

# Scope of Supply

Product: Mux Control System

REFERENCE <b>SO 832231A</b>	REFERENCE DESCRIPTION <b>NOV Proposal Ref: 165350</b>
<p>This document contains proprietary and confidential information which belongs to National-Oilwell Varco, L.P., its affiliates or subsidiaries (all collectively referred to hereinafter as "NOV"). It is loaned for limited purposes only and remains the property of NOV. Reproduction, in whole or in part, or use of this design or distribution of this information to others is not permitted without the express written consent of NOV. This document is to be returned to NOV upon request and in any event upon completion of the use for which it was loaned. This document and the information contained and represented herein is the copyrighted property of NOV.</p> <p><small>© National Oilwell Varco</small></p>	<b>National Oilwell Varco Rig Solutions Pressure Control Group</b>
	DOCUMENT NUMBER <b>10975064-SOS</b>

**REVISION HISTORY**

01	11 July 2014	New Release	Malcolm	Bartlett	Landrith
Rev	Date (dd.mm.yyyy)	Reason for issue	Prepared	Checked	Approved

**CHANGE DESCRIPTION**

Revision	Change Description
01	Initial Release

## Contents

<b>1</b>	<b>DOCUMENT NOTES .....</b>	<b>4</b>
1.1	Unresolved Issues .....	4
1.2	Application Notes .....	4
<b>2</b>	<b>PURPOSE.....</b>	<b>4</b>
<b>3</b>	<b>CONFIGURATION DETAILS.....</b>	<b>4</b>
3.1	Project Details.....	4
3.2	HPU Details .....	4
3.3	Accumulator Racks.....	4
3.4	Diverter Substructure Panel Specifications.....	4
3.5	Auxiliary Pumps .....	5
3.6	Fluid Recovery System.....	5
3.7	Mux Cable Reels .....	5
3.8	Hot Line Hose Reels.....	5
3.9	Central Control Console .....	5
3.10	Drillers Panel .....	5
3.11	Toolpushers Panel.....	5
3.12	Subsea Engineers Panel .....	5
3.13	Uninterruptable Power Supply .....	6
3.14	Rigid Conduit .....	6
3.15	Mux Pod .....	6
3.16	Acoustic Pod.....	6
3.17	EHBS Pod/ Auto Shear Circuit.....	6
3.18	Emergency Disconnect Sequence (EDS) .....	6
3.19	ROV Panel.....	7
	3.19.1 LMRP ROV Panels.....	7
	3.19.2 Lower Stack ROV Panels.....	7
3.20	Additional Instrumentation .....	7
<b>4</b>	<b>LIST OF DELIVERABLES .....</b>	<b>8</b>
<b>5</b>	<b>PRODUCT DETAILS .....</b>	<b>9</b>

## 1 DOCUMENT NOTES

### 1.1 Unresolved Issues

- Review of formal contract for project

### 1.2 Application Notes

- Review of NOV Quote 115876, Rev G included in this document.
- Review of Clarification List (19 April 2012) included in this document:
- Review of GTD Rev 10 with Circular 1 to 45 included in this document:
- Review of Charter Bid Rev 01 with Circular 1 to 19 included in this document:
- MOM dated 11 and 12 Sept 2012

## 2 PURPOSE

The purpose of this document is to detail the final configuration of the Mux Control System. This document is intended to be used by NOV and clients as the single source for the definition of the BOP Control System.

## 3 CONFIGURATION DETAILS

### 3.1 Project Details

Customer:	
Rig Name:	
Maximum Water Depth Rating:	10,000 ft
Certification:	ABS MODU
System Sizing Calculations Per:	ABS MODU API 16D
Pipe Shearing Requirements:	6-5/8", 40.87 lb/ft, S-135 10-3/4", 60.7 lb/ft, Grade P-110
Casing Shearing Requirements:	14", 113 lb/ft, Q-125HC
Electrical Code:	IEC
Surface Equip. Paint	AX040014, Paint System 1, Color Code 04 (red)
Subsea Equip. Paint	AX040014, Paint System 2, Color Code 01 (white)

### 3.2 HPU Details

Pressure Rating:	5,000 psi
Equipment Location:	Hazardous- Class Zone 2
Required Electrical Supply:	460 VAC, 3 Ph, 60Hz
Primary Pump Quantity/ Configuration:	3x Electrical Motor with 3x Motor Starters (Starters are off skid)

