 51 sacrificial anodes with a design utilisation factor of 0.9 and based on ISO DIS 15589. |
| Production Risers | The flexible risers connect the subsea Riser Base Manifold to the FLNG turret piping. The riser system is designed for 25 years of service.  The riser design accounts for maximum expected H2S and CO2 content. The selected material for the critical pressure sheath layer (i.e. PVDF) is capable of handling Prelude fluid and design temperature. An autoclave test program has been carried out to check the compatibility of PVDF pressure sheath inside the flexible pipe risers with the production gas stream solubility and temperature.  Each riser is protected by 6 sacrificial anodes in addition to protection from two sacrificial anodes placed on the Riser Base Manifold, together with the anodes for the protection of the manifold itself. The risers are electrically continuous with the RBM and provide electrical isolation between the riser cathodic protection (CP) system and the turret CP system. The end connections of a flexible riser can be subjected to cyclic loadings. To prevent damage to the riser’s structure from over bending, the termination is fitted a bend stiffener.  The flexible riser element is terminated in end fittings. The topside riser end fitting is hung off the riser hang-off collar at the top of the Turret I-Tube. A Riser Emergency Shutdown Valve (RESDV) is installed at the top of each riser in the FLNG turret.  Subsea riser end fitting is attached to a subsea UCON-H horizontal connector.  The riser system includes a Riser Vent Gas Monitoring System (RVGMS) to monitor diffusion of gas through the pressure sheath into the flexible pipe annulus, assess annulus condition and internal and external sheath integrity of the risers.  The flexible riser attachment at the bottom of the turret I-tubes utilise a diverless Bend Stiffener Latching Mechanisms (BSLM) keeping the bend stiffener in place while allowing pull-through of the topside riser end fitting. |
| Prelude Subsea Umbilical & Subsea Distribution Hardware | The umbilical provides hydraulic, electrical and chemical services, as well as signal on power controls communications to the subsea field. The umbilical has a functional design life of 25 years. Subsea control hydraulics and chemicals are transmitted in the umbilical via rigid stainless steel tubes while electrical power and communications are transmitted via quad core, copper submarine cables. The umbilical also incorporates two fibre optic bundles linking the Prelude facility to the NextGen fiber optic trunk line.  The main umbilical attachment at the bottom of the turret I-tube utilises a diverless Bend Stiffener Latching Mechanisms (BSLM) keeping the bend stiffener in place while allowing pull-through of the topside umbilical termination. |
| Safeguarding and Subsea Production Control System | The subsea Production Controls System (PCS) controls and monitors subsea facilities (inclusive of xmas trees, production manifolds and riser base manifold) by means of a multiplexed electrohydraulic control system.  It consists of surface equipment installed onboard the FLNG facility and subsea equipment installed on trees and manifolds. Subsea equipment consists of Subsea Control Modules (SCM) and tree/manifold-mounted sensors.  Surface installed equipment consists of Master Control Station (MCS), Electrical Power Unit (EPU) located in the forward electrical room and Hydraulic Power Unit (HPU) located in the turret. The HPU has the capacity supply for up to 15 SCMs, and the MCS and EPU combined have the capacity to control, monitor and power up to 20 SCMs, i.e.  • 12 production wells (i.e. seven plus five future)  • 2 production manifolds  • 1 riser base manifold  • 5 subsea control modules for future use  The main requirement of the subsea PCS is to provide the means to control and monitor the safe operation of the subsea production facilities, via the umbilical and distribution system, which interfaces with the topsides control and ESD systems. |

