

DEP SPECIFICATION

**DEEPWATER SUBSEA
COMPLETION/WORKOVER SYSTEMS
(AMENDMENTS/SUPPLEMENTS TO API SPEC 17G)**

DEP 37.80.10.30-Gen.

February 2014

ECCN EAR99

DESIGN AND ENGINEERING PRACTICE



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TABLE OF CONTENTS

PART I	INTRODUCTION	5
1.1	SCOPE.....	5
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	5
1.3	DEFINITIONS	6
1.4	CROSS-REFERENCES	6
1.5	SUMMARY OF MAIN CHANGES	6
1.6	COMMENTS ON THIS DEP	7
PART II	GENERAL.....	8
PART III	AMENDMENTS AND SUPPLEMENTS TO API SPECIFICATION 17G	9
1.	Scope	9
3.	Terms, definitions, abbreviated terms and symbols.....	11
3.1	Terms and definitions	11
3.2	Abbreviated terms	12
4	System requirements	14
4.2	Description of well intervention systems	14
4.7	Modes of operation	14
4.10	Operational principles	15
4.14	Regulations, codes and standards	15
5	Functional requirements	15
5.3	Common requirements	15
5.4	Tubing hanger orientation system	15
5.5	BOP spacer joint	16
5.10	Retainer valve	18
5.19	Emergency disconnect package (EDP)	19
5.20	Well control package (WCP)	19
5.21	Connectors	20
5.23	C/WO riser joints	20
5.24	Stress joint.....	20
5.31	Surface tree tension frame.....	21
6	Design requirements	21
6.1	Scope	21
6.9	Non-pressurized equipment design requirements.....	22
7	Materials and fabrication requirements.....	22
7.1	Scope	22
7.3	Material selection.....	22
8	Testing	22
8.4	Hydraulic cleanliness	22
8.5	Qualification testing	22
11	Documentation	22
11.4	Design analysis	22
11.9	Installation and operation manual(s)	23
ANNEX A (normative)	Lower workover riser package interfaces	23
A.2	Tree running tool interface	23
ANNEX B (informative)	Operational modes and global riser analysis	23
ANNEX I (normative)	Qualification of connectors	23
ANNEX M (normative)	Intervention workover control system.....	24
M.1	System requirements	24
M.2	Surface equipment.....	28
M.3	Distribution subsystem	57
M.8	Testing	62

PART IV REFERENCES 63

APPENDICES

APPENDIX A SHELL REFERENCE SCHEMATICS.....64

PART I INTRODUCTION

1.1 SCOPE

This DEP specifies the requirements and recommendations for deepwater subsea completion/workover systems in order to meet the Principal's system design requirements, based on API Specification 17G, 4th Working Draft, December 2012.

Part III of this DEP amends, supplements and deletes various clauses of API SPEC 17G. For ease of reference, the clause numbering of API SPEC 17G has been used throughout Part III of this DEP.

All clauses of API SPEC 17G not modified by this DEP remain valid as written.

Requirements relating to environmental conditions, water depths, pressure/temperature ratings, materials, etc., are covered within the Tender Documentation Package, Basis for Design and Project Equipment Specific Documentation packages.

The basis for the equipment design is provided in DEP 37.80.00.36-Gen. The following equipment items are excluded from the scope of this DEP, as they are covered in separate DEPs, as noted, or are not considered to meet the requirements of the Principal's Model for Subsea Completion/Workover equipment::

- Tubing hanger
- Internal and external tree cap (refer to DEP 37.80.00.36-Gen.).
- Subsea test tree for well to rig unloading/clean up and well kill.
- Tubing hanger orientation system (refer to DEP 37.80.00.36-Gen.).
- Surface coiled tubing unit.
- Surface wireline unit.
- Surface tree kill and production jumper.

This is a revision of the DEP of the same number dated September 2011; see (1.5) regarding the changes.

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This DEP is intended for use in facilities related to offshore oil and gas production facilities. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Abbreviations

See (Part III, 3.2).

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section or clause number is shown in brackets (). Other documents referenced by this DEP are listed in (Part IV).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated September 2011. The following are the main, non-editorial changes.