### 3.3 Accumulator Racks

Bottle Type:	Top Loading
Isolation:	Per Header

### 3.4 Diverter Substructure Panel Specifications

Power Supply:	Bop Controls HPU
Diverter Manufacturer and Model Number:	NOV PCG- 60.5"

Equipment Location:	Hazardous- Class Zone 2
---------------------	-------------------------

### 3.5 Auxiliary Pumps

High Pressure Electric Test Pump Pressure:	22,5000 psi
High Pressure Air Test Pump Pressure:	None
Glycol Injection Pump Pressure:	None
Equipment Location:	Non-Classed

### 3.6 Fluid Recovery System

Required:	No
Equipment Location:	N/A
Glycol Injection Pump Pressure:	N/A

### 3.7 Mux Cable Reels

Equipment Location:	Hazardous- Class Zone 1
Constant Tension:	Yes
Remotely Controlled:	Yes
Turndown Sheaves:	Drill Floor Mount / Qty = 4
Clump Weighted Roller Sheaves Qty:	2
Mux Cable Clamps Qty (One per joint recommended):	300
Choke and Kill Line Diameter	6.5" OD (NOV PCG FT-H)

### 3.8 Hot Line Hose Reels

Constant Tension:	Yes
Remotely Controlled:	Yes
Turndown Sheaves:	Drill Floor Mount / Qty = 2
Clump Weighted Roller Sheaves Qty:	1
Hot Line Hose Clamps Qty (One per joint recommended):	Integrated with Mux Cable Clamp
Choke and Kill Line Diameter	6.5" OD (NOV PCG FT-H)

### 3.9 Central Control Console

Equipment Location:	Non-Classed
Dynamic Positioning System Integration:	Yes/ Kongsberg
Riser Recoil System Integration:	Yes/ NOV
Rig Management System:	Yes/ NOV Cyberbase

### 3.10 Drillers Panel

Equipment Location:	Hazardous- Class Zone 1
Diverter Remote Panel:	Integral

### 3.11 Toolpushers Panel

Equipment Location:	Safe Area
Diverter Remote Panel:	Integral

### 3.12 Subsea Engineers Panel

Not Supplied

### 3.13 Uninterruptable Power Supply

Equipment Location:	Non-Classed
---------------------	-------------

### 3.14 Rigid Conduit

Number of Conduits:	2 (NOV PCG FT-H)
---------------------	------------------

### 3.15 Mux Pod

Style:	112 Line
Retrievable:	No
Wet Mate Connector:	Yes
Stack Integrator:	NOV
Qty/ Type of Annulars in Lower Stack:	See 10648553-SOS
Qty/ Type of Annulars in LMRP:	See 10648553-SOS
Qty/ Type of Pipe Rams:	See 10648553-SOS
Qty/ Type of Shear Rams:	See 10648553-SOS
Shear Circuit:	1x
Qty/ Type of C&K Gate Valves:	See 10648553-SOS
Qty/ Type of Gas Valves:	See 10648553-SOS
Qty/ Type of C&K Isolation Valves:	See 10648553-SOS
Wellhead Connector pressure Reducing Circuit/ Connector Manufacturer:	No
LMRP Connector pressure Reducing Circuit/ Connector Manufacturer:	No
Choke and Kill Stabs:	Fixed/ Non-Locking
Mud Boost Valve/ Type:	Yes- See 10648553-SOS
Special Notes:	

### 3.16 Acoustic Pod

Electronics Manufacturer:	Kongsberg
Required Functions:	Upper Shear Ram- Close Middle Shear Ram- Close Lower Shear Ram- Close All Stabs- Retract LMRP Connector Primary- Unlock LMRP Connector Secondary- Unlock Upper Pipe Ram- Close Upper Pipe Ram- Lock
Special Notes:	

### 3.17 EHBS Pod/ Auto Shear Circuit

EHBS Selectable Functions:	Yes- Upper or Lower Shear Rams are to be Selectable
EHBS Pod Functions	Upper Sear Ram- Close Lower Shear Ram- Close
Auto-Shear Circuit:	Yes
Special Notes:	

