A15 & B10 DEVELOPMENT

FEED STUDY STAGE 2+

Petrogas Doc. Number: AB2-0003-PPL-SPC-PTG-0000-00005-00	**Rev: H01** **Date:08-11-2021**

Doc. Title: FUNCTIONAL SPECIFICATION (UMBILICAL) - PHASE 3 A15/B10 PLATFORM

Asset: AB2

Tag Number / Equipment Details: -

Issue Purpose:FOR REVIEW

Petrogas PO/Contract Number : 4100002758

Other Reference: -

Originator:PTG - Petrogas

Approval Status:			**Signature/ Date:**
1	REVIEWED NO COMMENTS	NO COMMENTS	WORK MAY PROCEED
2	REVIEWED WITH COMMENTS	FULLY INCORPORATE ALL COMMENTS AND RE-SUBMIT FOR REVIEW	WORK MAY PROCEED
3	REVISE AND RESUBMIT	FULLY INCORPORATE ALL COMMENTS AND RE-SUBMIT FOR REVIEW	WORK MAY NOT PROCEED
4	NOT REVIEWED (FOR INFORMATION ONLY)	FOR INFORMATION ONLY	WORK MAY PROCEED

Client

Petrogas Transportation B.V.

Project

Stage 2+ Project, A15 & B10 Development

Document

Phase 3 – A15/B10 Platform – Umbilical – Functional Specification

Project number	19025
Document number	AB2-0003-PPL-SPC-PTG-0000-00005-00
Revision	H01
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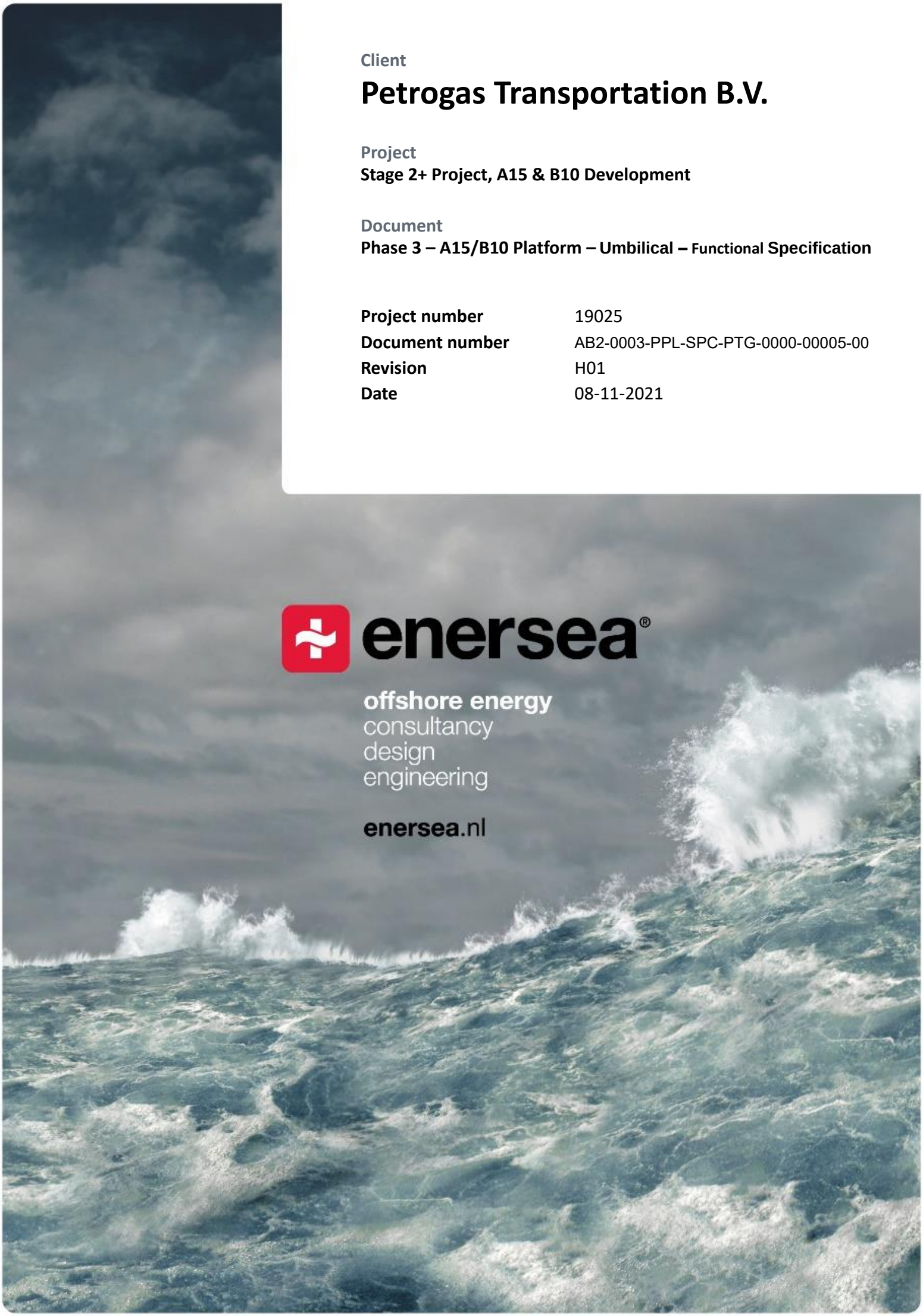


Revision History

Revision	Description
E01	For Client comments
H01	Client comments incorporated

Revision Status

Revision	Description	Issue date	Prepared	Checked	Enersea approval	Client approval
E01	For Comments (FEED)	19-10-2021	10.2.e			
H01	Approved for Design (FEED)	08-11-2021				

Table of content

1. Project Introduction

1.1. Project Introduction

The project introduction is captured and maintained in document AB2-0000-TEC-RPT-PTG-0000-00089-00_~~E01c~~E01 Project introduction.

1.2. Scope of this Document

The objective of this document is to clearly define the scope of work and technical requirements for the supply of the umbilical equipment and support services; it does not relieve Vendors of its obligations to provide the umbilical equipment which meets all other requirements as detailed in the Vendor's other supporting documents.

Company philosophy is to procure equipment in line with recognised industry standards. As such the umbilical supply Shall meet the requirements of API 17 E 5th Edition 2017 with the supplementary requirements as specified within this specification.

The scope of this document consists of two umbilicals complete with pull-in and hang off assemblies including J-Tube seals and VBR's.

1.3. Vendor Responsibilities

Vendor Shall be responsible for the engineering, design, manufacture, and testing of the umbilical and termination units.

Vendor Shall be responsible for appropriate analysis to ensure the proposed loads imparted by the installation process to the installed equipment can be accommodated.

1.4. Abbreviations

Abbreviation	Description
BoD	Basis of Design
BR	Bend Restrictor
CPP	Central Processing Platform
CS	Carbon Steel
DWP	Design Work Pressure
FAS	Free Alongside Ship
FAT	Factory Acceptance Test
FEED	Front End Engineering Design
FOC	Fibre Optic Cable
FOPP	Fibre Optic patch Panel
GRP	Glass Fibre Reinforced Plastic (Polymer)
DTAW	Gas Tungsten Arc Welding
HAZ	Heat Affected Zone
HD	High Density
HDG	Hot Dip Galvanized
HSE	Health, Safety, Environment
MSDS	Material Safety Data Sheets
OTDR	Optical Time-Domain Reflectometer
PED	Pressure Equipment Directive
RT	Radiographic Test
SAT	Site Acceptance Test
SIT	Site Integration test
SOL	Start of Life

SS	Stainless Steel
TDR	Time-Domain Reflectometer
TUTU	Topside Umbilical Termination Unit
UPS	Uninterruptible Power Supply
UT	Ultrasonic Test
UTA	Umbilical Termination Assembly
VBR	Vertebrae Bend Restrictor
VDR	Vendor Documents Requirements
WPQ	Welding Performance Qualification
WPS	Welding Procedure Specification

Table 1: Abbreviation

1.5. Environmental Data

1.5.1. Ambient Temperature

The following design ambient air conditions will be used:

- Maximum Air Temperature: 21.5 °C
- Minimum Air Temperature: - 5.5 °C
- Maximum Relative Humidity: 100%
- Minimum Relative Humidity: 60%

1.5.2. Seawater Temperatures

The following design seawater surface temperatures from the C12 CPP are used:

- Maximum surface seawater temperature: 20.17°C
- Minimum surface seawater temperature: 3.6°C
- Design Minimum seawater temperature: 3.6°C
- Design Maximum seawater temperature: 16.6°C

1.5.3. Design Water Depth

- Platform A12 CPP – 29.0 m
- Platform A15 – 28.25m
- Platform B10 – 28.4m

1.6. Codes and Standards

The specification, engineering, design, fabrication and installation of all works Shall be in accordance with the latest revisions of international Laws, Regulation, Codes, Standards and Authorities.

Standard Number	Title
API RP 578 3rd Ed	Guidelines for a Material Verification Program (MVP) for New and Existing Assets
EN 10204	Metallic materials. Types of inspection documents
BS EN 62230:2007+A1:2014	Electric cables. Spark-test method.
DNV RP B401	Recommended Practice for Cathodic Protection Design
DnV RP F109	On-bottom Stability Design of Submarine Pipelines
DnV RP O401	Safety and reliability of Subsea Systems
DNVGL-ST-N001	Marine operations and marine warranty.
DNVGL-RP-0232	Pipeline and cable laying equipment.
DNVGL-RP-0360	Subsea power cables in shallow water.
SAE AS 4059	Aerospace fluid power - cleanliness classification for hydraulic fluids
ISO 13628-1	Design and Operation of subsea production systems Part 1 General requirements and recommendations.
API 17 E	Design and operation of subsea production systems – Umbilical's
ISO 13628-6	Design and Operation of subsea production systems Part 6 Subsea production control systems.
ISO 14732	Welding personnel. Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials.
ISO 15607:2003	Specification and qualification of welding procedures for metallic materials. General rules.
ISO 15609-2:2001	Specification and qualification of welding procedures for metallic materials Welding procedure specification -- Part 2: Gas welding
ISO 15611:2003	Information to explain the requirements referenced in ISO 15607 concerning the qualification of welding procedures based on previous welding experience
ISO 15612:2004	Specification and qualification of welding procedures for metallic materials Qualification by adoption of a standard welding procedure
ISO 15613:2004	Specification and qualification of welding procedures for metallic materials Qualification based on pre-production welding test
ISO 15614-1:2004	Specification and qualification of welding procedures for metallic materials Welding procedure test -- Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys.
ISO 404:2013	Steel and steel products. General technical delivery requirements.
ISO 9712:2012	Non-destructive testing. Qualification and certification of NDT personnel.
SNT-TC-1A	Recommended Practice for NDT Personnel Qualification and Certification.
ISO 17635:2016	Non-destructive testing of welds – General rules for metallic materials.
BS EN ISO 3834-2:2005	Quality requirements for fusion welding of metallic materials. Comprehensive quality requirements
ISO/IEC17025	General requirements for the competence of testing and calibration laboratories. [Please see note 1 below]
ITU-T G.650	Definition and Test Methods for the Relevant Parameters of Single Mode Fibres
ITU-T G.652	Transmission media characteristics – Optical fibre cable: Characteristics of a single-mode optical fibre cable.
ITU-T G.970–G.979	Optical fibre submarine cable systems
ITU-T G.976	Test methods applicable to optical fibre submarine cable systems.
IEC 60502	Specification for power cables / cores ('Part 1, Cables for rated voltages of 1kV and 3kV' / 'Part 2, Cables for rated voltages from 6kV up to 30kV')
IEC 60228	Conductors of insulated cables
BS EN10257-2	Zinc or zinc alloy coated non-alloy steel wire for armouring either power cables or telecommunication cables. Submarine cables.
BS EN10244-2	Steel wire and wire products. Non ferrous metallic coatings on steel wire. Zinc or zinc alloy coatings
NORSOK M-501	preparation and coating

Table 2:International Standards

Vendor Shall be required to notify of any proposed deviations from the applicable standards, codes and regulations. If the information presented within this document is not exhaustive, the responsibility for obtaining additional information rests with the Vendor.

Note 1 –

ISO/IEC17025 General requirements for the competence of testing and calibration laboratories Conformity of the quality management system within which the laboratory or test facility operates to the requirements of ISO 9001 does not of itself demonstrate the competence of the laboratory or test facility to produce technically valid data and results. Nor does demonstrated conformity to ISO/IEC 17025 imply conformity of the quality management system within which the laboratory or test facility operates to all the requirements of ISO 9001.

Company recognises that ISO/IEC 17025 contains all of the requirements that testing and calibration laboratories have to meet if they wish to demonstrate that they -

1. operate a management system,
2. are technically competent, and
3. are able to generate technically valid results.

1.7. Conflict Between References

In the event of a conflict between references, the following precedence shall apply:

- National laws and regulations.
- Project specifications
- Company codes and standards.
- API 17 E
- National and international standards.