Section/Clause	Change
GENERAL	DEP sections completely re-arranged to match layout of 17G.
4.4	Reference to DEP 37.80.00.39-Gen is removed.
4.5	Reference to DEP 37.80.00.39-Gen is removed. Deleted requirements for size and weight requirements.
5.5	Added section for THRA requirements.
5.20	Bullet #4, corrected PXOV to RXOV.
5.21.3	Changed requirement for connections that do not need specialized machinery to a recommendation.
6.9.6	Changed design of padeyes and lifting devices to comply with API 17A, 17D, and regional requirements.
Annex A	Amended requirements based on new 17G content. DEP requirements are additive to 17G.
Annex B	Removed reference to DEP 37.80.00.39-Gen
Figure 5.1	Revised ESD table to close UBSR and LBSR in ESD II coil tubing mode.
M.1.3.16.3	Removed section on abort functionality for EDP connector unlock command during ESD.
M.2.4.1.2.1	Changed container and padeyes to comply with DNV 2.7-1, DNV 2.7-3, and regional requirements.
M.2.4.1.2.2.5	Defined HVAC operational temperature range as 32 to 104 degrees F.

M.2.4.1.2.2.10.6.7, M.2.4.1.2.2.10.6.8, M.2.4.1.2.2.10.6.9, M.2.4.1.2.2.10.6.11	Added additional description of interlock pop-up and confirm operation pop-up. Added additional description of time configuration pop-up under choke control pop-up section.
M.2.4.2.1	Changed container and padeyes to comply with DNV 2.7-1, DNV 2.7-3, and regional requirements.
M.3.3.2	References to SDS-US-42 and SDS-US-43.
M.3.3.3.11	Bullet e; levelwind changed to 0 to 80 degrees adjustability.

1.6 COMMENTS ON THIS DEP

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DEP Standard Form (Other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

PART II GENERAL

1. Part III of this DEP is written as clarifications, amendments and supplements to API SPEC 17G, 4th Working Draft, December 2012. Wherever reference is made to API 17G, it shall be understood to mean API SPEC 17G, 4th Working Draft, and December 2012, as amended/supplemented/clarified by this DEP.
2. For ease of reference, the clause numbering of API 17G has been used throughout Part III of this DEP.
3. Clauses in API SPEC 17G, which are not mentioned in this DEP, shall remain valid as written.
4. Requirements relating to environmental conditions, water depths, pressure/temperature ratings, materials, etc., shall be provided within the Tender Documentation Package, Basis for Design and Project Equipment Specific Documentation packages.
5. The basis for the equipment design shall be DEP 37.80.00.36-Gen.

PART III AMENDMENTS AND SUPPLEMENTS TO API SPECIFICATION 17G**1. Scope**

Add the following:

1. API 17G, Figure 2 and Figure 3 describe the industry-typical, system set-up for performing work in tubing hanger (TH) and tree modes. API 17G, Figure 4 and Figure 5 are typical examples of the schematics associated with those set-ups.
2. The subsea wellhead (and tubing head) shall have the following features:
 - a) 18-3/4 in fullbore or slimbore body with an H4 profile;
 - b) rated for 5,000, 10,000 or 15,000 psi working pressure;
 - c) the tubing head shall provide a hang off profile with passive orientation for a TH, a vertical connection for a flowline jumper, downhole annulus access and provide orientation of the Xmas Tree (XT), and;
 - d) the tubing head connector hydraulically actuated by an ROV.
3. The tree and TH shall have the following features:
 - a) dual bore 5 in x 2 in (2 in equivalent annulus diameter) vertical tree with the production bore concentrically aligned to the TH;
 - b) rated for 5,000, 10,000 or 15,000 psi working pressure;
 - c) the wellhead connector hydraulically actuated by an ROV;
 - d) an 18-3/4 in H4 profile re-entry mandrel with an internal lockdown profile for tooling intervention;
 - e) the TH shall have a concentric production bore and a minimum of seven (7) and maximum of 11 radial penetrations for electrical, hydraulic and chemical functions;
 - f) the controls requirements and interfaces in accordance with DEP 37.80.00.33-Gen., and;
 - g) the ROV related items in accordance with DEP 37.80.03.31-Gen.
4. The completion/workover system equipment shall comprise:
 - a) Riser joints [fully fabricated units completion/workover (C/WO) riser end connections] for well completion, TH Installation/Recovery and XT Installation/Recovery and Intervention.
 - b) Workover Control System comprising of (but not limited to):
 - i. Hydraulic power unit (HPU)
 - ii. Workover Umbilical (installed on a umbilical reeler)
 - iii. Umbilical clamps
 - iv. Remote control panels
 - v. Riser control station
 - vi. Emergency disconnect package/lower riser package (EDP/LRP) mounted controls package
 - c) Surface flow tree
 - d) Surface tree tension frame