### 3.18 Emergency Disconnect Sequence (EDS)

EDS Selection 1:	Non-Shear
------------------	-----------

EDS Selection 2:	Lower Blind Shear Ram
EDS Selection 3:	Upper Blind Shear Ram
EDS Selection 4:	Casing Shear/Lower Blind Shear Ram
EDS Selection 5:	Casing Shear/Upper Blind Shear Ram

### 3.19 ROV Panel

#### 3.19.1 LMRP ROV Panels

Function	Option	Gauge	Ball Valve	Stab
LMRP Accumulator Dump	std	1	2	1
Riser Connector Unlock (Primary)	std	0	0	1
Riser Connector Unlock (Secondary)	std	0	0	1
Riser Connector Gasket Release	std	0	0	1
All Stabs Retract	std	0	0	1
Riser Connection POCV Bypass	std	1	2	0
Rigid Conduit Dump 1	std	0	1	0
Rigid Conduit Dump 2	std	0	1	0

#### 3.19.2 Lower Stack ROV Panels

Function	Option	Gauge	Ball Valve	Stab
Stack Connector Unlock (Primary)	std	0	0	1
Wellhead Connector Unlock (Secondary)	std	0	0	1
Stack Connector Gasket Release	std	0	0	1
Stack Connector POCV Bypass	std	1	2	0
Blue Pod Female Sec Extend	std	0	0	1
Blue Pod Female Sec Retract	std	0	0	1
Yellow Pod Female Sec Extend	std	0	0	1
Yellow Pod Female Sec Retract	std	0	0	1
Acoustic Accumulator Dump	std	1	2	1
EHBS Accumulator Dump	std	1	2	1
Upper Shear Rams Close	std	0	0	1
Middle Shear Rams Close	std	0	0	1
Lower Shear Rams Close	std	0	0	1
Glycol- Wellhead Injection	included	0	0	1
Acoustic Shear Supply and EHBS	std	0	0	1
Upper Pipe Ram Close & Lock	std	0	1	1

### 3.20 Additional Instrumentation

Wellbore Pressure and Temperature Probe Qty/ Location:	1x Riser Adapter 1x Lowest BOP Ram Outlet
Electric Riser Angle Sensor Qty:	2
Special Notes:	

#### 4 LIST OF DELIVERABLES

##### From Section 8.02 of Quote 115876 (MUX Controls)

Item	Description	Qty	Revision Notes
1	Surface Equipment	1	
2	Electric/Remote Control Equipment	1	
3	Uninterruptible Power Supply (UPS)	1	
4	Cable Reel	2	
5	Mux Cable Sheave	4	
6	Clump Assembly	3	
7	Dual Cable & Hose Clamp Assemblies	300	
8	Hotline Hose Reel	1	
9	Hotline Manifold Assembly	1	
10	Hotline Hose Sheave	2	
11	Control Console- Remote, Three Reels	1	
12	Subsea MUX Control Pod	2	
13	Pod Test Stand	1	
14	Test Bench Assy	1	
15	CCC Simulator	1	
16	Stack mounted Control Equipment	1	
17	Emergency Hydraulic Backup System (EHBS)	1	
18	Acoustic Emergency Backup Control	1	
19	High Pressure and High Temperature (HPHT) Sensor	2	
20	High Pressure Test Unit	1	
21	Riser Angle Install Package	1	
22	Dual MUX Cable & Hot Line Assy	3	
23	Dual MUX Cable & Hot Line Assy w/Bracket	1	
24	Transportation to the port of Houston	1	

##### From Section 8.04 of Quote 115876 (Riser)

14	Riser Spider/ Running Tool Control Panel	1	
17	Tension Ring Control Panel	1	



## 5 PRODUCT DETAILS

### From Section 8.02 of Quote 115876 (MUX Controls)

#### 1 Surface Equipment

##### A. Hydraulic Power Unit with Mixing System

Hydraulic Power Unit (HPU) is rated for 5,000 psi working pressure and designed to meet the requirements of API 16D 2nd Edition (Jan 2005) and ABS MODU, API RP53 and API RP 64.