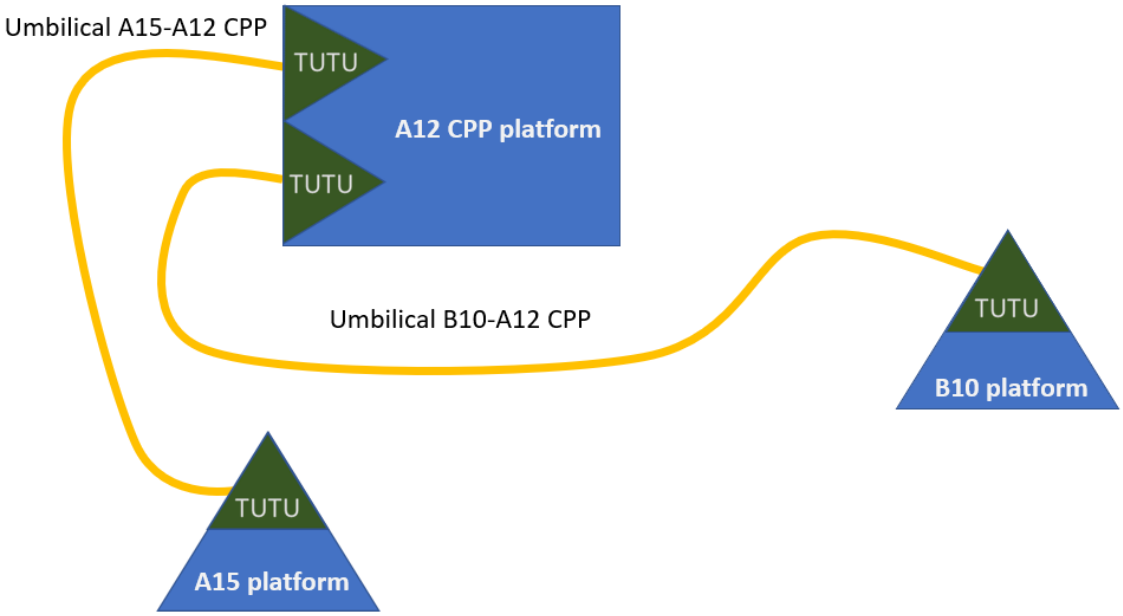
1.8. Definitions

Syntax	Meaning
Project	Stage2+ - A15 & B10 Development
Company	Petrogas Transportation B.V.
Engineering	Enersea BV
Vendor	The party responsible for the design, manufacturer and testing of the Umbilical, end terminations and ancillary equipment
Shall/Must	Indicates a mandatory requirement
Should	Indicates preferred course of action or is recommended as Good practice
Will	Indicates an intent
Might/May	Vendor can decide
Goods	Deliverables, equipment or merchandise to be provided to the Company by the Vendor under the terms of the contract. In this document means umbilical and terminations (TUTU, UTA)

Table 3: Definitions

2. Scope

The umbilicals shall consist of hydraulic, ~~chemical~~ methanol~~),~~, fibre optic lines and power supply from A12 CPP to both A15 and B10 platforms.



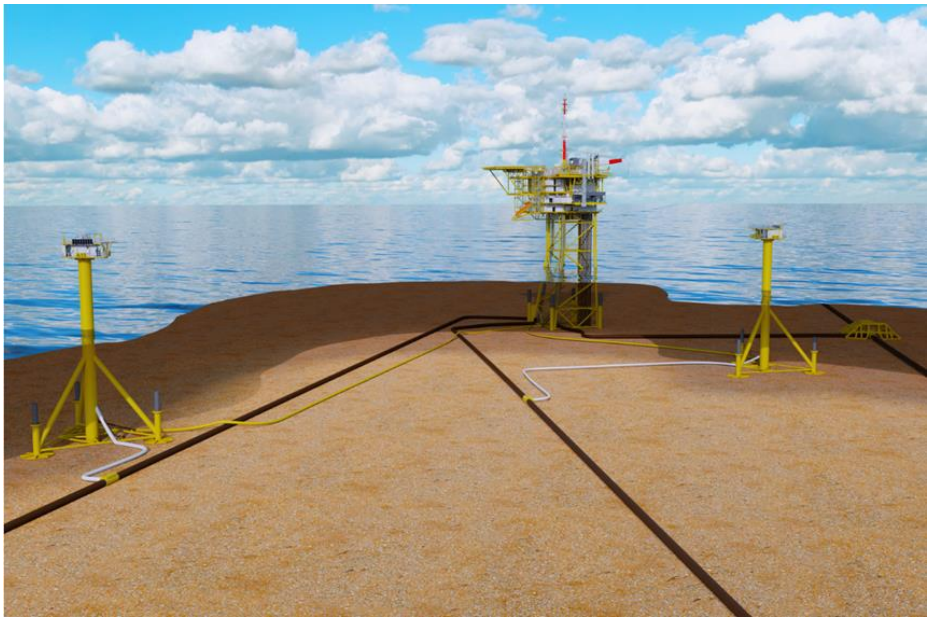


Figure 2-1: A/B blocks field layout

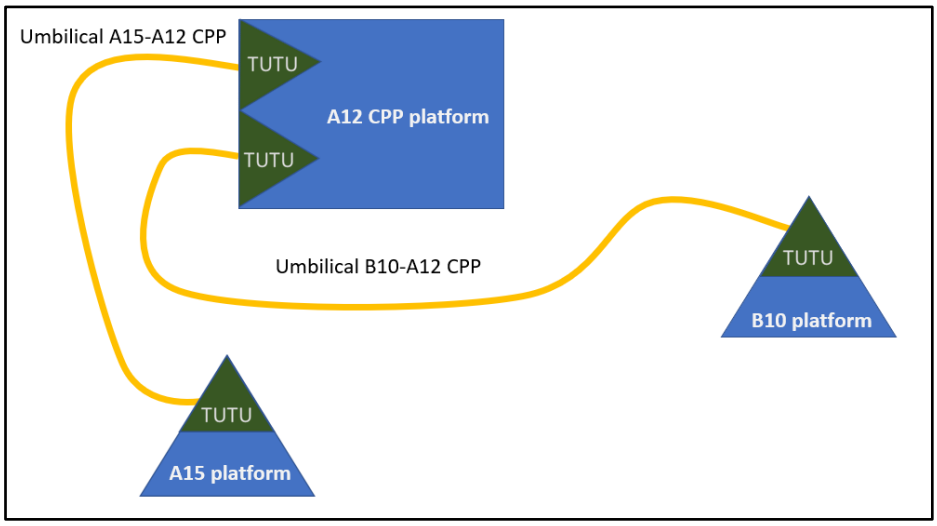


Figure 2-2: Umbilical and TUTU connection

There will be a two new TUTU required on A12 CPP and one TUTU on A15 and one TUTU on B10 platform. Supply of the TUTUs are excluded from this scope.

Vendor scope is defined as follows:

2.1. Scope of Supply

The scope of supply is briefly presented as below:

Item	Material	Remarks	~~Type~~
1	Umbilical A15-A12CPP	FAS on an installation reel specified in section 6 including any rigging, electrical connectors/hydraulic couplers and test fittings for both ends. 30 days free storage period from completion date.	~~Firm~~
2	Umbilical B10-A12 CPP	FAS on an installation reel specified in section 6 including any rigging, electrical connectors/hydraulic couplers and test fittings for both ends. 30 days free storage period from completion date.	~~Firm~~
3	Uraduct or similar approved	2 x 30m at C12 CPP location (each umbilical)	~~Firm~~
4	Vertebrae Bend restrictors	At each end of each umbilical to protect and to restrict bending during installation and at J-tube bell mouth and support the free-spans.	~~Firm~~
5	J-Tube seals (diverless c/w BR's)	At each end.	~~Firm~~
6	Topside cable and hose protection system	At each end. Fire protection and spiral guard.	~~Firm~~
7	Pull-in Heads & Hang-off flanges	At each end suitable for the pull-in loads.	~~Firm~~
8	Fluid fill and test fluid	Umbilical pressurised to nominal 70bar + Test fluid for both onshore and offshore.	~~Firm~~
9	Recommend spares	Recommended by Vendor for Company approval. Minimum requirement is a single repair joint box for reinstating the full cross-sectional components.	~~Firm~~
10	Testing	In accordance with Company requirements.	~~Firm~~
11	Monitoring manifolds	Monitoring manifolds for both umbilicals separated into fluid types and pressure types	~~Firm~~
~~12~~	~~Installation reels~~	~~Certified offshore installation reel per umbilical suitable for reel drive system and with certified rigging~~	~~Optional~~
~~13~~	~~Extended storage~~	~~Beyond the planned 30 days completion~~	~~Optional~~

Table 4: Scope of supply

Item	Material	Remarks
12	Carousel load-out	Spooling and monitoring during load-out.
13	150m spare umbilical	Complete with two repair joints.
14	Offshore termination and test	Fitment of topside ancillary equipment and umbilical installation testing.
15	35mm^2 Power Cable	To replace the 50mm^2 Power Cable.

Table 4a: Optional Scope of supply

2.2. Scope of Work

The scope of work to be undertaken under this specification for provision of the umbilical equipment shall be as listed above and below and comprise the minimum scope of work:

- Full engineering design verification based on the Project requirements as minimum:
  - On bottom stability for one year storm conditions (10*D acceptance criteria) untrenched locations.
  - Fatigue analysis for all umbilical internals and J-Tube seal.
  - Pull-in analysis
  - Free span analysis
  - Installation and recovery analysis
  - Tube material selection and compatibility.
  - Umbilical cross section

  - Design verification based on historical data.
  - Installation reel, cradles, hardware and rigging.
- Procurement of materials, functional components, sub-components, fluids, terminations, ancillary items and services as applicable.
- Design and manufacture of the umbilical ancillary equipment.
- Design manufacture and supply of an installation reel including cradles, rigging and partition/ramp suitable for offshore work scope to interface with installation contractors hub drive system.
- Fitment of terminations and ancillary equipment including provision of topside protection systems.
- Factory acceptance and completion testing.
- Site integration testing (in Conjunction with Control System Vendor).
- Packaging and protection for handling and shipping.
- Material certification and traceability records.
- Compilation of final shipping dossier and MRB
- Load-out. FAS within reach of vessel crane.
- Planning, progress monitoring and expediting
- Project Management and Document control
- Interface management
- Sub-Contractor/Vendor design verification/validation as well as factory acceptance testing.
- QA and products inspection, verification and validation.

2.3. Responsibilities

Vendor shall be responsible for supplying actual performance data of the functional lines in the umbilical and the electrical characteristic of the electric cable(s)/power cores. Vendor shall be responsible for ensuring that the designs, materials and methods of construction will result in the Goods being fit for purpose for the specified design life. In this context, fit for purpose specifically includes being suitable for reeling/unreeling load-out, onshore/offshore transportation, deployment from an installation vessel, trenching into the seabed, seabed stable, recovery/reinstallation and operation for the design life.

Vendor shall be responsible for precisely defining and obtaining an agreement with Company for the transfer of responsibility for the Goods from Vendor to the installation/shipping Vendor.

Vendor shall be responsible for providing data/documentation and review procedures developed by others to enable Company to safely install and commission the Goods.

Where Vendor's standard or preferred design option requires special consideration in respect of these requirements, such considerations shall be clearly detailed and advised to Company.

The Goods shall be complete and tested in accordance with the requirements of this specification taking due account of preservation, storage, shipping and installation/recovery requirements.

Sourcing of functional components of the same generic type from different Vendor approved sub-Vendor is acceptable subject to such sub-Vendor meeting the relevant requirements of this specification and approval by Company.

Vendor shall take account of any size, weight, delivery, installation and service constraints applicable to the Goods as part of the design process. Any design, manufacture, testing and delivery constraints shall be clearly identified by the Vendor for Company agreement.

2.4. Interfaces

Interfaces have been identified by Company as a critical area and Vendor shall liaise with Company and other interfacing organisations to determine product and service compliance and to ensure that interface responsibilities are agreed and accurately defined early in the programme. Vendor shall participate in interface co-ordination with Company's other Vendor and Vendor's sub-Vendor to ensure such interfaces are properly managed. Vendor shall be responsible for selection of all interfacing materials within Vendor scope of supply based upon the design and functional requirements of this specification and the materials of construction of other interfacing equipment. The chosen materials shall be justified by means of appropriate analysis and shall be subject to review and approval by Company.

The interface areas and specific interface details are provided in Attachment A of this specification.

2.5. Load-out Facilities

Vendor shall provide all Goods FAS within the reach of the vessel crane in accordance with the agreed notification methodology.

Vendor shall provide the ability to monitor pressure and test cable continuity during or after load-out. This data shall be submitted for Company approval within 1 hour of completion of the load-out.

Vendor shall provide all necessary documentation to support the load-out and installation.

2.6. Spares

Vendor shall provide Company with a list of recommended spares to provide Company with contingency during

- System installation recovery repair and re-installation
- Commissioning
- Operation

This list may be in addition to spares already defined by Company in this specification. Responsibility for selection of spares to be provided by Vendor will rest with Company.

Vendor shall provide Company with preservation procedures applicable to the spares provided by the Vendor.

2.7. Inspection

Meaningful and effective inspection shall be undertaken at each stage of manufacture of the Goods, functional components, sub-components and other elements that are incorporated into the Goods to ensure the requirements of this specification are achieved, the Goods are fit for purpose and, reliability is maximised. Such inspection shall be in accordance with formal schedules and planned arrangements developed to meet the requirements of this specification.

In the event issues arise in the manufacturing process resulting in non-conforming product or the potential for non-conforming product, if deemed necessary by Company, the frequency of the inspection shall be increased. Additionally, the nature and form of the inspection may be modified to reflect the nature of the issue.

Design, manufacture and test of the Goods shall be subject to Company inspection. Vendor shall afford Company inspector(s) access to Vendor's facilities and personnel as and when required. Vendor and its' sub-Vendor(s) shall make available inspection equipment for reasonable use by Company's inspector(s) and, where necessary, Vendor's personnel to operate specialist equipment, to verify conformance with Company requirements.

The Vendor shall:

1. Submit, within the time period specified by the Contract, for Company's review and acceptance Inspection & Test Plans detailing inspections and tests to be undertaken and the Inspection and Test certification to be produced;
2. Provide Inspection and Test Plans (including those of sub-Contractors) for review/clarification at Company attended pre inspection meeting and achieve Company acceptance prior to commencement of the applicable activity;

3. Submit, within the time period specified by the Contract, for Company review and acceptance individual Inspection and Test Plans for all Work performed by sub-Contractors;
4. Identify within Inspection and Test Plans submitted to Company, the extent of Vendor or Contractor's Inspection Review, Surveillance, Witness and Hold Points to be implemented at their own manufacturing/fabrication/construction sites and those of their sub-contractors; and
5. Include within Inspection and Test Plans submitted to Company the extent of Inspection Review, Surveillance, Witness and Hold Points for the IVB, whether the IVB is engaged by Company, Vendor or Contractor.
6. Company shall advise Vendor or Contractor of the activities, tests, inspections and trials that Company's representatives shall attend.