- e) Lower workover riser package comprising of:
 - i. LRP
 - ii. EDP
- f) Tubing hanger running assemblies (THRA) comprising of:
 - i. Tubing hanger running tool (THRT)
 - ii. BOP spanner joint
 - 1. THRT adaptor joint
 - 2. Spacer spool(s)
 - 3. Emergency disconnect latch [specific for dynamic positioning (DP) Rig]
 - 4. Shear joint (specific for DP rig)
 - 5. Slick joint(s)
- g) Lubricator valves
- h) Retainer valves
- i) Shear subs
- j) Swivels
- k) Annulus circulation equipment comprising of:
 - i. Annulus high collapse restraint (HCR)hose (installed on annulus hose reel)
 - ii. Annulus hose reel
 - iii. Hose clamps
- l) Riser spider
- m) Umbilical clamps used for inside drilling riser and open water work for well completion, TH Installation/Recovery and XT Installation/Recovery and Intervention.
- n) Handling and test tools

- NOTES:
- 1. The above lists have been taken from Section 1 of API 17G. The list has been revised to show where the Principal's global requirements can be found.
 - 2. Additional comments have been added to identify what the equipment is used for relative to completion and workover activities and where the details of the specific requirements can be found.
 - 3. The activities cover operations from both moored and DP rigs.

5. The following items are excluded from the scope of this DEP. Details are provided in a separate DEP, as noted, or are not considered to meet the requirements of the Principals Model for Subsea Completion/Workover equipment:
- a) Internal and external tree cap - refer to DEP 37.80.00.36-Gen.
 - b) Subsea test tree for well to rig unloading/clean up and well kill.
 - c) Tubing hanger orientation system - refer to DEP 37.80.00.36-Gen.
 - d) Surface coiled tubing unit.
 - e) Surface wireline unit.
 - f) Surface tree kill and production jumper.

3. Terms, definitions, abbreviated terms and symbols

Add the following before 3.1:

NOTE: The terms and definitions listed here are common terms and definitions used by industry to describe the equipment being specified in this document. The descriptions are relative to the Principal's equipment design parameters and the intended operational modes for Deepwater Subsea applications.

3.1 Terms and definitions

3.1.21 Completion/workover riser

Add the following to this definition:

This riser may be drill pipe, completion tubing or a "special" riser. It may be used for installation, recovery or completion work but always within the drilling riser.

This riser shall only be used in open water work.

3.1.100 Lower workover riser package (LWRP)

Add the following to this definition:

Tree running tool is the WCP connector that also allows the package to connect to a tree for intervention work.

3.1.130 Re-entry spool

Add the following to this definition:

In the Principal's terms of reference, this is called the tree re-entry mandrel. In addition to the external profile that is used for handling and LRP re-entry, the mandrel is required to have internal profiles. They allow the setting of an ROV tree cap and attachment of a tie-back tool to be used during downhole intervention work.

3.1.151 Slick joint

Add the following to this definition:

This term is replaced in the Principal's terms of reference by 'cased wear joint'.

3.1.185 Tree running tool

Replace the definition with the following:

Refer to (3.1.100) above.

3.1.188 Tubing hanger running tool (THRT)

Add the following to this definition:

Common interface to latch into the TH, provide production bore access, and hydraulic/chemical/electrical interface to downhole functions.

3.1.189 Tubing riser

Add the following to this definition:

This term is replaced in the Principal's terms of reference by 'completion riser'.