HPU consists of the following:

Three (3) electrically driven triplex pump packages to be mounted on Item A, and each consisting of the following:

- 1- Triplex pump delivering 43.5 GPM @ 5,000 psi
- 1- 150 HP 460VAC 60Hz
- 1- V-belt drive system w/ belt guard
- 1- Adjustable automatic pressure switch set @ 5,000 psi.
- 1- 3" pump suction strainer complete w/ shutoff valves
- 1- High pressure discharge check valves
- 1- Base skid assembly

Motor Starters are to be provided by NOV. Motor Starters are not to be mounted on the HPU skid.

One (1) 316 SS Reservoir assembly mounted on Item A consisting of the following:

- 1- 1000 gal. mixed fluid reservoir complete with sight glass, automatic level control, and low fluid alarm.
- 1- 550 gal soluble oil reservoir complete with sight glass and low fluid alarm.
- 1- 500 gal Glycol reservoir complete w/ sight glass and low fluid alarm.

One (1) Batch type "PLC" based adjustable soluble oil/water/glycol mixing system capable of producing 100 GPM of mixed fluid mounted on Item A consisting of the following:

- 1- Positive displacement electrically driven soluble oil pump complete with suction strainer, isolation valve discharge check valve, flow switch, and discharge filter.
- 1- Positive displacement electrically driven glycol pump complete with suction strainer, isolation valve, discharge check valve, flow switch, and discharge filter.
- 1- Two (2) inch water flowmeter
- 1- Two (2) inch water filter
- 1- Mixing system control j-box

High pressure stainless steel piping system mounted on Item A consisting of the following:

- 1- 5,500 psi set relief valve
- 1- Two (2) inch normally open SPM valve for accumulator isolation.
- 2- Two (2) inch normally closed SPM valves for rigid conduit 1 & 2.
- 1 – One (1) inch normally closed SPM for Hotline Reel Supply
- 1- Pilot circuit for controlling above SPM valves.
- 2- Two (2) inch 316 SS 10 micron filter assemblies complete with isolation valves and bleed valves.
- 1- Flowmeter for hydraulic fluid output.
- 1- Junction Box to house required pressure switches, transducers and solenoids.

##### B. Surface Accumulator Bottle Racks

Surface accumulator bottle racks 5,000 psi working pressure, Bladder Type, SS fluid port, sized according to API 16D 2nd Edition and ABS.

### C. Diverter Control Panel

The diverter control system is designed for operating the NOV diverter system and consists of the following major components and controls:

- 1- 1" Pneumatic piloted gear motor driven stainless steel hydraulic regulator and reducing valve for controlling diverter packer pressure. The valve has remote operation, manual override capability, and "stay put" design features incorporated in the event of the loss of pilot pressure.
- 1- ½" Pneumatic piloted gear motor driven stainless steel hydraulic regulator and reducing valve for controlling slip joint hydraulic pressure. The valve has remote operation, manual override capability, and "stay put" design features incorporated in the event of the loss of pilot pressure.
- 1- 1" Manual Koomey Regulator (MKR) stainless steel manual pilot pressure regulator and reducing valve for controlling flowline seals pressure.
- 2- 1" Manual Koomey Regulator (MKR) stainless steel manual pilot pressure regulator and reducing valve for controlling pressure. These valves are used to control:
  - 5,000 psi to 3,000 psi reducing regulator
  - Diverter manifold pressure.
- 2- 1" four (4) way hydraulic control valve complete with air cylinder, for the Diverter packer- open/close function, and flowline seals vent/pressure
- 11- ¼" four (4) way hydraulic control valves complete with air cylinders, for the following functions:
  - Diverter lockdown dogs lock/unlock
  - Overboard- Port valve open/ close
  - Overboard- Starboard valve open/ close
  - Mud Gas Separator valve open/ close
  - Fill Line valve open/ close
  - Flowline valve open/ close
  - Trip tank valve open/ close
  - Shaker valve open/ close
  - From Trip Tank Pump valve open/ close
  - Hyd. Slip Joint Upper pressure/vent
  - Hyd. Slip Joint Lower pressure/vent
- 5- Pneumatic control valves for the following functions:
  - Port/Starboard Overboard Select valve – Port Open/STBR Close - Port Close/STBR Open
  - Slip Joint Upper/ Lower Packer Pneumatic (inc/ dec)
  - Slip Joint Upper/ Lower Packer Hydraulic (inc/ dec)
  - Diverter Packer Pressure (inc/ dec)
  - Shaker/ Trip Tank Select valve – Shaker Open/Trip Tank Close – Shaker Close/Trip Tank Open
- 8- Gauges for the following:
  - Diverter packer regulated pressure
  - Diverter accumulator pressure
  - Diverter supply accumulator pressure
  - Diverter air supply pressure
  - Flowline seals pressure
  - Diverter manifold pressure
  - Slipjoint (pneumatic) pressure
  - Slipjoint (hydraulic) pressure

1 - Five (5) gallon separator bladder type accumulator for use as a surge dampener for the diverter packer.