   A "Hold" point is defined as a point in the process beyond which it is not permitted to proceed without the presence of a nominated witness, unless written confirmation from Company's representative of non-attendance has been received.

   A "Witness" point is defined as a point in the process where the Company's nominated witness representative must be given the option to attend. For repetitive activities witnessing of a percentage of the total may be specified.

   A "Surveillance / Monitor" point is defined as a spot check activity for which the Company will identify stage inspections to take place within the ITP on a monitoring basis. No formal notification to Company is required.

   A "Review" point is defined as a point in the process at which a record of the activity is required to be reviewed by the Company's nominated representative. The nominated representative is required to review / endorse these records, which shall be presented to him by the Vendor or Contractor at the earliest opportunity.
7. Vendor or Contractors and sub-Contractors shall not commence the process before review and acceptance of all relevant Quality Plans and ITPs by the Company.
8. Quality Plans and ITPs shall form contractual parts of the Contract, and shall be subject to revision and re-acceptance by Company if changes to the work scope occur.
9. ITPs shall follow a format to be approved by Company and include a clear and unambiguous acceptance criteria (with reference to where this comes from), and a clear and concise reference to the verifying document/report/certificate used to demonstrate that the acceptance criteria has been met.

2.8. Certification

Final design, manufacture and test of the Goods are subject to Third Party approval. Vendor shall also afford Company's Certifying Authority and site representative access to Vendor's facilities and personnel.

All materials incorporated in the Goods shall be certified by Vendor and sub-Vendor(s) as being of the correct form, type and of the correct chemical and physical formulation.

In addition, Vendor shall provide all materials with EN10204 certification. The Vendor shall specify what level of certification is to be provided for non-metallic components, however, end product shall be a minimum of 3.1.

Where traceability is lost, or the integrity of a metallic alloy is questioned and at the discretion of Company, Vendor shall undertake PMI to the recommended practices of API RP-578.

2.9. Installation and Commissioning Support

Installation and final connection of the Goods shall be performed by the installation Contractor. Umbilical Vendor shall provide personnel and equipment to assist the installation Contractor in respect of, integrity monitoring, hook-up and commissioning (such support is outside the scope of this Purchase Order and will be provided for in a separate contract between Vendor and Company).

Vendor shall review the installation Contractor's procedure to confirm that key design parameters applicable to the performance of the Goods will not be compromised during load-out, storage, deployment, pull-in, hook-up, and testing or any recovery operation.

2.10. Substitutions and Modifications

Vendor shall make no substitutions of Vendor's proposed material or modifications to Vendor's proposed designs without the prior written approval of Company.

Should Vendor wish to make such substitutions or modifications, it shall submit a request in writing to Company clearly stating the reason and demonstrating the adequacy of the proposed change(s).

2.11. Delivery Locations

Delivery location(s) for the Goods shall be as per Contract

3. Design Requirements

Vendor shall review the Company supplied Engineering design carefully, complete it and optimize for the project requirements.

Both umbilical's have identical functional requirements, if not stated differently in the text.

The umbilical system Shall be engineered, designed, manufactured and tested in accordance with API 17 E, which sets the minimum requirements to the product. Any deviations Shall be approved by Company.

A static umbilical Shall typically be of a free flooding, multiple armoured wire design and Shall be torque balanced to ensure that the control system terminations are not subject to excessive rotational loads during installation. Armour wire layers shall be pre-formed and applied with uniform tension which shall be verified during manufacture.

The umbilical Shall contain all electrical power/communication cables, hydraulic supply lines and chemical injection cores as specified in section 3.1.2.

Hydraulic/Chemical lines and cables of the umbilical Shall be bundled into a circular cross section and with no torsional stress applied to the individual components. No joints or splices in the individual elements Shall be permitted unless operational requirements dictate. If this is the case, Vendor Shall seek Company's approval.

The umbilical Shall be covered with an outer layer of abrasion resistant material on top of the armour layers. The colour of the outer layer to be proposed by the Vendor. The outer layer should allow free removal of permeation products. A longitudinal stripe shall be applied to the inner and outer layers to facilitate the monitoring of product rotation during assembly and installation/recovery. Vendor shall provide acceptance criteria for the allowable rotation per meter in all components and final product.

The use of equipment and components that are field proven is preferred. Equipment that is not field proven Shall require to be highlighted and be subjected to approval testing prior to being approved for use.

3.1. Umbilical Functional Requirements

3.1.1. Design Life

The design lifetime of for an umbilical Shall be a minimum of 15 years. The factor of safety for fatigue design for dynamic umbilical Shall be ten to one (i.e. 150 years).

3.1.2. Umbilical Length

The umbilical length is calculated as below. During manufacturing the length Shall be monitored and calculated using a calibrated instrument.

Acceptable final length tolerance will be + 0.5%, - zero.

Length reference points will be the termination arrangement flange on either end, i.e. the pigtails will not be included when calculating the umbilical length.

Final cut/termination length will be defined by Company during the detailed engineering phase of this development.

Umbilical length A15-A12 CPP

A12 CPP platform pigtails	3	m
J-tube length A12 CPP platform	57	m
umbilical routing length	9549	m
J-tube length A15 platform	55	m
A15 platform pigtails	3	m
Total length	9667	m

Umbilical length B10-A12 CPP

C12 CPP platform pigtails	3	m
J-tube length A12 CPP platform	57	m
umbilical routing length	12785	m
J-tube length B10 platform	55	m
B10 platform pigtails	3	m
Total length	12903	m

2% contingency in the total length has been considered for the route profile.

Bend restrictor length:

Platform A12 CPP	5	m	+ 30m of Uraduct or equivalent protection (2x)
Platform A15	5	m	
Platform B10	5	m	

3.1.3. Rating Design Criteria

The umbilical shall provide the following services:

Umbilical:

- One Electrical Power supplies (880VAC 50Hz) for 5 kW, 2 x 1Cx 50 mm^2.
- High Pressurized hydraulic line ~~3/8~~1/2 “. Design pressure 5000 psi (34.5 MPa). Max operating pressure is 26 ~~Mpa~~MPa. Max flow is estimated ~~3~~33.6 l/h.
- ~~Low pressurized hydraulic line ½”. Design pressure 5000 psi (34.5 Mpa). Max operating pressure is 18 Mpa. Max flow is estimated 30 l/h.~~
- Spare High Pressurized hydraulic line ~~½”.~~1/2”. Design pressure 5000 psi (34.5 ~~Mpa~~MPa).
- Methanol for injecting to the wells (upstream of the choke valve), is basically only required for the start-up condition:
    - The source pressure: Design pressure is 135 barg and max operating pressure 70 barg.
    - The methanol flow rate at host: 25 l/h
    - The selected line size is ~~½~~1/2 “
- Fibre optic cable for the control and monitoring applications with the following specification:
    - Single mode 9/125 µm
    - Wave length: 1310 nm
    - Max cable attenuation: 20 dB

The umbilical shall be supplied with an inner sheath, outer sheath and armour suitable for the marine application based on the following criteria as a minimum:

3.1.4. Inner Sheath

The inner sheath of LLDPE, a minimum of 4 mm thick, shall be applied over the laid-up umbilical prior to the application of the armouring.

The extrusion process used shall ensure that there are no adverse effects on any of the core components due to the high temperatures involved.

3.1.5. Outer Sheath

The umbilical shall be finished with a tough sheath of LLDPE, a minimum of 4mm in thickness and of a continuous circular solid extrusion of polyethylene, or by polypropylene roving on a bed of slushed bitumen. Vendor to propose the outer sheath colour. The heat from the slushed bitumen shall not affect the mechanical properties of any GRP tape layers.

The umbilical outer sheath must be capable to withstand the loads implied by trenching and rock-dumping. Contractor shall prove this by qualification testing or documented evidence.

3.1.6. Steel Wire Armour

Protection and tensile strength shall be provided using two layers of suitably sized hot dip galvanised, contra-wound steel armour wires to produce a torque balanced construction. The complete assembly shall be capable of withstanding the marine deployment stresses involved in umbilical laying and pull-in and any recovery activities.

The galvanised steel armour wires shall be selected to provide adequate weight, axial strength and corrosion resistance over the design life. In order to allow sufficient installation loading a minimum axial design load of 10 mT shall be used.

Armour lay pitches shall be selected to minimise extension under load while maintaining good flexibility and torque balance.

Armour wire layers shall be pre-formed and applied with uniform tension which shall be verified during ~~manufacture~~manufacturing.

Vendor shall prove the design to be suitable for the application required, particularly in respect of torque balance, elongation, tensile strength and submerged weight.

A layer of tape shall be wound over the inner armour layer to prevent fretting between the inner and outer armour layers during handling.

3.1.7. Fluid Conduits

All chemical and hydraulic lines shall be capable of operating at their maximum working pressure when curved to the minimum radius.

For thermoplastic hose the lines Shall be extruded in continuous lengths and no joints or repairs Shall be accepted under any conditions. The liner Shall also be compatible with all fluids and liner material Shall be low permeability for methanol functions.

All lines when filled with the service fluid Shall be capable of withstanding an external pressure greater than 1.5 times the maximum static head at the design water depth less the internal static head pressure of the service fluid without deformation, at zero internal pressure (gauge).

Hoses Shall be filled with project fluid for testing/shipment and pressure maintained within the lines to prevent collapse/deformation during manufacture and installation.

The proposed liners, conductor insulation and sheathing materials Shall be compatible with the fluids stipulated in this document in section 3.1.10

All hoses shall be terminated in 316L JIC female swivel couplers, Vendor to advise JIC size for topside interface.

Identification of the hose lines shall be provided throughout the entire finished length of each hose nominally every meter, by legible printing on the outer sheath in indelible/waterproof ink, to include the following:

i. Manufacturer
ii. Manufacturer's reference (trace/batch No.)
iii. Date of manufacture
iv. Procurement specification reference.
v. Length marking meterage.
vi. Description & size
vii. Design pressure rating
viii. Line reference.
ix. Typically : "Manufacturer" – "Ref No." – "Month/Year" – Spec Ref - Meterage – Size – DWP – Line

3.1.8. Power Cable

Power cables shall be designed to transmit power in the voltage range 0 V rms to 0,6 /1(1,2) kV rms as defined in IEC 60502-1. Vendor may propose higher rated cable design which is already qualified.

Cables shall be manufactured in accordance with the manufacturer's written specification which shall be submitted to Company for approval prior to cable procurement. In recognition that IEC 60502 excludes submarine cables Company has specified the additional DNVGL-RP-0360 requirements and normative references.

Electric cores and cables should be manufactured as continuous lengths. No repairs shall be permitted to the insulation or semiconducting layers and no manufacturing splices shall be permitted within the conductors.

Spark testing performed during manufacture Shall be chart recorded to demonstrate compliance with the requirements.

Insulation and cable jacket extrusion dimensional data shall be reported as absolute values and NOT averaged values.

If repair splices are necessary to achieve the final length requirements, these shall be carried out in accordance with Company approved qualified procedures by qualified personnel detailed in the Vendor or Sub-Vendor written specification.

The electrical cores sizes Shall be verified and confirmed by Vendor based on the required power consumption.

Dimensional samples shall be removed from each end of each cable for verification post manufacture.

All electrical cables Shall comply with the following minimum requirements:

- Electrical cores Shall be of stranded copper construction and incorporate a water blocking compound. The cable generally shall be designed to prevent longitudinal penetration of water and the Vendor shall perform a water penetration test at the maximum design water depth to demonstrate compliance with this requirement.
- Supplier Shall provide full details on the proposed insulation materials and conductors, including construction, qualification data etc.
- Cables Shall be designed and qualified to operate when the umbilical is completely flooded with sea water.
- Cables Shall be screened and terminated to a pin connection in the Seacon electrical connectors at either end to achieve core/screen continuity for monitoring purposes.

- Identification of the cables shall be provided throughout the entire finished length nominally every meter, by legible printing on the outer sheath in indelible/waterproof ink, to include the following:
    1. Manufacturer
    2. Manufacturer's reference (trace/batch number)
    3. Date of manufacture
    4. Procurement specification reference
    5. Length marking meterage
    6. Description & conductor size
    7. Maximum voltage rating
    8. Line reference.
    9. Conductor insulation shall be colour coded such that individual conductors are easily identifiable. Electrical cable outer sheath shall also be uniquely colour coded.

- Vendor shall supply (but not limited to) the following data for Company approval prior to umbilical assembly:
    1. Inspection Certificate (EN 10204:2004 Type 3.1) & Inspection Release Note
    2. Cable insulation extrusion records (Reference Section 7~~.5.2~~ of ~~ISO 13628-5~~API 17 E)
    3. Results of hydrostatic tests (as applicable)
    4. Post assembly or lay-up tests results
    5. Factory acceptance test results
    6. Geometrical measurements
    7. All test reports shall be traceable to a unique cable line and located within the data book in a suitable order.

3.1.9. Fibre Optic Cable

The umbilical shall be provided with 1 (one) off 24 fibre optic core -assemblies. The design of the fibre optic cable sub-assemblies shall conform to ITUG.650.I and ITU G.655. The design shall ensure that individual fibres are fully protected from damage during umbilical manufacturing processes.

Fibre optic used in the umbilical shall be:

- Dimensions: 9/125 µm
- Connector type: SC (In case)
- Wave length: 1310 nm

Attenuation

Attenuation to be performed using a backscattering method (OTDR) on the whole length of each fibre in accordance with ITU-T G.976.

Measurements to be made at 1550 nm and obtained from each end of the fibre.

Optical attenuation of the finished cable < 0.37 dB/km at 1310 nm

< 0.25 dB/km at 1550 nm

Maximum Fibre Splice Loss 0.14 dB/splice at 1550 nm

The optical attenuation of the fibre shall not include point losses greater than 0.14 dB at 1310 nm or 1550 nm

All fibre cores shall be manufactured as a continuous length with no breaks or joints.