Add the following new definitions:

3.1.210 BOP spanner joint (BOPSJ) (known as BOP Spacer Joint 17G definition)

Intermediate assembly providing interface between the IWOCS umbilical, workstring, and the THRT. The BOPSJ typically does not have isolation valves in the production bore for vertical tree configurations. The BOPSJ spaces-out within the BOP and includes ram spools, shear joints, and annular slick joints.

3.1.211 Tubing hanger running assembly (THRA)

Comprised of the BOP SJ and THRT.

3.2 Abbreviated terms

Add the following new terms:

ACK	Acknowledgement
AIV(RAIV)	(Riser) Annulus isolation valve
BOP SJ	BOP spanner joint
CWO	Completion/Workover
DHPT	Downhole pressure/ temperature
DP	Dynamic positioning
EAS	EDP annulus swab
EAM	EDP annulus master
EDP	Emergency disconnect package
EPU	Electrical power unit
ESD	Emergency shut down
EXOV	EDP crossover valve
FSC	Fail safe closed
FSO	Fail safe open
HCR	High Collapse Restraint
HOA	Hand-Off Automatic
HMI	Human machine interface
HP	High pressure
HPU	Hydraulic power unit
IWOCS	Intervention workover control system
LBSR	Lower blind shear ram
LP	Low pressure
LRP	Lower riser package
LWRP	Lower workover riser package
MCP	Master control panel
MCS	Master control station
MODU	Mobile offshore drilling unit
NACK	Negative acknowledgement
PRV	Production bore retainer valve
PSCM	Production subsea control module
PSR	Pipe slip ram
PXOV	Production crossover valve
RCS	Riser control station
RPIV	Riser production isolation valve

RXOV	Riser crossover valve
SEM	Subsea electronic module
SCM	Subsea control module
SCSSV	Surface controlled sub-surface safety valve
TH	Tubing hanger
THL	Tubing hanger lock
THRA	Tubing hanger running assembly
THRT	Tubing hanger running tool
UBSR	Upper blind shear ram
VDU	Video display unit
WCP	Well control package
WHPU	Workover hydraulic power unit
WSCM	Workover subsea control module
XT	Christmas (Xmas) Tree

4 System requirements

4.2 Description of well intervention systems

Add the following:

Figure 4.1 provides a simple schematic of a LWRP as defined in (3.1.100).

NOTE: A more explicit diagram is provided in (Appendix A, Figure A4).