# Appendix B – Definitions and Abbreviations

|  |  |
| --- | --- |
| Term/Abbreviation | Definition |
| 3LPP | 3 layer Polypropylene (external corrosion coating component of Flowline & Flowline Jumpers 5LPP coating system) |
| 5D | 5 x Diameter – a dimension normally used to define MBR |
| 5LPP | 5 Layer Polypropylene (coating/insulation used for Flowlines & Flowline Jumpers) |
| AMV | Annulus Master Valve |
| AP | Aft Peak, an area near the stern of a vessel |
| ASV | Annulus Swab Valve |
| ASVD | Acoustic Sand Vibration Detector. |
| ASD | Acoustic Sand Detector |
| AWV | Annulus Wing Valve |
| AVV | Annulus Vent Valve |
| Ballast Module | An underwater weighted device which provides a controlled amount of ballast in order to achieve the desired profile of a flexible, in this case Production Riser or Umbilical. |
| Bend Stiffener | A conically shaped polyurethane moulding designed to add local stiffness to a riser, flowline, cable or umbilical. |
| Bend Restrictor | A mechanical device that functions as a mechanical stop which limits the local radius of curvature of the flexible pipe to a minimum value |
| Bilge Keel | A component of a marine vessel’s hull, normally one on each side (Port & Starboard), which hydrodynamically reduces the vessel’s tendency to roll. |
| Bioprobe | Intrusive biological or biochemical device used to detect and collect samples of bacteria in oil and gas systems. |
| BSLM | Bend Stiffener Latching Mechanism (for risers and umbilical) |
| BT | Buckle Trigger |
| Buoyancy Module | An underwater floatation device which provides a controlled amount of buoyancy in order to achieve the desired profile of a flexible, in this case Production Riser or Umbilical. |
| CFD | Computational Fluid Dynamics |
| CITHT | Closed In Tubing Head Temperature |
| CITHP | Closed In Tubing Head Pressure |
| CIV | Chemical Injection Valve |
| cm | Centimetre |
| CM | Corrective Maintenance |
| CMMS | Computerised Maintenance Management System |
| COPS | Communications of Power System |
| CP | Cathodic Potential – an indication of a metal’s corrosion status, measured in Volts |
| CPP | Cathodic Protection Potential |
| CRA | Corrosion Resistant Alloy |
| CSU | Commissioning and Start Up |
| CVI | Close Visual Inspection |
| DC | Drill Center |
| DC-1 | Drill Centre 1, located approximately 3 kms south of the Prelude FLNG facility and the location of the Prelude subsea production system. |
| DCC | See “Off-Track” |
| Deviation | A controlled waiver to operate outside the integrity envelope provided a risk assessment is completed with acceptable outcome and approval is granted at an appropriate level of authority. |
| DHG | Downhole Gauge |
| DOF | DOF Subsea Australia Pty Ltd |
| DOL | See “Off-Track” |
| EC | Electronic Connector |
| ED | Erosion Detector |
| EDM | Electrical Distribution Manifold |
| EFL | Electrical Flying Lead |
| EHFL | Electro-Hydraulic Flying Lead |
| El | Elevation (in this context, with respect to mean sea level, e.g. El-30m) |
| EPU | Electrical Power Unit |
| ER Probe | Intrusive probe used to measure corrosion rate by measuring electrical resistance. |
| ESDV | Emergency Shutdown Valve |
| ESFL | Electrical Steel Flying Lead |
| EVDT | Enhanced Vertical Deepwater Tree |
| FCRBV | Fail Closed Riser Base Valve(s) |
| FFP | Fit (or Fitness) for Purpose |
| FIV | Flowline Isolation Valve |
| FJ | Field Joint – lay barge weld between pipe lengths (~12m) including its associated corrosion coating |