Insulation material shall be polymeric or elastomeric of suitable grade to meet the environmental conditions required.

Optical Fibre Cables shall be designed, manufactured and tested in accordance with the ITU standards and manufacturer's written specification which shall be submitted to Company for approval prior to cable procurement.

Optical-fibre cables shall be capable of continuous operation immersed in a seawater environment for the design life detailed within this specification. The cable construction shall be able to withstand the minimum bending radius without mechanical damage or reduction of performance.

The cable-construction materials shall be compatible with fluids with which they may come into contact, for example, end terminations.

The design of the optical-fibre cables shall recognize that the cables terminate in some form of water blocking arrangement, which shall function throughout the design life.

The Vendor shall advise the maximum number of factory joints or splices, either in the cable or in any of its components, to meet the required lengths. No joints or splices shall be permitted without Company approval. Each end of the cable shall be sealed with heat-shrinkable caps prior to dispatch from the cable manufacturer.

Dimensional samples shall be removed from each end of each cable for verification post manufacture.

Average X-Y data sets for all cable jacket extrusion dimensional recording is not permitted, only absolute data records will be reviewed by Company.

Spark testing performed during manufacture Shall be chart recorded to demonstrate compliance with the requirements.

Full colour without ring stripe marking (other colour coding systems may be submitted for COMPANY approval).

Any ring colour if applicable shall be complete circumferentially and clearly visible.

The water-repellent gel should contain a hydrogen-absorbing component to avoid attenuation increases in the optical fibre due to hydrogen. The gel shall provide flooding protection to the fibres in the event of mechanical failure of the metallic tube.

The gel must be compatible with an optical fibre design life of 15 years, both in terms of mechanical and optical performance.

The carrier tube steel material shall be AISI 304 stainless steel or copper tube subject to COMPANY approval. The tube nominal outside diameter shall be 3.7 mm and the tube wall nominal thickness shall be 0.2 mm.

The tube shall be designed to minimise hydrogen evolution and there shall be an excess length of 0.14% optical fibre within the tube to prevent the fibres being subjected to excessive strain.

CABLE IDENTIFICATION

Identification of the cables shall be provided throughout the entire finished length by legible printing on the outer sheath in indelible / waterproof ink containing the following:-

1. Manufacturer
2. Manufacturers reference (trace/batch or order No.)
3. Date of manufacture
4. Specification Ref
5. Quantity and type of fibres
6. Cable type
7. Line no.
8. Meterage.

Typically :-

“Manufacturer” – “Ref No.” – “Month/Year” – Specification Ref – 24 x SM – Optical Fibre Cable Line A -Meter marking (m).

TEST RESULTS MUST BE TRACEABLE TO INDIVIDUAL CABLES ON THE BASIS OF SHEATH PRINTING.

Printing to be repeated at intervals not more than 1000mm.

Embossed printing is NOT permitted.

Each end of each cable shall be sealed with heat-shrinkable caps prior to dispatch from the cable manufacturer.

Shipping reels shall fully protect the optical cables using timber battens.

Optical cables shall be wound onto steel shipping reels evenly at touch pitch using a uniform tension prescribed by the cable manufacturer and umbilical manufacturer which will not allow the optical cable to propagate slack during the umbilical assembly. This spooling tension shall be verified by the CONTRACTOR during the final spooling process at the optical cable supplier.

Shipping reels shall be clearly and permanently tagged with the following as a minimum but not limited to—:

- Reel weight.
- Cable length.
- Cable type batch or lot number.
- Project ID

3.1.10. Umbilical Fluids Materials

	Fluid	Type	Remark
1	HP / LP Hydraulic	Oceanic HW 443 R	
2	Methanol	80% purity at least	

Table 5: Fluids material specification

3.1.11. Cross Section ~~– Umbilical Option 1~~

	Component	Qty.	Nominal size	Rating/Pressure (psi)	Specification
1	~~LP~~HP Hydraulic Fluid	1	½"	5,000	XLPE PE or Nylon (To be advised by Vendor)
2	HP~~/LP~~ Hydraulic Spare	1	½"	5,000	XLPE PE or Nylon (To be advised by Vendor)
~~3~~	~~HP Hydraulic Fluid~~	~~1~~	~~3/8"~~	~~5,000~~	~~XLPE PE or Nylon (To be advised by Vendor)~~
4	Methanol	1	½"	3,000	XLPE or PE(To be advised by Vendor)
E1+E2	Power cable	2	2 x 1C x ~~50 mm²~~50mm²,	(880VAC 50Hz) for 5 kW	Non-Armour
F1	Fiber Optic cable	1	24 fibers	N/A	Armoured

Table 6: Umbilical components (Chemical)

3.2. Umbilical Weight Estimate

Vendor shall calculate and submit the weight of the proposed umbilical together with hardware and reel/cradles for load-out purposes.

3.3. Umbilical Component Termination

Umbilical conduits (tubes) shall be terminated with JIC female swivel couplings in order to be connected to the TUTU connections. All connectors shall be installed in the factory and properly tested.

Electrical cables shall be terminated with Seacon series 55 connectors to allow monitoring and testing during load-out/installation

Fibre optic cables shall be terminated with environmental seals for load-out/installation and will be terminated to the topside junction boxes (supplied by others).

Vendor shall issue pulling head and hang-off design for company approval.

Vendor shall provide a cost for an intermediate pull-in collar option.

All component terminations shall be cathodically protected for 12 months storage subsea.

3.4. Pulling Head and Hang-off

Umbilical shall be supplied with pulling heads/shackles suitable for the pull-in loads. The pulling stress shall be calculated based on the umbilical weight, friction and so on. The pulling head shall be capable to tolerant the 1.5 times of the total force on the umbilical. The pulling heads shall be connected to the umbilical armour wires and shall be designed in such a way that they do not damage the umbilical armour. The Vendor shall design the pulling heads to facilitate the J-tube arrangements as shown in Attachment A.

The pulling head design shall facilitate access to the umbilical components for monitoring and/or testing via QC/DC couplers and Seacon connectors. Umbilical component pigtail lengths nominal 3m to be verified during detailed design. Pigtail fire and mechanical protection to be provided by Vendor and clarified during de-tailed design.

The pulling heads shall be subjected to a load test and NDE as part of the acceptance testing where fabricated components are used.

The Vendor shall design, manufacture and test a pull-in and termination assembly for termination to the end of the platform J-Tube terminations with 150# flat faced flange. Testing will consist of proof load testing only of the fabricated pad eyes, and where historical qualification is considered unsatisfactory, tensile testing of the termination components of the Pull-In and hang-off shall be undertaken. Pulling head and hang-off shall be cathodically protected for 12 months storage subsea. Only armour clamping designs shall be provided above the hang-off and pulling head locations these designs shall be fully qualified and these locations shall be supported and protected using mini bend stiffeners sized to prevent over-bending during installation and handling. Abrasive/hand cutting of the armour package post installation is not permitted.

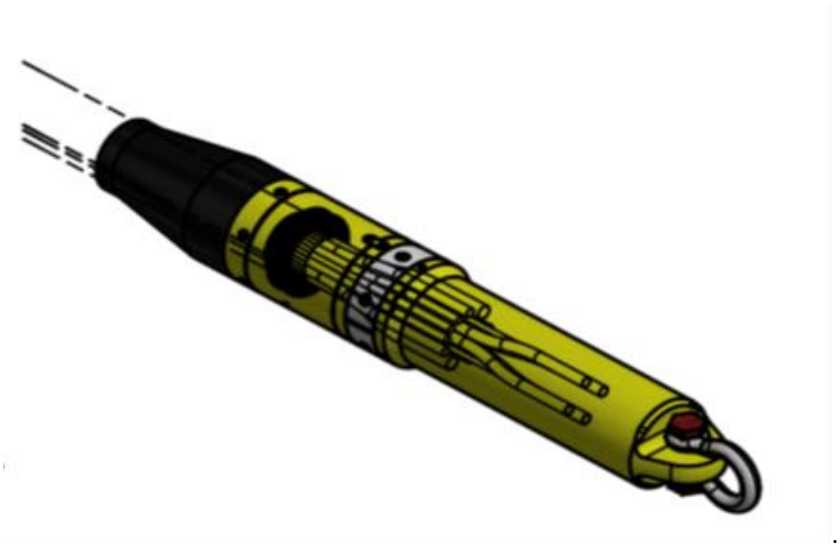


Figure 3-1: Typical pull head design

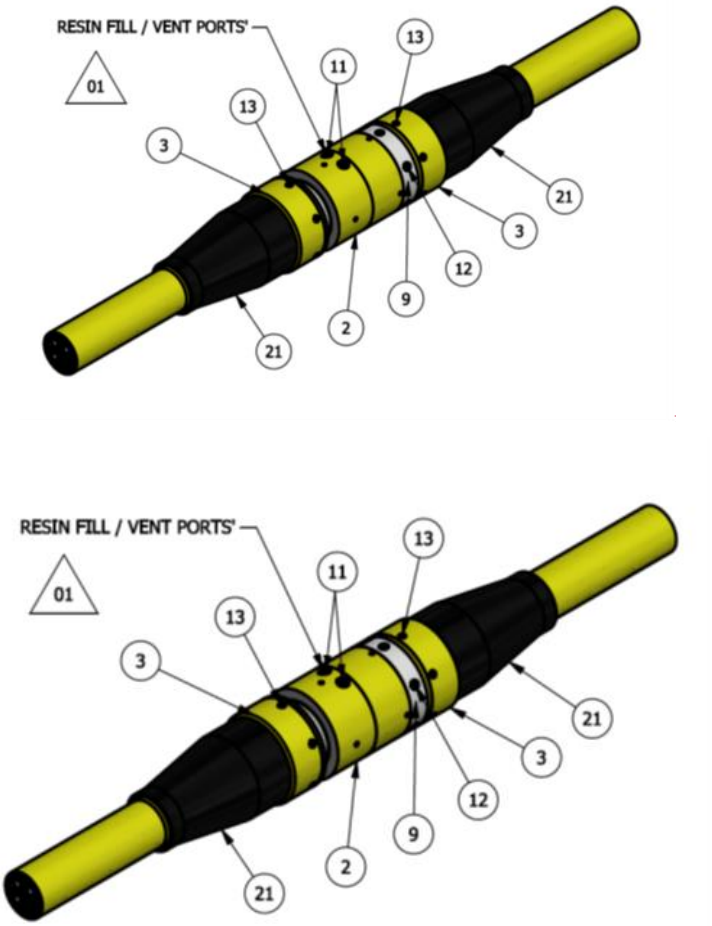


Figure 3-2: Typical hang-off assembly

3.5. Analysis

The umbilical and its constituent components shall be designed to meet the functional and technical requirements of API 17 E clause 6 and the requirements defined in this document. The inputs for the analysis shall be

gathered from a referenced documents for the umbilical risk evaluation. The risk evaluation document shall be submitted to Company for approval. The factors that shall be considered are, amongst others, the environmental and service conditions for the umbilical and the consequences of non-performance.

Fatigue analyses shall include fatigue at operating temperature, a prediction of load cycles and translation of load cycles into nominal stress or strain cycles. The load cycles shall include reeling, handling, construction, installation, unplanned events such as partial recovery and reinstallation, as stated in the design basis.

The effect of mean stresses, internal (service) and external (environmental) plastic pre-strain and rate of cyclic loading shall be considered when determining fatigue resistance.

Assessment of fatigue resistance may be based on either S-N data obtained on representative components or a fracture mechanics fatigue-life assessment. The selection of safety factors shall consider the inherent sensitivity in fatigue-resistance predictions for such designs. Account shall be taken of the effect of the strain accumulated during manufacturing, handling and installation on the umbilical fatigue performance.

Vendor shall undertake and document the following analysis as a minimum however if the results of the risk evaluation identify other factors then these should also be analysed.

- Fatigue analysis. (manufacture test load-out and installation, service (free-span) and VIV.
- Installation/recovery analysis identifying limiting factors MBR, axial compression end termination loads etc.
- Seabed stability design life (in trench and out of trench).
- Pull-in analysis through J-Tube (ref Attachment A);
- Corrosion/CP.
- Seabed stability (during installation window). Reference is made to attachment B for the applicable environmental data.
- Maximum flow rates for chemical injection lines.

3.6. Reliability

The use of designs, equipment and components that are field proven is preferred. Equipment that is not field proven shall be highlighted by the Vendor and may be subjected to extensive qualification testing prior to being approved for use.

3.7. J-Tube Seal and Bend Limiter.

Vendor shall design, manufacture, test and supply a diver-less J-Tube seal c/w nominal 5m of bend limiters at each J-Tube location which shall be attached to the umbilical during installation. Vendor shall provide a rate per meter to increase or decrease the length of the VBR assemblies. The design shall support a pull-through system to remove the risk of locating the seals incorrectly on the umbilicals. The maximum pull-through distance is estimated as 600mm to be confirmed during detailed design.

Vendor shall provide a detailed J-Tube seal procurement specification and design report for Company approval.

Vendor shall demonstrate that these J-Tube seal arrangements can be assembled offshore, and the correct clamping pressure can be obtained to allow the pull-in operation to be completed.

The bend limiter fasteners shall be subjected to PMI to verify compliance with the purchase specification requirements.

All metallic components and polyurethane raw materials are to be supplied with full traceability and Certificates of Conformity.

The interface between the J-Tube seal and bend limiter string shall allow the J-tube seal and the string of bend limiters to be assembled separately and then interfaced together to reduce the assembly time during installation.

Vendor shall consider the following specific design requirements including but not be limited to:

- Overview of seal design requirements.