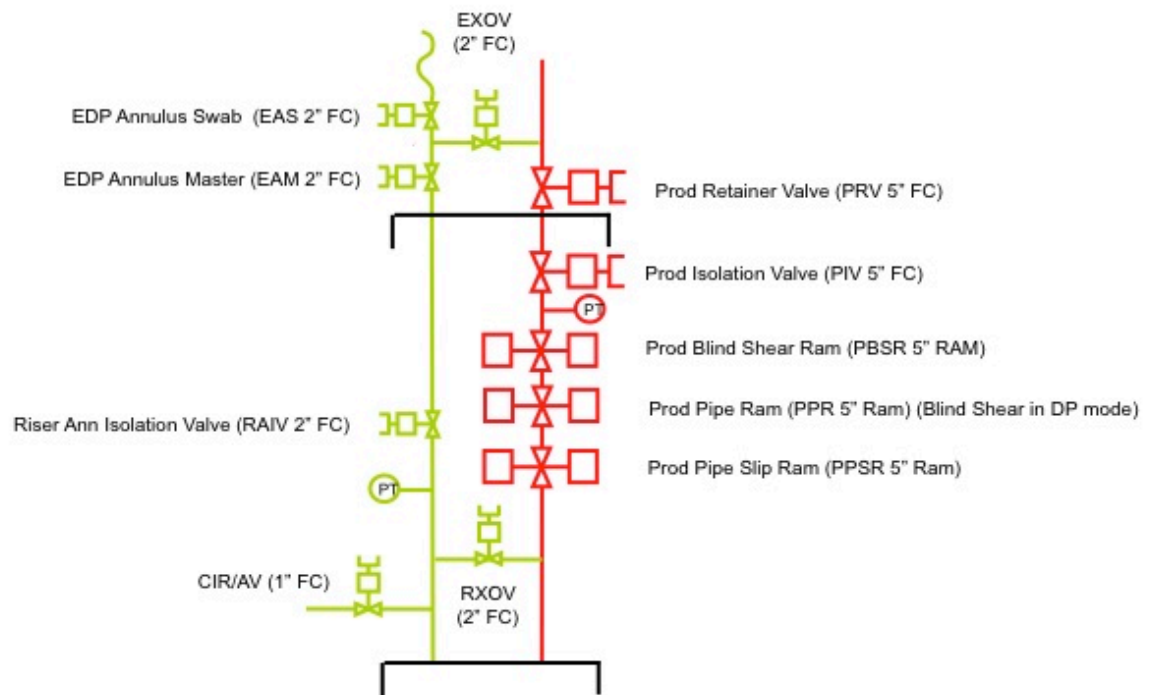


Figure 4.1 EDP/LRP simplified schematic

4.7 Modes of operation

Add the following:

1. DEP 37.80.00.36-Gen. shall be referenced to define the systems and cover the equipment required during each mode of operation.

Table 1 below is complementary to the existing 17G table.

2. The Table 1 below provides a list of the operations the system shall cover to meet the Principal's requirements for completion and workover operations from a DP or moored rig.

Table 1 List of operational activities

Mode of Operation	CWOR System	BOP on Tree with SSTTA	THRA System
Well completion			X
Well completion (TH) recovery			X
Well Intervention-Open Water	X		
Well Intervention-inside drilling BOP/riser		X	
Well Workover	X	X	

4.10 Operational principles*Add the following:*

1. The Contractor shall identify from the Design Analysis, the equipment or component that is the designated weak point of the system and how, operationally, that failure is to be accommodated.

4.14 Regulations, codes and standards*Add the following:*

1. The Principal nominated requirements are provided in the project specific data sheets.

5 Functional requirements**5.3 Common requirements***Add the following:*

- t) The riser system shall be designed for guidelineless operations only from either a DP or moored rig.

5.4 Tubing hanger orientation system*Add the following:*

1. The requirements of DEP 37.80.00.36-Gen. shall be addressed. Those requirements stipulate that a tubing head shall be used to support the TH and that the orientation system provided shall be "passive" in nature.
2. The following requirements are those that relate to the actual operation of TH installation:
 - a) The system shall allow the TH to be installed and tested in a single trip and shall be highly tolerant to debris.
 - b) The system shall exhibit control over these operations:
 - i. Initial interface of the TH seal within the tubing head
 - ii. Re-entry of the THRT into the installed TH
 - c) The installation procedure shall not require the engagement of a pack-off within the tubing head more than once.
 - d) The system shall provide clear indication at the drill floor as to the status of the installation operation, in particular relating to orientation, lockdown and tie-back.
 - e) The installation procedures shall be compatible with the Completions group procedures for the setting of packers.

- f) Throughout the installation procedure, it shall be possible to monitor the downhole electrical line integrity and communicate with the hydraulic and chemical line functions.
- g) The TH installation procedure shall not be limited by vessel heading.
- h) The TH installation system shall be designed to be capable of accommodating an external test pressure of the Equipment Design Pressure + the hydrostatic head of fluid within the drilling riser with the completion riser bore at ambient surface pressure.
- i) It shall not be necessary to apply torque to any running string in order to achieve alignment of the TH or to activate any seals.
- j) The running system shall include a temporary stabbing funnel guide that fits onto the THRT and facilitates free stabbing of the tool onto a TH in the correct attitude at the drill floor.

5.5 BOP spacer joint

Add the following:

NOTE: BOP 'spacer' joint with the THRT is referred to as the THRA.