2 – Fifteen (15) gallon separator bladder type accumulator for use as a backup supply for diverter skid

Complete with the necessary solenoid valves and pressure switches for remote operation of the diverter panel from the electrical panels. Pressure transducers are supplied for remote reading of gauge pressures.

Note: Loss of pneumatic supply pressure to the slipjoint packers will result in an automatic changeover to hydraulic pressure on the lower packer. This loss of pneumatic supply pressure and changeover to hydraulic supply will also generate an audible and visual alarm on the driller's and toolpushers's control panels.

NOTE: Valve position status to be based on valve limit switches, not pneumatic switches (where applicable)

#### D. Nitrogen Boost Pump Assembly

The Nitrogen Boost Pump is used to boost the nitrogen from supply bottles to the pressures required in the subsea accumulator bottles, to a maximum of 10,000 PSI.

#### E. Charging and Gauge Set

The charging and gauge set includes the necessary valve, gauge, hose and adapters to precharge with nitrogen the accumulators used in the BOP Control System.

## 2 Electric/Remote Control Equipment

### A. DRILLER'S CONTROL PANEL

The driller's control panel is a 316 stainless steel enclosure located near the driller's position on the rig floor. The driller's control panel will be suitable for use in a zone 1 area.

The panel consists of the following:

- Two 19" touchscreen operator interface terminals (OITs).
- Redundant Ethernet switches
- Redundant power supplies and distribution
- Hardwired buttons for push and hold to operate, lamp test, EDS activate and alarm acknowledge.
- Critical functions to have a pop-up window to confirm operation
- Selection of the desired emergency disconnect sequence will be via the touchscreen (5 EDS selections are provided).
- BOP control system alarms will also be annunciated (visually and audibly) on this panel. These alarms include UPS alarms (loss of main feed, UPS fault, circuit breaker tripped, etc).

### B. TOOL PUSHER'S PANEL

The toolpusher's control panel will be identical in functionality to the driller's control panel except that it is designed for safe area operation and it will contain the second PLC controller.

### C. CENTRAL CONTROL CONSOLE (CCC) AND ENGINEERING WORKSTATION (EWS)

Central Control Console (CCC) consists of a system configured to meet the requirements of providing a redundant communication platform for the control and monitoring of the subsea control pods. The system employs a main chassis containing the main processor, the dual power supplies, communication modules and the analog and digital I/O modules.

The Engineering Workstation (EWS) Master Panel provides the operator interface for the BOP stack status and alarm/fault logging functions. These include the following:

- Graphical representation of BOP stack and ancillary equipment status.
- Textual indication of alarm and fault conditions.
- Hard copy (to printer) of alarms and faults.
- Function Logger
- Event Log and Alarm Log to zip files into a drive.

The EWS Master Panel is comprised of one terminal that can display multiple screen designs with appropriate information data. The EWS communicates over dual Ethernet networks to duplicated redundant PLCs in order to determine system status. The EWS operates under the Windows operating system, a multi-tasking and networking operating system. As the operating system and application software are resident on the hard disk of the EWS, each will be capable of independent start-up and operation. The Communication to the CCC PLCs is via the Duplex Ethernet LAN.

The EWS Standby Panel is a replica of the EWS Master Panel.

The EWS Master Panel and the EWS Standby Panels are installed in separate custom-built rack assembly, suitable for safe area installation.

### 3 **Uninterruptible Power Supply (UPS)**

The dual UPS provides power conditioning for the MUX control System (does not include pump motors) and primary power requirements to subsea pods at 440VAC. Power distribution is configured so that either of the dual UPS's can supply the CCC and associated surface remote control panels as well as both subsea pods at 100%. Separate cabinets are provided for the following:

- UPS 1 and the distribution system
- UPS 2 and the distribution system
- UPS 1 batteries
- UPS 2 batteries

The equipment is designed for safe area mounting.