- Applicable codes and standards.
- Level of sealing required. (1.5. x difference in hydrostatic head due to tidal movement).
- Maximum engagement load 1Te. Minimum pull-through load 2Te.
- Specific fixing or fastener requirements, tools, torque settings and material certification.
- J-tube reference.
- Interfacing details.
- Bend limiter interface and free-span support.
- Assembly procedures and time to assemble offshore.
- Installation loads and conditions.
- Over-bending of the umbilical at the front face of the seal during installation.
- Design of the bend restrictor element and assembly.
- The structural assessment of the bend restrictor string.
- The locking radius assessment of the bend restrictor string under design load.
- The design of the J-Tube sealing assembly and clamping arrangement, including the pull-in load and clamping load required to resist slippage during engagement but allow pull-through.
- Design of the cathodic protection system which will protect the J-Tube seal, the clamping arrangement and the interface flange.
- The design shall comply with the applicable project specification, industry standards and recommended practices for fatigue and VIV.
- The design of the bend restrictor end fitting system.

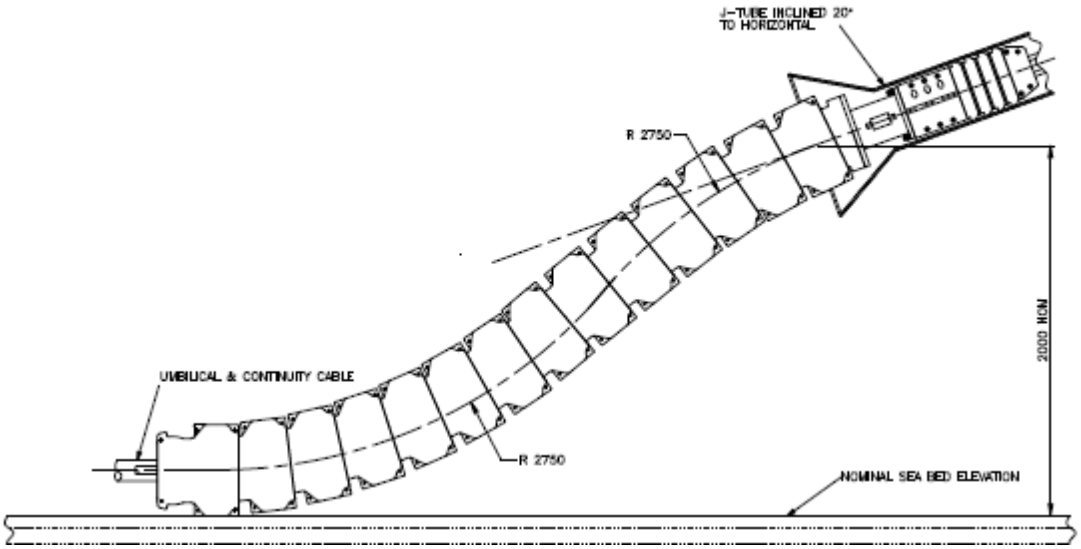


Figure 3-3: Typical J-Tube Seal & Bend Limiter Configuration.

A test procedure shall be produced that describes the tests required for the verification and validation of the bend restrictor and J-Tube seal designs. This procedure shall state the acceptance criteria for each test.

These tests shall include:

- Factory acceptance test (FAT)

- Bend restrictor locking radius without load test
- Bend restrictor load test without locking radius
- J-Tube seal and clamp assembly slip load test
- J-Tube pull-in and pull through test.
- J-Tube seal leak rate test.

All load testing shall be chart recorded to provide objective evidence of compliance with the requirements.

Vendor shall consider the following specific design requirements including but not be limited to:

- Overview of design requirements.
- Applicable codes and standards.
- Specific fixing or fastener requirements, tools, torque settings and material certification.
- Interfacing details.
- Assembly procedures and time to assemble offshore.
- Installation loads and conditions.
- Design of the elements and assembly.
- The structural assessment of the VBR string.
- The design of the assembly and clamping arrangement, including the load and clamping load required to assemble.
- The design shall comply with the applicable project specification, industry standards and recommended practices including corrosion protection if required.
- Vendor shall specify the maximum impact energy the riser protection can safely absorb and the bending stiffness on both strong and weak plane of the umbilical VBR.

~~and the bending stiffness on both strong and weak plane of the umbilical VBR.~~

- Vendor shall design riser VBR or provide tooling to allow for handling in a vertical and horizontal orientation. Structural lifting and handling points shall be included for equipment or components weighing more than 50 lbs (23 kg).
- Vendor shall provide suitable corrosion resistant fasteners to hold the umbilical VBR shells together. Fasteners shall be easy to install and suitable installation tooling, both manual and powered tools, to be provided by the Vendor.
- Spares: Unless specified otherwise, 10% minimum spare of all fasteners and other loose parts. 10% Spare for moulding shells
- Vendor to provide sufficient half-shells to make up the required section length and spare section length.
- Vendor to provide any lifting aids to assemble both required section and spare section lengths.
- Vendor to provide 10% spares lifting aids for both required section and spare section lengths.

A test procedure shall be produced that describes the tests required for the verification and validation of the VBR system. This procedure shall state the acceptance criteria for each test.

These tests shall include:

- Factory acceptance test (FAT).
- Dry fit-up.
- Demonstration of clamp and fastener assembly and disassembly including any tooling required.
- Bending under tension.
- Impact protection to the agreed value using a dropped object representative of the rock dump.

3.8. Uraduct or similar approved umbilical protection.

Vendor shall design, manufacture, test and supply 30m of umbilical dropped object protection system which shall be attached to the umbilical during installation.

Vendor shall provide a detailed procurement specification and design report for Company approval.

Vendor shall demonstrate that this system can be assembled offshore and the correct assembly can be obtained to allow the umbilical to be protected.

The protection system fasteners shall be subjected to PMI to verify compliance with the purchase specification requirements where applicable.

All metallic components and polyurethane raw materials are to be supplied with full traceability and Certificates of Conformity.

The interface between the protection system and bend limiter string shall allow the two systems to function correctly.

Each protection moulding shells shall be marked / stamped with identification with the following information:-

“Size” “Project” “(Weight) KG”

Vendor shall consider the following specific design requirements including but not be limited to:

- Overview of design requirements.
- Applicable codes and standards.
- Specific fixing or fastener requirements, tools, torque settings and material certification.
- Interfacing details.
- Assembly procedures and time to assemble offshore.
- Installation loads and conditions.
- Design of the protection elements and assembly.
- The structural assessment of the protection string.
- The design of the protection assembly and clamping arrangement, including the load and clamping load required to assemble.
- The design shall comply with the applicable project specification, industry standards and recommended practices including corrosion protection if required.
- Vendor shall specify the maximum impact energy the riser protection can safely absorb and the bending stiffness on both strong and weak plane of the umbilical protection.
- Vendor shall design riser protection or provide tooling to allow for handling in a vertical and horizontal orientation. Structural lifting and handling points shall be included for equipment or components weighing more than 50 lbs (23 kg).
- Vendor shall provide suitable corrosion resistant banding to hold the umbilical protection shells together. Banding shall be easy to install and suitable installation tooling, both manual and powered tools, to be provided by the Vendor.
- Spares

  Unless specified otherwise, 10% minimum spare of all bandings and other loose parts. 10%Spare for moulding shells
- Vendor to provide sufficient half-shells to make up the required section length and spare section length.
- Vendor to provide straps to assemble both required section and spare section lengths.
- Vendor to provide 10% spares straps for both required section and spare section lengths.

A test procedure shall be produced that describes the tests required for the verification and validation of the protection system. This procedure shall state the acceptance criteria for each test.

These tests shall include:

- Factory acceptance test (FAT)
- Dry fit-up
- Demonstration of clamp and fastener assembly and disassembly including any tooling required.
  - Bending under tension.
  - Impact protection to the agreed value using a dropped object representative of the rock dump.

3.9. Packing

Unless otherwise agreed, the packing of the umbilical J-Tube seal VBR and protection shall be in wooden crates suitable for safe lifting, storage, preservation, road and marine transportation. Packing arrangements shall be agreed upon prior to manufacture. The packages shall be clearly stencilled (min 40 mm lettering) with the following information at visible location:

a) Manufacturer

b) Delivery Address

c) PO Number

d) Weight

e) Product Type

f) Umbilical Structure Number.

Expected documentation is listed below and required for Company review –

a) Inspection and Test Plan (ITP)

b) Schedule

c) General Arrangement Drawings

d) Material Storage and Handling Procedures

e) Weight and Dimensional Control Procedures

f) Manufacturing and Control Procedures

g) Factory Acceptance Test / Site Integration Test Procedure

h) Packing, Marking and Shipping Procedures

i) Assembly Procedures for Installing Umbilical Protection onto the Umbilical

j) Corrosion Protection for Any Metallic Parts

k) Manufacturing Records to including – Material certificates, weight and dimensional control reports, material test reports.

4. Manufacturing

4.1. General

Manufacture of the umbilical equipment Shall be undertaken in accordance with the requirements of API 17 E using formally trained process operatives working to formally documented manufacturing procedures. Manufacture and fitment of end terminations and ancillary equipment Shall be in accordance with Vendor provided and/or approved designs and Vendor provided and/or approved assembly/test procedures.

4.2. Splices and Repairs

For thermoplastic hose, the lines Shall be extruded in continuous lengths and no joints or repairs Shall be accepted without Company approval. For cables and insulated conductors the extrusion Shall be in continuous lengths and no joints or repairs shall be accepted without Company approval. For extruded umbilical sheath no joints or repairs are permitted without Company approval.

4.2.1. Factory Splices

Where factory splices to umbilical and/or functional components are necessary to achieve production lengths, the location of the splices Shall be visibly identified on the umbilical equipment at all stages of manufacture. The locations of the splices Shall be recorded as part of the manufacturing process mapping/marking exercise.

Splices Shall be kept to a minimum and performed to verified and documented procedures.

Vendor shall specify in his bid whether tube or cable joints are required to produce the required umbilical length.

4.2.2. Repairs

Where product has been damaged and cannot be replaced, the repair location Shall be visibly identified on the product at each stage of manufacture. The location of the repairs Shall be recorded as part of the manufacturing process mapping/marking exercise. Prior to undertaking a repair Vendor Shall formally notify Company of the damage and the proposed work scope to affect a repair and any impact to the project schedule.

Repairs Shall be performed to verified and documented procedures approved by Company.

4.3. Sub-Contractors and Material Suppliers

Only sub-Contractors that have been formally approved by Company Shall be used for the provision of products and services that will be incorporated in, or, used in conjunction with the manufacture and test of the umbilical equipment. The use of such sub-Vendors Shall be subject to Company approval.

Vendor Shall provide a list of the proposed sub-Contractors, the respective sub-contract work scopes and the respective manufacturing locations as part of its bid proposal submission.

All major procurement specifications Shall be reviewed and approved by Company.

4.4. Heat treatment

Where metals (steel tube, bar stock, etc.) are subject to heat treatment as part of the manufacturing process, the heat treatment history Shall be formally documented in respect of annealing/conditioning temperatures, temperature profiles, residence times, quenching details, etc.

Heat treatment is invariably critical to the resultant physical and performance characteristics and, as such, shall be undertaken under controlled and verified process operations.

Vendor shall prove by qualification testing that proposed materials have required design strengths after heat treatment caused by manufacturing.

4.5. Length Measurement

In view of the criticality of the length of the umbilical equipment, accurate length measurement Shall be undertaken during the manufacture of all functional components at each stage of manufacture. Accurate measurement Shall also be undertaken at each stage of umbilical manufacture (lay-up, sheathing, armouring, etc.). At each

stage a calibrated measuring device Shall be used. Where discrepancies arise, these Shall be investigated and notified to Company.

4.6. Mapping

Mapping forms a critical part of the work scope to allow Company to make informed decisions during design, manufacture, load-out, installation and operational service of the umbilical equipment.

Where a manufacturing incident occurs, or a repair or factory splice is undertaken these Shall be mapped by Vendor identifying the precise location of the events. The location of such incidents Shall also be highlighted by means of appropriate markings on the external surfaces of the umbilical equipment.

The as-built map Shall be issued to Company prior to load-out in order to identify any areas that may require special attention during load-out/installation and associated handling of the umbilical equipment.

Where an incident occurs during load-out and/or installation, the as-built map Shall be revised to record such events.

4.7. Marking and Tagging

4.7.1. Hose Marking

Each hose Shall be uniquely marked, as a minimum with the following:

Line no, max working pressure, manufacturer's identification (batch no etc).

Heat shrink tubes Shall be applied at hose ends with unique colour for each of the service fluids. The marking Shall be maintained on mechanical protection to be used at the pigtail ends, as applicable.

Stainless Steel tags Shall also be assembled to identify each line.

4.7.2. Tube Marking

All tubes Shall be marked in accordance with the requirements of API 17 E.

4.7.3. Cable Marking

Each cable Shall have a uniquely coloured outer sheath. Each core in a cable Shall have a unique colour. Manufacturer's own marking for traceability Shall also be included. The marking Shall be maintained on mechanical /fire protection to be used at the pigtail ends, as applicable.

4.7.4. Umbilical Marking

All items of equipment and peripheral items (eg. Spares), forming the umbilical equipment Shall be tagged with Vendor and/or Company references. Packaged items Shall also be tagged on the outside of each package to facilitate easy identification. Such tagging Shall be of a permanent nature and Shall not degrade in the installed/storage conditions.

Length marking of the umbilical equipment and marking of individual functional components Shall be in accordance with API 17 E. All marking Shall be durable throughout storage, load-out and installation of the umbilical and legible to divers or underwater video cameras providing all-round visibility and with a minimum character height of 25,4 mm.

The umbilical Shall have a continuous longitudinal stripe (lay line), min 10 mm wide. Colour Shall contrast with outer sheath/roving colour.

Positions for ancillary equipment (e.g. bend restrictors, J-tube seals) to be fitted post-delivery Shall be clearly and durably marked on the umbilical equipment.

Marking to highlight the location of a factory splice or repair on the interior and exterior surfaces of the umbilical equipment Shall be durable during subsequent processing, load-out and installation operations.

Where accessories are to be fitted to the umbilical equipment as part of the installation campaign, the fitment locations Shall be accurately identified on the umbilical equipment. The form of identification Shall be agreed with Company.

5. Testing

5.1. General

Tests in accordance with API 17 E Shall be performed at each stage of component manufacture and assembly to verify the functional and structural integrity of the umbilical and its elements.