1. The THRA is considered to comprise the THRT and BOPSPJ assemblies noted in Figure 5.1 below.

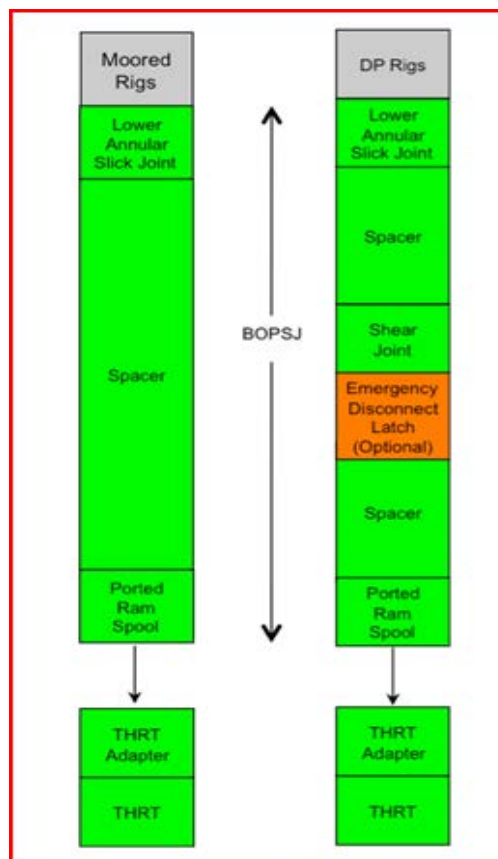


Figure 5.1 Simplified Landing String layouts for DP and Moored rigs

Add the following list items q) and r):

q) Functional Requirements

- i. Centralization of the THRA shall ensure proper alignment during angled entry and re- entry ($\pm 1^\circ$). The THRA shall have spaced centralizers that will ensure that the THRT interface to the TH is not compromised nor are any seal surfaces in the Tubing Head Assembly damaged.
- ii. The BOPJS shall have an overshot profile for tool retrieval post shear.
- iii. The BOPJS latch tool shall be below the shear joint. During securing well and/or disconnect event, the blind shears will close. With the latch below the shear joint, the shear joint section and above will be clear of the shear rams.

r) Subcomponent Requirements

- i. Ported Ram Spool
 1. The THRA shall have a ported ram spool to allow the specified pipe ram to seal on the smooth outer diameter and allow pressurization below the pipe ram.
 2. The ported ram spool shall be located across the BOP annular and allow closure and sealing of the annular element around a smooth diameter.
 3. The ported ram length shall provide a smooth uniform sealing area across the longitudinal length of the pipe ram element.
 4. The ported ram spool shall be ported for all control and electrical lines, allowing the pipe ram to seal on the specified outer diameter without compromising the system controls.
- ii. Overshot Adapter
 1. The tool shall be designed to slip over the cut shear joint to mate with the quick connect ratch-a-latch on the adapter located below the shear joint, to enable retrieval of the lower half of the sheared THRA.
 2. Overshot recovery tool shall have an ID that will clear the cut shear joint. No milling operations shall be required and overshot profile shall be discrete from the shear joint.
- iii. Latch Assembly
 1. The subsea latch provides a disconnect point below the BOP shear rams. The production bore through the latch shall be concentric to its centreline. All hydraulic and electrical lines shall be configured with wet mate connectors to allow disconnect and re-connect subsea. Hydraulic couplers on the lower shear latch assembly shall be configurable with either full-checking or bleed-type couplers.
 2. The subsea latch shall provide an alignment feature (key/helix) to allow for re-establishment subsea after a disconnect. The alignment system shall provide centralization of the upper latch to the lower latch prior to engagement of the production stab into the receiving seal entry profile on the lower latch assembly. The lower latch assembly shall have an outer centralizer assembly near the latch location to maintain the lower latch in the centre of the riser bore.
 3. The upper latch assembly shall contain the production stab with dual elastomer seals. The use of a seal test port between the elastomer seals should be provided for verification of seal integrity.
 4. The interface between the upper and lower latch assembly shall be debris tolerant. The lower latch interface profile should avoid recessed couplers and/or gathering points for riser debris.