### 4 **Cable Reel**

A. Air powered cable reels, which are mounted on heavy duty oilfield skid. Complete with disc-type friction brake, air motor, local control panel and internal rotating J-box. Slip rings are hazardous area rated. Includes pin type lock system and automatic level wind. To include automatic tensioning device to maintain proper tension in the cable during deployment and retrieval.

B. 11,000 -foot length of multiplex cable. The cable shall provide a transmission media for power and communication for the subsea electronics package. The cable shall be complete with a polyurethane sheath and a pre-formed contra-helical double armor package.

C. Cable will be terminated with pressure balanced oil filled subsea connector with 4x 10 AWG electrical contacts and 8x fiber optic contacts.

### 5 **Mux Cable Sheave**

The full diameter sheave is designed to change the direction of the mux cable for deployment and retrieval. The sheave groove diameter is in excess of the minimum bend radius of the cable. The unit is equipped with a guard to prevent the cable from falling out of the sheave.

## 6 Clump Assembly

The clump assembly is designed with a hanging adjustable weight to remove the excess slack from the mux cable or the hotline hose after deployment. The partial radius sheave is designed with a series of smaller rollers on a radius in excess of the minimum bend radius.

## 7 Dual Cable & Hose Clamp Assemblies

Stainless Steel Dual Cable & Hose Clamp assemblies for attaching the two (2) Mux cables and hot line hose to the Marine Riser. Includes one (1) cable & hose clamp per cable and hose, per riser joint.

## 8 Hotline Hose Reel

- A. Air powered Hot Line Hose Reel, mounted on a heavy duty oilfield type skid, complete with air motor, drive sprocket, disc brakes, and automatic level wind. Swivel assembly is provided for hydraulic power. To include automatic tensioning device with manual override to maintain proper tension in the hose during deployment and retrieval.
- B. 11,000 ft of 1" 5000 psi hose.

## 9 Hotline Manifold Assembly

The manifold assembly is installed on the LMRP and is the termination for the Hot line hose. Two pilot operated valves direct the fluid to either of the two pods.

## 10 Hotline Hose Sheave

The full diameter sheave is designed to change the direction of the hotline hose for deployment and retrieval. The sheave groove diameter is in excess of the minimum bend radius of the hose. The unit is equipped with a guard to prevent the hose from falling out of the sheave.

## 11 Control Console- Remote, Three Reels

The remote control console will control up to three reels (two cable and one hotline hose).

## 12 Subsea MUX Control Pod

112 Line 12,000 Foot Capacity Subsea Control Pod is configured for high reliability and ease of service and maintenance and consists of three (3) sections: the Subsea Electronics Assembly (SEA) and the Electro-Hydraulic (E-H) and the Hydraulic section:

### A. Subsea Electronics Assembly (SEA)

The Subsea Electronics Assembly (SEA) controls the electro - hydraulic POD. It interfaces with the Central Control Console (CCC) through the subsea cables (fiber optic/ copper). The cable interfaces to the electronics through the one atmosphere subsea J-box. The cable supplies power and command signals. The subsea electronics processes the command signals and activates the respective solenoids contained in the electro-hydraulic section. All connectors and housing are sealed with double O-rings. O-ring test ports are provided in each case where the interface is at a differential pressure above that of the compensator. The SEA electronics consists of two assemblies each, containing power supplies, I/O modules, and modems. The electronics are housed within a one atmosphere enclosure. All openings are sealed with redundant seals. Test ports are provided to ensure that the seals are working properly.

### B. Electro-Hydraulic Section (E-H)

The Electro-Hydraulic (E-H) section houses the solenoids and pressure transducers. The E-H section consists of the following components:

Compensated chamber: This enclosure provides a mounting location for the solenoids and pressure transducers as well as the electrical connectors from the MUX umbilical, flow meter and stack mounted electronics. This chamber, once assembled is filled with dielectric fluid. Pressure Compensated Chamber to

house the solenoids and pressure transducers. The solenoids and pressure transducers are powered, controlled, and monitored through the SEA. A high pressure dual redundant electrical bulkhead connects the one atmosphere section to the E-H section. The E-H section is a compensated, dielectric assembly which provides additional reliability by providing a dielectric barrier between the solenoids and transducers and sea water.