| FLNG | Floating Liquefied Natural Gas (in this context, refers to the Prelude Host floating structure) |
| FLNG Mooring System | A system of 16 Mooring Legs connecting the FLNG Turret to Anchor Piles. |
| FLOC | Functional Location |
| Flying Lead | A short flexible electrical, hydraulic or electro-hydraulic line used to link connections between subsea structures such as manifolds, trees, Umbilical Termination Units and Subsea Distribution Units. |
| FM | Flow Module |
| FO | Fibre Optic |
| Frame | A single longitudinal section of a marine vessel hull structure. The Prelude FLNG frames are numbered consecutively moving forward from Frame 1 adjacent to the Aft Peak. |
| FSR | Facility Status Report |
| FTHP | Flowing Tubing Head Pressure |
| FTHT | Flowing Tubing Head Temperature |
| GPS | Global Positioning System |
| GVI | General Visual inspection (normally by ROV video camera but can also be performed by divers) |
| HBL | Hot Baseline Inspection |
| HDM | Hydraulic Distribution Manifold |
| Heel Anchor | In this context, a device used to hold back the static section of a Production Riser. |
| HFL | Hydraulic Flying Lead |
| HIV | Header Isolation Valve |
| HP | High Pressure |
| HPU | Hydraulic Power Unit |
| HSES | Health, Safety, Environment and Security |
| ID | Internal Diameter |
| IED | Intrusive Erosion Detector |
| IMSA | Integrity Management System Application |
| IMPP | Injection Moulded Polypropylene (coating type used on flowline bends) |
| I-Tube | A vertical fixed tube which allows another tubular to pass through a component. In this context, refers to the Prelude FLNG I-Tubes for the risers and umbilical, located within the FLNG Turret. |
| Jumper | In this context, a short segment of flexible or rigid pipe with a connector half at either end. A jumper is commonly used to connect flowlines, Xmas Trees and/or subsea facilities together. |
| kg | Kilogram |
| km | Kilometre |
| KP | Kilometre Post (typically to 3 decimal places), e.g. KP24.526 |
| LARS | Launch & Recovery System |
| LOT | Leak-off Test |
| LP | Low Pressure |
| LPG | Liquefied Natural Gas |
| m | Metre |
| Max | Maximum |
| MBES | Multibeam Echo Sounder |
| MBR | Minimum Bending Radius |
| MBV | Manual Ball Valve |
| MCS | Master Control Station – in this context refers to MCS-A and –B, part of the subsea control system located on the FLNG Host. |
| MEG | Methyl Ethylene Glycol |
| MG | Marine Growth |
| MIE | Maintenance and Inspection Execution |
| Min | Minimum |
| ML | Mooring Leg – a component of the FLNG Mooring System assembled from chain, wire rope and assorted ‘jewellery’ |
| mm | Millimetre |
| MMI | Mechanical, Materials and Inspection |
| MPa | Mega-Pascal |
| MoC | Management of Change |
| MSL | Mean Sea Level |
| N | Newton |
| NB | Nominal Bore |
| Novolastic | Insulation material used on xmas trees and well jumpers |
| OD | Outside Diameter |
| OEM | Original Equipment Manufacturer |
| Off-Track | As-found variation in position of line from the design route, e.g. “-2m”, with +ve implying to the right side, viewing in direction of flow (and KP numbering); also known as Distance Cross Course (DCC, flowline convention) and Distance Offline (DOL vessel heading-related convention |
| OFL | Optical Fibre Lead |
| PCE | Production Critical Element |
| PCV | Production Choke Valve |
| PE | Polyethylene |
| PFAP | Permanent Flowline Anchor Suction Pile |
| PHPU | Production Hydraulic Power Unit – part of the subsea control system located on the FLNG Host. |
| Pig | A tool that is sent through a pipeline and propelled by the pressure of the product flow in the pipeline itself. There are a number of uses for Pigs including separation of fluids, cleaning and inspection of a pipeline. |
| Pig Launcher | A device which uses a pressurized container to launch Pig into a pipeline without interrupting flow. |