5. The latch assembly shall include an overshoot profile for assembly recovery in event of failure or shearing of the shear joint. The diameter of the overshoot profile shall be sufficient to allow adequate clearance between the overshoot tool ID and a sheared section of the shear joint.
 6. The latch assembly shall be capable of disconnect under tension.
 7. The lower latch shall be provided with a surface handling tool to allow handling of lower THRA assembly from the horizontal position (i.e., pipe deck) to the vertical position in the derrick. The lower latch assembly shall provide a means to hang off the lower THRA in the rotary.
 8. The upper latch assembly shall be provided with a bottom handling cap to prevent damage to the upper latch during handling of the upper THRA from horizontal to vertical position in the derrick.
- iv. Spacer Spools
1. As required, the THRA shall have spacer spools to bridge the distance between major subassemblies.
 2. The spacer spool shall be ported for all control and electrical lines.
- v. Test Shear Joint
1. The test shear joint shall be fabricated from the same steel and heat as the shear joint.
 2. The test shear joint shall include all clamps, tubing, electrical lines, etc. to match the cross section of the shear joint.
 3. THRT Secondary Release Mechanism
 - a. The BOP SJ shall have a secondary release mechanism that allows release of the THRT from the Tubing Hanger in the event hydraulic control through the umbilical is lost.
 - b. The secondary release mechanism shall operate by closure of the BOP pipe ram around the ported ram spool and applying pressure below the ram through the choke or kill line.
 - c. During normal operation, the pressurization of the THL (tubing hanger lock) circuit shall prevent operation of the secondary release mechanism when BOP test pressure is applied below the pipe ram.
- vi. THRT
1. The THRT (Tubing Hanger Running Tool) shall:
 - a. hydraulically latch into the TH for deployment, installation, and recovery of the TH
 - b. have a sealing provision to pressure test the gallery area between the TH and THRT prior to deployment
 - c. shall hydraulically stroke the THL mandrel for locking and unlocking the TH from the tubing head spool
 - d. provide positive indicators for TH lock and tool latch verification
 - e. provide a seal test port for pressure testing the TH seals once the TH is locked to the tubing head spool

5.10 Retainer valve

Addition the following:

1. To meet the requirements of the Principal, Figure 4.1 and (Appendix A, Figure A4) in this DEP show the location of the production bore retainer valve (PRV) as an integral part of the EDP assemblies.

5.10.3 Retainer valve - Open water intervention mode

Replace item a) after the first sentence with:

- a) The retainer valve or EDP *should* include features to vent trapped pressure between the closed retainer valve and the shut-in WCP open sea in the case of an emergency quick disconnect.

5.19 Emergency disconnect package (EDP)

Add the following:

- l) The package shall be capable of use as an emergency disconnect connector set in the landing string above the LRP. The connector shall incorporate a ROV override facility for emergency release/disconnection.
- m) The package shall be capable of accepting a workover control module and the connection of the workover umbilical and the annulus circulation line.
- n) The interface with the EDP/LRP shall be made with metal to metal seals that can be replaced subsea by ROV.
- o) The package shall contain the following valves which are to be located as shown in Figure 4.1 and (Appendix A, Figure A4).
 - i. The production bore valve (PRV) shall be fail safe close gate valve suitable for isolating the production bore prior to disconnection.
 - ii. The EDP shall have a fail safe close annulus master valve (EAM) and a failsafe close annulus swab valve (EAS) arrangement as well as a failsafe close crossover gate valve (EXOV) located between the two aforementioned valves for inter bore communication, circulation and clean out.

5.20 Well control package (WCP)

Add the following:

NOTE: The text states the package contains a well control package which in the Principal's terms of reference is known as the lower riser package (LRP).

- r) The LRP package shall contain the following valves which shall be located as shown in Figure 4.1 and (Appendix A, Figure A4) in this DEP. This configuration meets the Principal's requirements. Typical specification details may be provided by the Principal in a sample equipment data sheet. Project may elect to make up their own layout which would be referenced with the Project specific data sheets or specification.
- s) The LRP package shall be capable of isolating the production bore by closing either the lower or upper shear ram. Both shear rams shall be sealing and capable of shearing coiled tubing, braided wire, slickline, and electrical cable. A pipe slip ram (PSR) below the lower blind shear ram (LBSR) should capture the coil tubing string prior to shear closure.
- t) The sizes and materials of the tubing, line and cable shall be provided in the Project Tender Document Package.
- u) The LRP package shall have an annulus through path that allows access to the Tree and the Annulus Circulation Hose. The Path shall incorporate a fail-safe close riser isolation valve (RAIV) and a fail-safe close riser crossover valve (RXOV) between the annulus and production bore. The crossover porting shall be below the PSR (if equipped) or lower shear ram and the riser annulus isolation valve (RPIV).
- v) The LRP package structure shall attach to the connector and provide these features:
- w) Have a funnel down re-entry arrangement and if required a system of passive orientation.