### C. Hydraulic Section

The Hydraulic section is a non-fluid recovery type and consists of:

(1) 1-1/2" turbine flowmeter complete with pigtail for connection to pressure compensated electrical junction box.

Manifold to mount the Shaffer Sub Plate Mounted (SPM's) manifolds and valves. The SPM's are the primary control devices for directing hydraulic fluid to a specific BOP tack or LMRP function. The manifolds are mounted below the compensated chamber. One quarter inch tubing connects the CCSV's (solenoid valves) to the SPM's. High pressure hoses connect the SPM's. The fluid from the SPM is routed through the manifold to the male, which is permanently mounted below the manifold. The top portion of the male routes fluid to the LMRP functions. The hoses for the LMRP functions are connected directly to the male. For BOP stack functions, a quick disconnect interface is provided. This disconnect uses a ring receptacle that engages the males with seals attached. The BOP function hoses are connected to the receptacle. This receptacle is elevated when the pod is active and is lowered away from the male when the LMRP is to be disconnected.

The male stab is permanently attached to the pod. The male stab is complete with high-pressure packer seals and seal retainers.

(4) Filters, two (2) 10 micron to be connected in parallel for filtered supply pressure with bypass capability.

(2) 3 micron filters connected in parallel for filtered pilot pressure

(3) 2-1/2 gallon accumulators for pilot supply pressure storage.

(10) 1/2 gallon piston type accumulator bottles to be used as surge dampener/pilot supply on each regulator function.

(1) 1-1/2" stainless steel manual regulator for reducing 5,000 psi supply to 3,000 psi

(1) 1/2" stainless steel manual regulator for the pilot circuit

(5) 1-1/2" full flow hydraulic pressure reducing and regulating valves

- two (2) for regulating pressure to the annular preventers
- one (1) for regulating pressure to the BOP manifold
- one (1) for regulating pressure for the wellhead connector
- one (1) for regulating pressure for the LMRP connector

The pod will also have straight through passages.

The number of straight through passages will be determined by the stack configuration.

## 13 Pod Test Stand

The pod test stand provides the mechanical, hydraulic, electrical, communication and operator interface to the subsea control pod. The pod test stand is designed for installation in a safe area.

### Mechanical and Hydraulic Interface

The pod test stand incorporates a lower female carrier assembly with plugged hydraulic ports which accepts the pods male stabs and establishes a hydraulic seal with the lower pod stab outlets. The upper pod stab outlets are plugged after mounting in the seal carrier to seal the remainder of the pod hydraulic outputs. Hydraulic fluid supply and return to the pod test stand comes from the main HPU. The pod test stand is a heavy duty, oil field type skid with lifting provisions and includes the required hand control valves, pressure gauges, bleed valves, check valves, and filters to operate the pod hydraulic supply and return functions.

#### Electrical and Communication Interface

Electrical and communication to the pod is facilitated through the CCC simulator. The required electrical connectors, primary electrical power and communications connectors are provided with the CCC simulator and connected directly to the pod.

#### Operator Interface

The CCC simulator operator interface is a rugged industrial hand held device for exercising and confirms all functions of the pod.

### 14 Test Bench Assembly

The test bench assembly is designed to allow for testing of subsea control valves utilized on the 5th Generation MUX subsea control pod. The bench assembly consists of a painted carbon steel frame designed to house the control manifold, electric control j-box and provide interconnect points for electrical and hydraulic supply.

The manifold assembly consists of a hydraulic fluid supply filter, isolation and venting valves and control valves for test circuits as well as pressure monitoring gauges. Hydraulic fluid accumulators are also supplied for the regulator control loop and to provide a reservoir for the test fluid that flows through the valves and regulators being tested.