| Pig Receiver | A device which uses a pressurized container to retrieve a Pig from a pipeline without interrupting flow. |
| PLET | Pipeline End Termination (also called Flowline End Termination) |
| PM | Production Manifold |
| PME | Production Manifold East |
| PMI | Positive Material Identification |
| PML | Production Maintenance Library |
| PMV | Production Master Valve |
| PMW | Production Manifold West |
| Polymer Coupon | An intrusive sacrificial component used to determine changes in molecular weight, chemical properties and hardness of the polymer pressure sheath of a flexible pipe. |
| PP | Polypropylene |
| ppb | Parts per Billion |
| ppm | Parts per Million |
| PSDV | Production Shutdown Valve |
| PSV | Pressure Safety Valve |
| PSV | Production Swab Valve |
| PTT | Pressure/Temperature Transmitter |
| PU | Polyurethane |
| PVDF | Polyvinylidene Fluoride |
| PWV | Production Wing Valve |
| RBI | Risk Based Inspection |
| RBM | Riser Base Manifold |
| RCA | Root Cause Analysis |
| RCV | Riser Choke Valve |
| RESDV | Riser Emergency Shutdown Valve |
| RHA | Riser Heel Anchor |
| RMS | Root Mean Square |
| ROV | Remotely Operated Vehicle |
| RVGMS | Riser Vent Gas Monitoring System |
| SAPL | Shell Energy Australia Pty Ltd |
| SBP | Sub-bottom Profiler |
| SCC | Stress Corrosion Cracking |
| SCE | Safety Critical Element (or Equipment) |
| SCM | Subsea Control Module |
| SCSSV | Surface Controlled Subsurface Safety Valve |
| SDH | Subsea Distribution Hardware |
| SDV | Shutdown Valve |
| Sea Chest | A recess in the hull of a marine vessel which provides an intake reservoir from which piping systems draw raw seawater. |
| SFL | Steel Flying Lead |
| SCSSV | Surface Controlled Subsurface Safety Valve |
| Shell Plating | The ‘skin’ of a marine vessel hull. Can be subdivided into Side Shell Plating and Bottom Shell Plating. |
| Soga | Soga Asia Technologies Inc |
| SPCU | Subsea Electrical Power Control Unit – part of the subsea control system SPCU-A and –B located on the FLNG Host. |
| SS | Stainless Steel |
| SSH | Subsea Historian Server Cabinet - part of the subsea control system located on the FLNG Host. |
| Swivel Stack | Swivel Stack Structure – in this context a component of the FLNG Turret which provides an interface for production lines, umbilicals etc. between the geostationary and weather vaning sections of the vessel. |
| TA | Turn Around (usually refers to a shutdown for planned maintenance) |
| TA | Technical Authority(ies) |
| TDC | Top Dead Centre |
| TFMC | Technip FMC PLC |
| TMS | ROV Tether Management System |
| TMS | Prelude Turret Mooring System |
| Tree Cap | A subsea xmas tree debris cap (ROV installed in this context). |
| Torus III | An FMC diverless, ROV installed and activated subsea connection system, in this case used to connection well jumpers to xmas trees and manifolds. |
| Tubing Hanger | A component used in the completion of oil and gas production wells. It is set in the tree or the wellhead and suspends the production tubing and/or casing. Sometimes it provides porting to allow the communication of hydraulic, electric and other downhole functions, as well as chemical injection. |
| TH | Tubing Head (Spool) - A spool-type unit or housing attached to the top flange on the uppermost well casing head to support the tubing string and to seal the annulus between the tubing string and the production casing string. |
| Turret | A component of a moored vessel to allow weather vaning. Contains a swivel which provides an interface for production lines, umbilicals etc. between the geostationary and weather vaning sections of the vessel. In this context, refers to the Prelude FLNG Turret, an internal non-disconnectable design. |