All tests Shall be performed in accordance with the procedures prepared by the Vendor based on the requirements of this specification and approved by Company.

Vendor Shall provide all necessary test equipment and facilities for the duration of the tests. If a sub-Contractor is required for any test facilities, the sub-Contractor Shall be subject to review and approval by Company.

All test equipment where appropriate, shall have a valid calibration certificate. Calibration certificates Shall be available for inspection at the start of each test activity and included as part of the final documentation package.

The Vendor Shall incorporate all test sheets and results into the Manufacturing Dossier.

All hydraulic test equipment Shall be shown to comply with the hydraulic fluid cleanliness requirements of this specification prior to connection.

The umbilical and all its components and additional equipment included within the Vendor's scope of supply Shall be subject to qualification and acceptance testing.

Vendor shall issue an inspection and test plan for review and approval to Company and Certifying Authority. The ITP shall list all required tests in accordance with section 5 and shall contain columns for Company and Certifying Authority inspection points.

All acceptance criteria Shall be agreed with Company.

5.2. Verification and Acceptance Testing Components

These tests Shall include all the specified verification and component acceptance tests in API 17 E Section 7 for the electrical, fibre optic cables and thermoplastic hoses.

Verification testing on the umbilical assembly Shall be performed as specified in API 17 E, Section 10

5.3. Fluid Compatibility and Permeability Tests

Fluid compatibility tests will be performed on the specified materials with the fluids specified in the umbilical data sheets and in accordance with procedures approved by Company. The tests Shall be performed under pressure cycling regime which results in a prediction of the minimum design life.

Permeability tests Shall be carried out to determine whether the hose liner is permeable to the specific service fluids as per the requirements of API 17 E.

5.4. Factory Acceptance Testing

Factory acceptance tests Shall be carried out on each umbilical assembly in accordance with the requirements of API 17 E, Section 11. If these are performed prior to the fitment of the PIHOs they shall be repeated after the fitment of the PIHO s. Where this is not possible for technical reasons; such as connectors being able to withstand high voltages, the Vendor Shall apply to Company for a concession.

5.5. Pre-Load-Out Tests

Pre-load-out tests Shall be carried out in accordance with API 17 E, Section 14 when the umbilical has been transported from the manufacturing site to another site or has been stored for more than 3 months.

5.6. Post-Load-Out Tests

In the case where load-out is reel lift to vessel the Vendor Shall perform a post-load-out pressure check and continuity test on the umbilical once loaded on the vessel. Company representatives Shall witness these tests.

5.7. Testing during Lay and Post-Installation Testing

The Vendor Shall provide personnel and equipment for both monitoring and testing during lay and post lay which Shall consist of the tests specified in API 17 E Section 15 with the following exceptions –

Electrical testing –

IR testing shall be performed at 1000Vdc for 2 mins minimum.

Acceptance criteria = ≥5000Mohms.km

Conductor/Screen resistance testing value to be confirmed during FAT for information only.

Conductor/Conductor resistance testing value to be determined by IEC requirements.

Pressure testing –

Shall be performed for 60 mins minimum following 30 minute stabilisation.

Acceptance criteria = the line(s) under test shall demonstrate stabilisation during the hold period, if the line(s) under test do not demonstrate stabilisation then the test can be extended for up to 4hrs. The pressure during the hold period shall never fall below 10% of the agreed test pressure.

Monitoring and post installation tests shall be performed from the host platform and all monitoring results shall be continuously recorded using digital data and pressure transducers. The use of traditional chart recorders is not permitted.

All test data shall be presented to Company representative for approval prior to service technicians leaving the work site.

Item	Responsible party	Test/monitoring location	Company	Umbilical supplier	Contractor	Remarks
FAT / pre-load out test at fabrication yard, prior to load out	Umbilical supplier	Yard	Accept	Accept	Accept	Tests as per API 17 E 5th Ed.
Post load-out pressure verification & looped CR/Screen testing.	Umbilical supplier	Installation vessel	Accept	Accept	Accept	Tests as per API 17 E 5th Ed. Umbilical pressure 70 bar +/- 30 bar
A12, Umbilical lay and A15/B10 pull-in continuous monitoring: - Tension - Squeeze pressure - Reel pay out speed - Vessel position - Load on level winder on reel (tbc by Reel Drive System supplier if load cell is incorporated) - Touch down point - Visual inspection of umbilical prior to overboarding - Pull-in winch tension - Umbilical rotation using the longitudinal stripe acceptance value 1 degree per meter.	Contractor	From installation vessel, except Pull-in winch tension	Monitor	N/A	Monitor	-
Umbilical lay and A15/B10 pull-in continuous monitoring: - Hydraulic lines: pressure monitoring - Power cable: looped conductor/screen resistance monitoring	Umbilical supplier	A12 platform	Accept	Accept	Monitor	Monitoring from A12 platform side only. No personnel or equipment required on lay vessel. Umbilical pressure 70 bar +/- 30 bar
Umbilical trenching monitoring: - ROV position - Jetting pressure - Umbilical position in front of and through ROV	Contractor	ROV from trenching vessel	Monitor	N/A	Monitor	-
Umbilical trenching monitoring: - Hydraulic lines: pressure monitoring - Power cable: looped conductor resistance monitoring	Umbilical Supplier	A12 Platform	Accept	Accept	Monitor	Umbilical pressure 70 bar +/- 30 bar
Post-trenching test connected to TUTU: - Hydraulic lines: pressure test 1.1 x DWP 30min stabilisation + 60 minute hold. - FOC: OTDR (both ends) - Power cable: looped conductor/conductor/screen resistance, insulation resistance (A12 end), TDR (both ends)	Umbilical supplier	A12 platform	Accept	Accept	Accept	Tests as per API 17 E 5th Ed. Looped long term protection caps will require removal for 1000vdc IR testing

Table 7: Testing and accepting responsibility table

6. Storage, Loadout and Shipping

6.1. Packaging and Protection

All items within the scope of supply Shall be suitable packaged and protected for handling, loadout, transportation, deployment/installation, long/short term storage, as applicable to the particular item within the scope of supply. During load-out, deployment/installation, terminations and ancillary equipment may be vulnerable to mechanical damage and Shall be suitably designed and protected to minimise the risk of damage. Ancillary equipment (e.g. topside umbilical termination) to be transported offshore for fitment, shall be suitably packaged to withstand the rigours of handling and shipping.

Umbilical shall be supplied on an installation reel c/w cradle suitable for offshore installation utilising a hub drive system.

Sea Fastening Design, Reels, Reels to Cradles and Cradles.

(a) Contractor shall consider transportation loads in the design of all equipment;

(b) Criteria for the development of transportation loads shall be based on the following parameters (Information based upon Noble Denton (NDI) Ltd. General Guidelines for Marine Transportation)

a. Roll = 30º

b. Pitch = 15º

c. Heave = 0.2g

Roll-and-Heave or Pitch-and-Heave shall be assumed to act concurrently; and

~~Linear~~ linear accelerations act at the COG of the structure.

Vendor shall provide and consider the following specific requirements including but not limited to:-

- Vendor shall design and supply a suitable transportation reel for the umbilical as required complete with any rigging, temporary fabrication, brackets, ramps and any other equipment required for storage or load-out and installation to an internationally recognised standard. The reel design and fabrication shall be verified and validated against this standard.
- All rigging and lifting points shall be supplied with current certification with minimum of 6 months validity from the time of shipping or load-out.
- The reel shall be suitable for offshore use spooling directly from the reel during installation without the use of a tensioner this being the worst-case scenario.
- Vendor to provide all necessary NDT, load testing an[d] 3rd party verification for all lifting, pulling and load bearing points.
- Vendor to ensure the umbilical(s) shall be wound on the reel(s) with sufficient back tension to prevent the formation of slack turns during subsequent unwinding of the umbilical(s) from the reel(s). If two umbilicals are packed on one reel the vendor shall prior to termination undertake a reel turning exercise to demonstrate that slack is not propagating on the reel.
- The fixing of end terminations or umbilical ends to the reel(s) shall utilise certified rigging where applicable and Vendor shall ensure such fixings are of adequate design to ensure safe storage, shipping, load-out and installation.
- The drum radius shall meet or exceed the minimum bending radius (storage) requirements of the umbilical and/or the bend restrictor if fitted.
- The size and design of the reel shall accommodate the volume of the umbilicals including particular provision for termination assemblies and accessories.
- The structure of the reel shall be capable of safely supporting the static and dynamic self-weight of the umbilicals during transportation and installation. Vendor shall submit to Company supporting calculations for approval.

- The packaging shall be such that the umbilical, fittings and appurtenances are protected against all expected environmental conditions during storage, transportation and through to installation without degradation or damage to the product. Specifically, the umbilical external sheath shall be protected against UV radiation during storage and transportation.
- All lines shall be pressurised to 1000psi and verified 48hrs prior to the commencement of load-out activities and verified periodically during any storage period.
- Vendor to provide details of rigging (inclusive of components WLL) details of ancillary components (pull / test heads, terminations, etc).

- If reels are to be stored for more than 30days then a tarpaulin shall be fitted to the reel to protect the product from UV and any environmental conditions.

6.2. Pressurising / Monitoring Manifolds

(a) The Vendor shall supply a pressuring / monitoring manifold to enable the transportation/installation pressures to be monitored, and if required bleed-off or topped up; and

(b) The arrangement of such a system shall be subject to Approval by Company, but should incorporate the following key features:

i. Double-block and bleed between the hoses/tubes and point of re-pressurising

ii. Groups of hoses/tubes with similar fluids and pressure ratings may be co-mingled to single gauges and re-pressuring points

iii. Company's preference is to 'lock-in' a suitably low pressure at the point of shipping such that the increase in pressure during transit does not require over-pressure control such as relief valves and fluid storage drums

iv. The pressurising manifolds shall be rated to enable the umbilical to be leak tested or pressure decay tested in accordance with API 17 E during the installation campaign

6.3. Shipping

The umbilical equipment may be subject to a significant change in temperature, e.g. when delivered to a different climate or completed at a time of low temperature and then stored during a period of increasing temperature. The impact of the increase in temperature on the pressure fluid conduits Shall be considered as part of the design evaluation to ensure the conduits Shall not be exposed to pressures in excess of their design capabilities.

The implications of the build-up of potentially hazardous high pressures and the safety implications for personnel Shall be considered. Accordingly, appropriate safety features Shall be built into the design and high visibility warnings incorporated on the umbilical equipment. Such safety implications Shall also be detailed in relevant documentation.

7. Installation Philosophy

7.1. Umbilical Installation

The umbilical will be laid from a vessel-mounted reel over deflectors/guides to maintain the umbilical minimum bend radius. Conventionally, the umbilical is stored on a reel on the deck of the vessel (in vessels particularly suited for this type of work). The umbilical will be unreeled from storage and simultaneously laid on the seabed.

The umbilical will normally be laid on the seabed and post-lay trenched with a plough trencher or with jetting equipment. Vendor Shall conduct a stability assessment for the umbilical on the seabed pre and post trenching. Some offshore Contractors may elect to lay and trench simultaneously. Pre-cut trenches are unlikely to be effective considering the local seabed mobility.

7.2. Trenching and Backfilling

~~Where the umbilical is in an area where commercial fishing may be undertaken it may be necessary to provide protection against potential impact or snagging loads associated with demersal fishing gear interaction.~~

~~Such protection is commonly provided by trenching the umbilical into the seabed. Fishing gear thus passes over the umbilical without interaction with them.~~ Trenching will be carried out either by jetting the umbilical into the seabed or by ploughing a trench along each line. If ploughs are used, the umbilical will be trenched post-lay using the pipeline and umbilical to guide the trencher.

~~Another option to provide protection~~Rockdump is to ~~rock dump the~~be installed at platform umbilical tie-in area's and at crossings of existing products. This provides a stable route for fishing gear to be diverted up and over the umbilical and provides overburden for stability.

The umbilical outer sheet must be capable to withstand the loads implied by trenching and rock-dumping. Vendor/Contractor shall prove this by qualification testing or documented evidence.

7.3. Repair Joints / Splice Kits

The Vendor shall submit a technical design report detailing ancillary equipment specifically including repair kits, procedures, terminations, bend restrictors/stiffeners, field repair joints, optical/hydraulic/electrical couplers/connectors and armour repair terminations for Company approval.

Where a design is proposed that has no proven history of use subsea in similar environmental and service conditions, the Vendor shall propose and execute a testing programme, following Company approved procedures, to verify and validate the suitability of the design.

Splices shall also be subject to the same qualification and acceptance criteria as the components.

(a) The Contractor shall supply umbilical repair joints suitable for the electro-hydraulic umbilical;

(b) Repair units shall be supplied in kit form containing all required materials (with the exception of specific swaging dies / pushers and consumables etc) to perform the repair offshore. Repair units shall include housing, anodes, BSR's, armour termination flanges, electrical splices and hydraulic fitting;

(c) The Contractor shall take cognisance of the Company's desire to minimise offshore termination time;

(d) The splice kit shall:

i. Maintain the mechanical, hydraulic, optical and electrical integrity of the umbilical for the design life

ii. Be capable of being used on the deck of a ship by a qualified person and minimise assembly times

iii. Once assembled, be capable of being handled, installed and recovered by conventional umbilical handling equipment.

iv. Be suitable for the environmental conditions.

v. Where possible incorporate component service loops to minimise any strain at the splice during installation and to facilitate re-termination if necessary.