- x) The structure shall be capable of supporting the weight of the LRP, EDP and Stress joint in free standing and test stand configurations.

5.21 Connectors

5.21.2 Remote release connectors

Add the following:

- m) The primary hydraulic actuation of the connector shall be performed through the Workover Control system and the C/WO umbilical. The connectors shall be provided with secondary operating and emergency override features that are operable with an ROV.

5.21.3 C/WO riser joint connectors

Add the following:

- p) The riser joint connectors proposed shall be proven high strength deepwater designs and they should have pre-loaded quick make-up break out capability at assembly. The connection design shall be robust and durable in order to maximise their use offshore, full interchangeability of connections is required.
- q) The Principal's recommendation is that the connection be made up or broken out without the use of sophisticated and specialised torque or tension machinery. However, specific project requirements may require a unique connector design that utilizes design specific make-up and break-out tooling.
- r) The Contractor is required to establish for each connection, a database of their operational use and all performed maintenance throughout their working lifetime.
- s) The Contractor is to provide with the bid, any details of preliminary analysis work on open water use and the effects of vortex shedding on the riser profile with a control umbilical attached and with and without an annular line in place, also.
- t) Suspended riser string weight is to include the LRP and EDP package weights and the Annulus Circulation Hose.

5.23 C/WO riser joints

Add the following:

- j) A means of maintaining pre-load and make-up shall be provided to prevent loss of seal integrity and connector back off and rotation during normal operations.
- k) Any lubricants or greases required for the joint make-up shall be compatible with operations both inside the drilling riser, in open water and from the internal mediums.

5.24 Stress joint

Add the following:

- g) The stress joint shall transmit stresses induced by the riser system during all modes of operation and in all year weather conditions without imposing any restrictions on the operations resulting from the weather conditions.
- h) The stress joint shall have an upper connection compatible to the riser joint connections and a lower connection that allows quick make-up and break out. In addition, the stress joint shall have a top connection saver sub in addition to the pup joints provided with the riser system.

5.31 Surface tree tension frame

Replace item c) with the following:

- c) The tension frame shall be capable of lifting the entire C/WO riser *string* including the *LWRP assembly*, and accommodate “overpull” requirements to verify equipment has been properly landed and locked in place. In addition, axial capacity of the tension frame shall be not less than that of the landing string or C/WO riser joints.

5.33 Annulus circulation line

Add the following:

- h) The annulus circulation line shall be:
 - i. equivalent in length to the Workover umbilical.
 - ii. rated for the working pressure available selected by project.
 - iii. installed on a reeler similar in design and function to the Workover umbilical.
- i) The end fittings shall be designed to interface with the rig choke and kill (directly or through adapters) and EDP connection. As a minimum, the connecting assemblies shall be similar in design, rating, construction and operation to those interfaces.
- j) The other additional considerations are that the equipment shall be supplied as a fully operational system and come complete with crossovers, subs, running sheave assemblies, running clamps and any surface jumpers that interface with other equipment on the unit.

6 Design requirements**6.1 Scope**

Add the following:

1. The Principal's requirements for hardware equipment installation are identified in project specific data sheets. Contractor shall address those requirements and, in addition, consider the following:
 - a) It is the responsibility of the Contractor to determine the ultimate bending capacity of the wellhead, tubing head and tree stack for all the stated relevant installation and workover configurations and vessel options. It is a requirement for these analyses to show that the ultimate failure point within the stacked system is above the TH in TH installation and workover mode and above the tree in tree installation and workover mode.
 - b) Equipment shall be designed to allow year round installation and workover and that function shall not be achieved by the imposition of onerous operational limitations. The operational limitations for equipment shall be presented in the form of data sheets and calculation packages to Principal for review and approval.
 - c) The applied safety factors used shall be noted for each case and, in addition, the following features considered:
 - i. Tensile and bending capacities of connectors and tools,
 - ii. Bending capacities of the completion/workover riser systems and tree stack-up relative to the corresponding vessel offsets and operating conditions for all installation and workover configurations and vessel options,
 - iii. Shock loading sensitivity (i.e., thermal, impact, etc.),