| TUTA | Topside Umbilical Termination Assembly |
| TUPA | Topside Umbilical Power Assembly |
| UCON | Universal Connector – an FMC diverless, ROV installed and activated subsea connection system. |
| ULS | Ultimate Limit State |
| UPS | Uninterruptable Power Supply |
| UTA | Umbilical Termination Assembly |
| UTH | Umbilical Termination Hub |
| VFI | Venturi Flow Meter |
| VGM | Venturi Gas Meter |
| VIV | Vortex Induced Vibration |
| VIV Strake | A helical device attached to the exterior or a cylindrical structure (in this case flowlines and jumpers), which suppresses vortexing caused by seawater flow, and hence the induced vibration. |
| VPI | Valve Position Indicator |
| Walking | Phenomenon of a pipeline or flowline snaking laterally due to thermal expansion and contraction causing lateral displacement of the line and axial ‘shortening’ of the pipeline, which can have an accumulative effect over multiple thermal cycles. |
| WA | Western Australia |
| WIR | Water Intake Riser(s) – in this context refers to the individual or the cluster of FLNG 9 Water Intake Risers (8 intakes and one structural). |
| WJ | Well Jumper |
| WLC | Weight Loss Coupons, intrusive, sacrificial components used to measure internal corrosion rate of piping or pressurised equipment. |
| WPF | Wet Parked Frame |
| WT | Wall Thickness |
| XOV | Crossover Valve |
| XT | Christmas Tree, a component of a well system located above the wellhead. |

# Appendix C – Reference Documents

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| **Document No** | **Document Title** |
| 2000-625-CS-3880-00001 | 2020 C1 Inspection Report - Subsea (Nov-Dec 2020) |
| 2000-625-UA-7180-00018 | 2020 C1 Inspection Campaign Summary Report (Nov-Dec 2020) |
| 220283-FR-SV-CL-401-0006\_B | 2020 C1 BUCKLE TRIGGER SPANS INCLINATION (Nov-Dec 2020) |
| 220283-FR-SV-CL-401-0007\_B | 2020 C1 PRODUCTION RISERS and MAIN UMBILICAL (Nov-Dec 2020) |
| WO 610999090 1, 2 & 3 | Turret General Visual Inspection, 30 Nov 2020 |
| 2000-005-S001-SS01-G00000-UA-3323-00074 | Technical Note: Riser & Umbilical Topside Inspection |
| 2000-010-UA-7180-00006 | Prelude Subsea Assets - Integrity Status Report 2019 |
| TEC\_PRE\_012551 | Subsea Asset Integrity Management Manual |
| 2000-115-S001-SS01-G00000-UA-7180-82002 | Prelude M1 Campaign (Sep 2017) |
| 2000-625-S001-SS01-G00000-UA-7180-00017 | Prelude C4A Campaign (Jan 2018 to Feb 2018) |
| 2000-625-S001-SS01-G00000-UA-7180-00023 | Prelude C4B Campaign – Cold Baseline (Nov 2018 to Dec 2018) |
| 220283\_398-IN-CL-403-0001 Rev B | Hot Baseline Survey - Inspection Report, DOF Subsea |
| 220283\_398-IN-CL-014-00010 | Hot Baseline Survey – Inspection Electronic Deliverables, DOF Subsea |
| 220283\_398-EN-CL-403-0001 Rev B | Hot Baseline Survey – Summary Report, DOF Subsea |
| 220283\_398-SV-CL-403-0002 | Campaign HBL - Baseline Survey (Hot) – Survey Operations Report |
| 220283\_398-SV-CL-403-0003 | Campaign HBL - Baseline Survey (Hot) – Survey Results Report |
| 2000-625-S001-SS01-G00000-UA-7880-00003 | Inspection Reporting and Data Deliverables Specification |
| 220283\_398-ENCL-403-0002 | P8(E3) Flow Module Replacement Summary Report |
| 220283\_398-ENCL-403-0003 | P3(E4) Flow Module Replacement Summary Report |
| 220283\_FR-SV-CL-401-0003 | 2019 Q2 P7 Flow Module Campaign,  Site Report - Production Flowloop System – GVI FL03 & FL04 |
| TBA | Prelude C2 Campaign (Sep 2016 to Nov 2016) |
| TBA | Prelude C3 Campaign (Jul 2017 to Nov 2017) |
| IMSA\_REPORT\_AN\_07 | IMSA Anomaly Criteria Report |
| N/A | KD Note Loss of IED on well jumper of P1-(TB EM 005) (Tom Bos & Ed Miller) |
| E2508-CTR1-TN-001 RevC | Gas Permeation Technical Note, Shell Prelude LOF Engineering (22 August2019) |

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