(e) Contractor shall consider specific requirements including but not limited to (where applicable):

i. Overview of repair philosophy and repair joint design requirements

ii. Applicable codes and standards

iii. Lifting interface arrangement

iv. Cathodic protection for the design life

v. Design qualification verification and validation

(f) The Vendor shall note that the 50mm2 are screened and that these screens shall be continued through the in-line splice via a dedicated socket / pin. Grounding of the screens onto the connector shall not be acceptable;

(g) Fibre optic cable jointing

The VENDOR shall design, qualify, procure and supply optical repair kits or splices to reinstate the integrity of the umbilical components during manufacture and installation. These repairs shall be undertaken by qualified personnel against procedures which have been reviewed and approved by Company. Joints/Splices shall also be subject to the same qualification and acceptance criteria as the umbilical components;

(h) The repair unit shall be supplied with CP to protect the housing and electrical / hydraulic fittings. Earthing straps shall be supplied for all 'loose' items requiring grounding to the splice unit housing or CP system;

(i) Hoses shall be terminated with in-line couplings, or anti-rotation female JIC hose couplings and unions;

(j) The repair unit / mid-line splice shall be capable of accommodating 'creep' in the umbilical hose / cable elements resulting in shortening of the effective pigtail lengths; and

(k) The repair unit shall be designed for installation loads consistent with the umbilical structure. Contractor shall provide pad-eyes on the splice unit to assist handling and over-boarding; such pad-eyes shall be suitably rated to suit the installation activities, and shall be located as agreed between the VENDOR and the Installation Contractor.

8. Quality Assurance and Control

8.1. General

Vendor shall be registered and operate a quality assurance system in accordance with the requirement of ISO 9001 for the design, manufacture and testing of the Goods and undertake such design analysis, investigations and testing to demonstrate that the Goods comply with the requirements of this specification.

Vendor shall demonstrate the application of a system of processes within the organisation, together with the identification and interactions of these processes, and their management, to produce the desired outcome; this can be referred to as the "process approach". An advantage of the process approach is the ongoing control that it provides over the linkage between the individual processes within the system of processes, as well as over their combination and interaction. When used within a quality management system, such an approach emphasizes the importance of –

- understanding and meeting requirements,
- the need to consider processes in terms of added value,
- obtaining results of process performance and effectiveness, and
- continual improvement of processes based on objective measurement.

Company will participate in defining requirements as inputs which are defined within this specification. Vendor shall demonstrate monitoring to Company satisfaction and the evaluation of information relating to customer perception as to whether the Vendor has met Company requirements.

Note: Vendor shall demonstrate the methodology known as "Plan-Do-Check-Act" (PDCA) which can be applied to all processes. PDCA can be briefly described as follows –

Plan: establish the objectives and processes necessary to deliver results in accordance with customer requirements and the organization's policies.

Do: implement the processes.

Check: monitor and measure processes and product against policies, objectives and requirements for the product and report the results.

Act: take actions to continually improve process performance.

Vendor shall develop a detailed Inspection and Test Plan ITP specifying the logical sequence of design, procurement, manufacture and testing of the Goods covered by this specification. The ITP shall also specify the codes, standards, procedures and acceptance and verifying criteria to which the Goods are to be accepted. This process shall be known as the planned arrangements and ~~CompanyY~~Company will identify the 'Intervention' points which will apply to the ITP activities.

Permission shall be given to Company personnel and/or designated representatives to witness fabrication, assembly, and testing of Vendor equipment and the equipment of its sub-vendor's on a routine basis and during specific operations in the manufacturing process. Vendor shall notify Company five (5) working days in advance in writing of the occurrence of those specific operations (monitor, witness, and hold points) that have been agreed upon and noted in the ITP.

Vendor's sub-Vendor's shall be bound by the same requirements of this specification.

Vendor shall ensure that product which does not conform to product requirements is identified and controlled to prevent its unintended use or delivery. A documented procedure shall be established by the Vendor to define the controls and related responsibilities and authorities for dealing with nonconforming product.

Where applicable, Vendor and/or Sub-vendor shall deal with nonconforming product by one or more of the following actions:

- by taking action to eliminate the detected non-conformity;
- by authorising its use, release or acceptance under concession by a relevant authority and, where applicable, by COMPANY;
- by taking action to preclude its original intended use or application;
- by taking action appropriate to the effects, or potential effects, of the nonconformity when nonconforming product is detected after delivery or use has started.

When non-conforming product is corrected it shall be subject to re-verification to demonstrate conformity to the requirements.

Project specific records of the nature of nonconformities and any subsequent actions taken, including concessions obtained, shall be maintained by the Vendor. All non-conformances shall be reported to COMPANY in a timely manner for review and resolution in conjunction with Vendor.

8.2. Inspection and Test Plans

Vendor shall provide for each element of the scope of supply specific quality plans otherwise known as inspection and test plans which shall detail the following requirements including but not limited to :-

- Applicable codes. Standards and project specific references.
- A flowchart illustrating each inspection point and its relative location in the procedure cycle where conformance of characteristics are verified.
- Project definitions.
- The characteristics to be inspected at each inspection point, the procedures, responsible person and acceptance criteria to be used.
- The procedures shall be provided to the Company representative as requested.
- Detail repair procedures where acceptable and applicable.
- Copies of specific forms to be used by the Vendor to record the results of each inspection.
- Company intervention points which require Company/3rd Party involvement.
- Company shall have intervention at Sub-Vendor(s).
- Witness notification period 5 days.
- Final inspection.
- Release.

Prior to the commencement of the work, the Vendor and sub Vendor shall prepare a written inspection plan that describes the inspection to be performed. The inspection plan shall reference a logical order of design, manufacture and test including procedures and acceptance criteria.

All changes to the inspection plan shall be subject to approval.

8.3. Quality Records

Records shall be established and maintained to provide evidence of conformity to the requirements and of the effective operation of the quality management system. Records shall remain legible, readily identifiable and retrievable. All records shall be available for the Company and Company representative for analysis and review.

8.4. Final Inspection

The Vendor shall inspect the final item or items to ensure compliance with contract requirements. A verification check shall be made of all inspection records to verify that items were inspected at all points shown in the inspection plan. These records shall be complete and available to the Company representative for review.

Visual inspection and dimensional checks shall be carried out at the point of discharge.

All non-conformances shall be closed prior to the Company accepting and or releasing the product.

8.5. Verification

All Vendor inspection systems shall be subject to evaluation and surveillance by the Company representative to ensure that the system meets the requirement of the Functional Specification and the Contract Documentation.

All Vendor operations required by the Specification are subject to :

- Procedures compliance checking at unscheduled intervals to determine that the Vendors inspection system is effectively applied.
- Product verification to determine compliance with control requirements. The method of verification is at the discretion of the Company representative.

8.6. Verification of Purchased Product

The Vendor shall establish and implement the inspection and other activities necessary for ensuring the purchased product meets the specified purchase requirements.

Where the Vendor or Company intends to perform verification at the Contractor's premises, the Contractor shall state the intended verification arrangements and the method of the product release in the purchasing information.

8.7. Pre-Production Meeting

A pre-Production meeting shall be conducted at the Vendors facility and each designated sub-vendor / Vendors fabrication facility where major or critical components are being manufactured, prior to the start of fabrication.

The agenda for the meeting is to be agreed but will include as a minimum: purpose of meeting and Introductions, Purchase Orders / sub orders, communications routes, contractor organisation, specification technical issues, testing requirements, QA/QC, certification, documentation, production schedule, delivery release, commercial, AOB, and a summary of all actions.

8.8. Site Facilities

The Vendor shall provide and maintain, at the Vendor's main engineering and manufacturing Sites, for the duration of the Work, a suitable lockable office with adequate furniture and equipment for the sole use of the ~~Company'sb~~Company's personnel. The standard of accommodation and furnishings shall be that afforded to the Vendors senior personnel, and shall be subject to the approval of the Company.

Such provision shall include temperature control to maintain comfortable working conditions, electric power lighting with regular cleaning.

The Vendor shall, make available an office at each of its other sites for use by the Company's personnel on an as required basis.

The Vendor shall provide access to and use of a photocopying machine. The machine shall be suitable for copying A3 & A4 reduction.

The Vendor shall provide car parking, at each site, close to the Company's allocated office for the use of the Company's personnel.

The Vendor shall make available suitable messing facilities, and secretarial services.

The Vendor shall provide, install and maintain for the unrestricted use of the Company's personnel the following:

- Suitable telephone service that will allow internal and external calls to be made/received without the need for switchboard operator intervention.
- An internet connection, or a network connection for Company's personnel to connect a laptop computer to gain outside internet access.

8.9. Access For Inspection

The Vendor shall allow and facilitate access to all project quality, manufacturing, process control, procedures and test records at all times in any location where the project deliverables are being designed manufactured or tested.

8.10. Non Conformance Reporting

The Vendor shall report all non-conformances to Company and Company's representative within 24 hours of occurrence. Records of non-conformance shall be documented and inspection reports submitted together with the non-conformance detailing the nature, type, material, dimensional, tolerance, specification, specification and any other matters relating to the non-conformance.

Non-conformances shall include:

- Product non-conformances
- Process non-conformances
- Sub-vendor non-conformances
- Inspection reports
- Any other method or procedure for detailing non-conformances, technical queries, goods receipt or deviation from qualified process, procedure or manufacturing specification.

No actions will be taken in relation to a non-conformance by the Vendor until the action(s) have been agreed in writing by Company.

All non-conformances shall be detailed within an inspection report which includes –

- Date and time of non-conformance.
- Detailed description of the non-conformance including root cause where known.
- Photographic evidence.
- Measurements.
- Specifications and tolerances.
- Corrective actions.
- Preventative actions.
- Concession request.

8.11. Certification

The certification requirements for each unit of equipment Shall be defined within the project specific requirements detailed in the relevant project scope. This will be based on BS EN 10204.

8.12. Equipment Acceptance and Release

Equipment Shall only be released for shipment on successful completion of a Factory Acceptance Test and the relevant documentation being signed by a Company representative.

8.13. Material Traceability

Vendor Shall retain all material traceability and manufacturing records within their own quality documentation system for a period not less than 5 years. All such records Shall be made available to Company on request.

9. Vendor Documentation

Vendor to provide Company with the following project specific requirements including but not limited to:

- Review of this specification and compliance matrix.
- Confirmation of acceptance of the project specification.
- Engineering design and analysis documents.
- Manufacturing and test records.
- As-built records.
- Material certification.
- Non-conformance records closed and endorsed by Company.
- Calibration certificates.
- Photographs.
- Final documentation package to a Company agreed format.
- Shipping manifest endorsed by Company
- Release/acceptance records endorsed by Company.
- Mapping records endorsed by Company.
- Dispatch dossier.

Vendor shall provide original documentation where possible where this is not possible Vendor shall wet stamp copies of documents as “VERIFIED TRUE COPY OF ORIGINAL”.

Records established to provide evidence of conformity to requirements and of the effective operation of the quality management system shall be controlled by the Vendor.

The Vendor shall establish a documented procedure to define the controls needed for the identification, storage, protection, retrieval, retention and disposition of records. Records shall remain legible, readily identifiable and retrievable.

Company documentation review cycle shall be achieved within ten working days. Vendor revision cycle shall be achieved within ten working days.

Final documents shall be sent in electronic native format.

The sub-supplier documents to be reviewed and approved prior to shipment from the sub-suppler to Vendor by both Vendor and Company. Vendor shall provide the following documents:

Table 8: Vendor master Document List

DOCUMENT DESCRIPTION	With Bid	Detail Design phase	With final MDB
CONTROL DOCUMENTS			
Compliance Matrix	Yes	No	Yes
Vendor Master Document List (MDL)	Yes	Yes	Yes
Overall Project Schedule	Yes	Yes	No
Monthly Progress Reports	No	Yes	No
Weekly Progress Reports	No	Yes	No
Sub Supplier Items List/Sub Order Copies	No	Yes	Yes
Umbilical Inspection and Test Plan	No	Yes	Yes
Actions Register	No	Yes	No
Project Organisation Diagram	Yes	Yes	No
DESIGN DOCUMENTS			
Endorsed Umbilical Functional Specification	No	Yes	Yes
Design Premises	No	Yes	Yes
Design Report	Yes	Yes	Yes
DRAWINGS			
Cross-section.	Yes	Yes	Yes
Pull-in and Hang-off Ga's at each location	No	Yes	Yes
Driverless J-Tube Seal GA + Bend Restrictors, each location	No	Yes	Yes
Electro-hydraulic Schematic	No	Yes	Yes
Cradle/Reel Packing GA	No	Yes	Yes
Uraduct or similar approved GA	No	Yes	Yes
Scope of supply	Yes	Yes	Yes
Print Length marking GA	No	Yes	Yes
ANALYSIS	No	Yes	Yes
J-tube through Pull	Yes	Yes	Yes
Historical Qualification Report for fluid conduits, Cables and Umbilical.	No	Yes	Yes
Pull-in Analysis.	No	Yes	Yes
Cathodic Protection Calculation	No	Yes	Yes
Seabed stability report.	No	Yes	Yes
Stress Analysis for Pulling Head	No	Yes	Yes
Fatigue analysis at J-Tube seal/free span if required.	No	Yes	Yes
Installation and Recovery Analysis Conditions	No	Yes	Yes
Reel packing analysis.	No	Yes	Yes
Bend stiffener performance plots	No	Yes	Yes
QUALITY CONTROL DOCUMENTS			
Quality Plan or Execution Plan	No	Yes	Yes
Inspection and Test Plan (ITP) including supplier and sub-suppliers (ITP)	No	Yes	Yes
Umbilical Length Specification	No	Yes	Yes
Manufacturing Data Dossier Index	No	+12	Yes
Design Data Dossier Index	No	+12	Yes
Dispatch dossier	No	Yes	No
Master Equipment List	No	Yes	Yes
PURCHASING DOCUMENTS			
Cable Procurement Specifications	No	Yes	Yes
Optical Cable procurement specification	No	Yes	Yes
PIHO Procurement Specification	No	Yes	Yes

DOCUMENT DESCRIPTION	With Bid	Detail Design phase	With final MDB
Seacon Procurement Specification	No	Yes	Yes
J-Tube Seal & Bend Restrictor Procurement Specification	No	Yes	Yes
Reel Procurement Specification	No	Yes	Yes
TEST PROCEDURES			
Fluid Compatibility	No	Yes	Yes
Filling Flushing and Cleaning	No	Yes	Yes
Cleanliness Assessment.	No	Yes	Yes
Flow Testing	No	Yes	Yes
Pressure Testing	No	Yes	Yes
Burst Testing	No	Yes	Yes
Collapse Test	No	Yes	Yes
Electrical Testing	No	Yes	Yes
Seacon Connector Test Procedure.	No	Yes	No
OTDR Test Procedure.	No	Yes	Yes
FAT Procedure	No	Yes	Yes
DOCUMENT DESCRIPTION	**With Bid**	**Detail Design phase**	**With final MDB**
GENERAL PROCEDURES			
Pulling Head Assembly	No	Yes	No
Load-out Procedure	No	Yes	No
Umbilical Sheath Repair	No	Yes	No
Umbilical Armour Wire Repair	No	Yes	No
Umbilical Armour Wire Termination	No	Yes	No
Electrical Cable Repair	No	Yes	No
Fluid Conduit Repair.	No	Yes	No
Optical Fibre Repair	No	Yes	Yes
Cable End Sealing	No	Yes	Yes
Umbilical Crush Testing	No	Yes	Yes
Umbilical Tensile Testing	No	Yes	Yes
Umbilical Bend/Flex Testing	No	Yes	Yes
Installation Guidelines	No	Yes	Yes
Coating Specifications	No	Yes	Yes

Table 7: Vendor Master Document List

Attachment A J-tube arrangements

- 10 and 12inch J-tube at A12 CPP platform: " A12-0000-STR-DTL-PTG-0000-04740-01_E01_A12 J-Tube Routing "

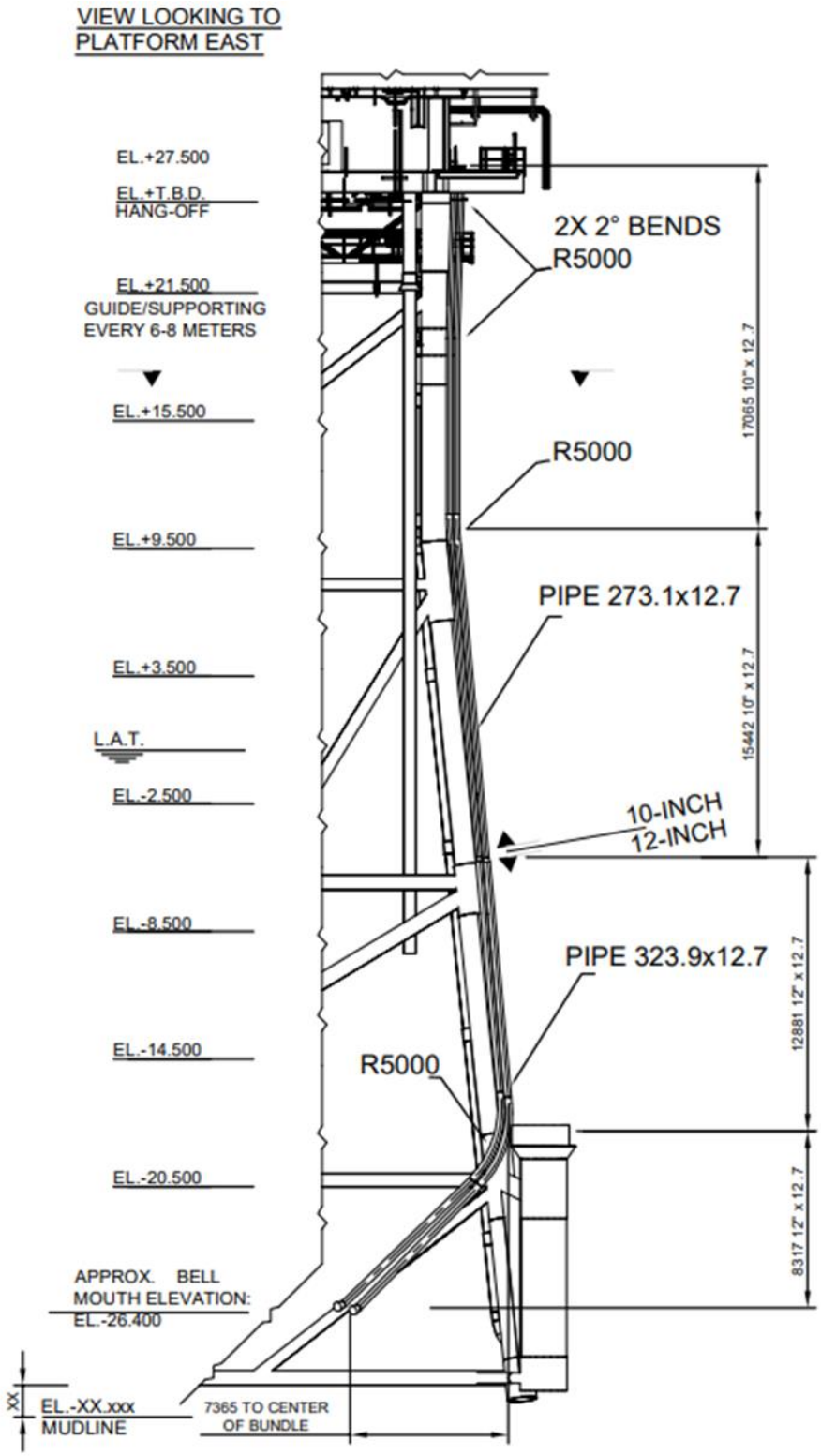


Figure 9-1; J-tube arrangement C12 CPP

- 12” J-tube arrangement of A15 and B10 platforms

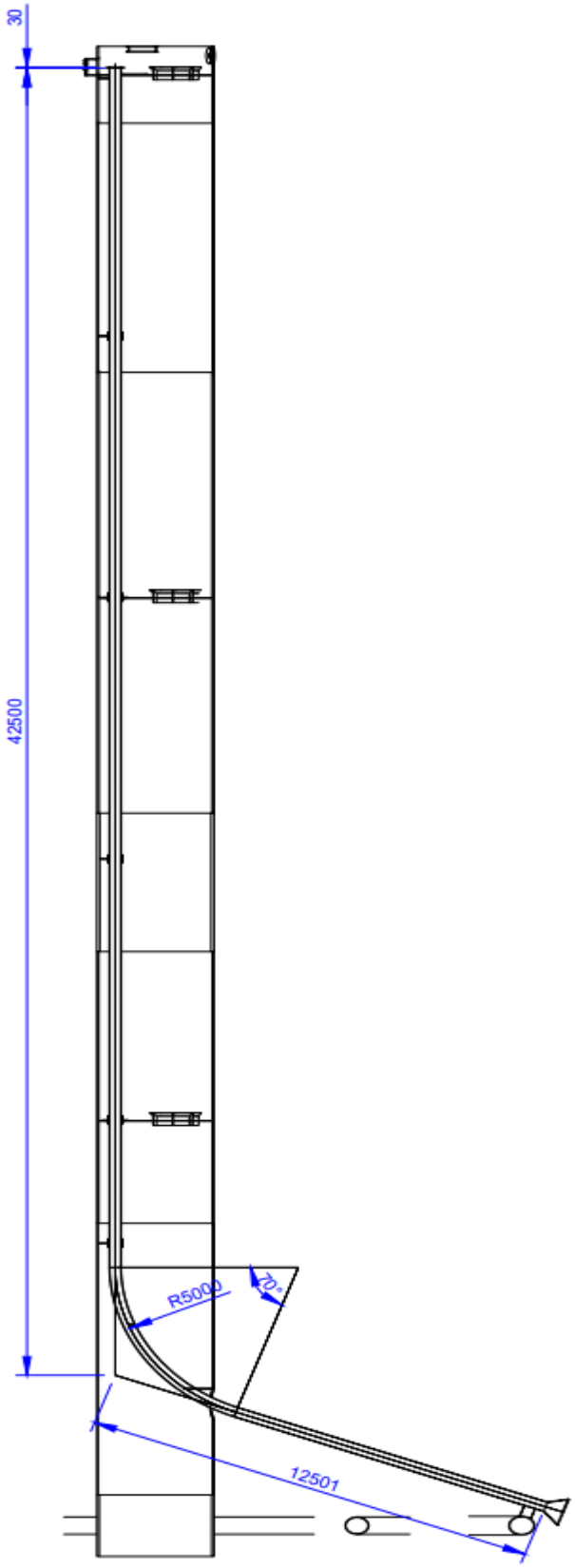


Figure 9-2, J-tube A15 and B10 platform

Attachment B Metocean conditions

Attached: Summary Metocean extract from AB2-0000-GEO-SUR-FGI-1FGI-00007-00_C02 for C12 CPP, A15 and B10

The omni-directional all-year wind, wave, current and water level criteria are presented in the following tables.

Table S.1: All-Year Omni-Directional Extreme Wind Criteria

Return Period	$Ws_{24\text{-hr}}$ [m/s]	$Ws_{12\text{-hr}}$ [m/s]	$Ws_{6\text{-hr}}$ [m/s]	$Ws_{3\text{-hr}}$ [m/s]	$Ws_{1\text{-hr}}$ [m/s]	$Ws_{10\text{-min}}$ [m/s]	$Ws_{1\text{-min}}$ [m/s]	$Ws_{15\text{-sec}}$ [m/s]	$Ws_{5\text{-sec}}$ [m/s]	$Ws_{3\text{-sec}}$ [m/s]
1-year	18.7	20.5	21.6	22.3	22.8	24.8	27.3	28.9	30.1	30.6
3-years	20.2	22.2	23.5	24.2	24.7	26.9	29.8	31.5	32.9	33.6
10-years	22.0	24.1	25.4	26.2	26.8	29.3	32.6	34.5	36.1	36.8
50-years	24.2	26.6	28.1	29.0	29.6	32.5	36.3	38.6	40.4	41.3
100-years	25.2	27.7	29.2	30.2	30.8	33.9	38.0	40.4	42.3	43.2
1000-years	28.5	31.3	33.0	34.1	34.8	38.6	43.5	46.5	48.8	49.9
10000-years	31.8	34.9	36.8	38.0	38.8	43.3	49.2	52.7	55.5	56.8

$Ws_{n\text{-hr}}$ = n-hour mean wind speed at 10 m above sea level, $Ws_{n\text{-min}}$ = n-min mean wind speed at 10 m above sea level
$Ws_{n\text{-sec}}$ = n-second gust speed at 10 m above sea level

Table S.2: All-Year Omni-Directional Extreme Wave Criteria

Return Period	Hs [m]	Tz [s]	Tp [s]	Cmax [m]	Hmax [m]	THmax [s]	U_{1m} [m/s]
1-year	7.4	9.8	13.2	8.6	13.4	11.0	1.68
3-years	8.5	10.4	13.9	9.7	15.0	11.4	1.99
10-years	9.5	11.0	14.5	10.7	16.6	11.8	2.29
50-years	10.6	11.5	15.2	11.9	18.3	12.2	2.63
100-years	11.0	11.7	15.4	12.3	19.0	12.3	2.76
1000-years	12.2	12.3	16.1	13.6	21.0	12.7	3.11
10000-years	13.1	12.7	16.5	14.7	22.8	13.0	3.38

Hs = significant wave height. Cmax = maximum crest height. Hmax = maximum wave height.
Tz = mean zero-crossing period. Tp = peak period. THmax = zero-crossing period associated with Hmax.
U_{1m} = Horizontal wave orbital velocity at 1 m above seabed

Table S.3: All-Year Omni-Directional Extreme Total Current Criteria

Return Period	Near Surface Total Current Speed [m/s]	Mid Depth Total Current Speed [m/s]	Near Bed Total Current Speed [m/s]
1-year	0.93	0.84	0.66
3-years	1.04	0.93	0.73
10-years	1.16	1.03	0.80
50-years	1.33	1.17	0.90
100-years	1.40	1.23	0.95
1000-years	1.65	1.43	1.09
10000-years	1.89	1.63	1.23

Table S.4: All-Year Omni-Directional Extreme Residual Current Criteria

Return Period	Near Surface Residual Current Speed [m/s]	Mid Depth Residual Current Speed [m/s]	Near Bed Residual Current Speed [m/s]
1-year	0.68	0.58	0.44
3-years	0.80	0.68	0.52
10-years	0.94	0.79	0.60
50-years	1.12	0.93	0.70
100-years	1.20	1.00	0.75
1000-years	1.46	1.21	0.90
10000-years	1.72	1.42	1.05

Table S.5: All-Year Directional Maximum Tidal Current

Direction [towards]	Near Surface Tidal Current Speed [m/s]	Mid Depth Tidal Current Speed [m/s]	Near Bed Tidal Current Speed [m/s]
North	0.38	0.36	0.29
North-east	0.24	0.22	0.22
East	0.14	0.13	0.09
South-east	0.30	0.29	0.24
South	0.29	0.29	0.24
South-west	0.22	0.22	0.19
West	0.20	0.19	0.18
North-west	0.20	0.19	0.16

Table S.6: All-Year Extreme Water Level Criteria

Return Period	Positive residual water level Relative to MSL [m]	Positive total still water level Relative to MSL [m]	Extreme Water Level Relative to MSL [m]	Extreme Water Level Relative to LAT [m]
1-year	0.84	1.04	9.37	10.01
3-years	1.06	1.22	10.62	11.26
10-years	1.30	1.46	11.77	12.41
50-years	1.63	1.77	13.17	13.81
100-years	1.77	1.91	13.75	14.38
1000-years	2.26	2.39	15.38	16.01
10000-years	2.76	2.91	17.05	17.68

Table S.7: Tidal Heights

Tidal Descriptor	Height Relative to MSL [m]	Height Relative to LAT [m]
Highest Astronomical Tide	0.54	1.17
Mean High Water Quarter 1s	0.28	0.91
Mean High Water Neaps	0.19	0.82
Mean Sea Level	0.00	0.63
Mean Low Water Neaps	-0.26	0.37
Mean Low Water Quarter 1s	-0.29	0.34
Lowest Astronomical Tide	-0.63	0.00

Table 8: metocean data