The manifold assembly is such that complete SPM valves and valve bodies (pockets) can be tested by bolting them to the test bench in the exact manner that they are integrated onto a pod. Additionally, manifolds are provided for testing the pod regulators. Also there is a 1" code 62 blinded flange connection port provided to allow a pressure tap point for test of other miscellaneous components. The test bench will have capacity for testing the following:

- One (1) 1-1/2" SPM 5th generation MUX pod valve body and valve assembly
- One (1) 1" SPM 5th generation MUX pod valve body and valve assembly
- One (1) 1/2" SPM 5th generation MUX pod valve body and valve assembly
- One (1) Compensated Chamber Solenoid Valve (CCSV) 5th generation MUX pod valve body and valve assembly
- One (1) 1/2" seal sub mounted HKR or MKR regulator assembly (pilot and connector)
- One (1) 1-1/4" seal sub mounted HKR or MKR regulator assembly (supply, manifold, shear, annular or manifold)

The manifold will be provided with blanks installed at the SPM valve body interfaces, the CCSV test interface and regulator interfaces. Control for the HKR regulators will be provided utilizing industry grade electrically controlled solenoid valves for ranging the regulators up and down. Additionally, a feedback loop is provided to confirm that the regulator can vent as well as supply fluid.

A test control j-box consisting of an on-off selector switch for operating the CCSV that controls the SPM and testing CCSV and a selector switch for operating the dedicated regulator solenoid valves. A power on/off switch and power on indicator are also provided.

The entire unit will be suitable for use in a non-hazardous environment with the enclosure and controls suitable for IP-55 environment.

### 15 CCC Simulator

CCC Simulator in conjunction with the Hand Held Monitor, and pod test stand, enables pod testing without the use of the Central Control Console.

### 16 Stack mounted Control Equipment

The following equipment is included in the stack mounted control equipment.

1- Lot Stack Mounted Accumulator Bottles, includes LMRP mounted bottles and shear circuit bottles.

Note: The actual accumulator quantity, size and type will be determined by Engineering to optimize the BOP Stack frame design to accommodate the BOP Stack accumulators. For any configuration of accumulator design, the total BOP Stack accumulator volume will always be equal or greater than the appropriate API 16D, 2nd Edition and ABS+CDS minimum accumulator sizing calculation.

Hydraulic Supply Manifold for control of both rigid conduit supply functions, consisting of :

- 2 1-1/2" SPM valve (normal close) for conduit flush.
- 4 1-1/2" SPM valves (normal open) for Pod and conduit isolation / supply.
- 1 1-1/2" SPM valve (normal open) for conduit crossover
- 1 2" SPM valve for ROV hotline reel interface.
- 2 ROV ball valves for flush valve backup
- 7 1/2" shuttle valves

Removed

1- Lot, SPM Valves mounted in valve pockets of BOP Stack / LMRP including:

- 1 1-1/2" SPM valve for accumulator isolator
- 3 1" SPM valves for accumulator dumps
- 2 1" SPM valves for accumulator isolators
- 1 Lot of shuttle valves and hoses for interconnecting manifold components

1- Lot, stack mounted control valves consisting of 1-1/2", 1", 3/4" and 1/4" shuttle valves and 1" SPM valves.

1- Lot, stack mounted control valves for the addition of the test BOP Functionality, including the following:

- 2 1" Shuttle Valve
- 4 1" 5000 PSI hydraulic hoses
- 4 1" SPM pockets mounted on the pods
- 4 1" SPM Valves mounted on the pods
- 4 Packer seals for SPM pockets mounted on the pods

4 CCSV solenoid valves and cables mounted on the pods

2 Pod Gripper

2 Sec Pod Gripper

1 Seacon Brantner CM2000 wet mate connection for use with the HPHT mounted on the BOP stack.

1 Spreader Bar for handling Pods.

## 17 Emergency Hydraulic Backup System (EHBS)

Shaffer Emergency Hydraulic Backup System (EHBS)(also referred to as Auto Shear Circuit), commonly called a "Deadman System" is an independent hydraulic control pod circuit mounted on the BOP stack. The system is actuated by the loss of hydraulic or electrical power to the pods. The EHBS active function is selectable by the operator from the BOP Control Panel. Either the Upper or Lower Pipe Shear Ram can be selected.

The EHBS is hydraulically powered from the stack-mounted Backup System Accumulator Bank and Shear Accumulator Bank. The Backup System Accumulator Bank provides the pilot signal pressure to all EHBS functions and supply pressure to all functions except shearing. All shearing function pressure is supplied from the Shear Accumulator Bank.

The EHBS system consists of the following major components:

- EHBS Assembly, housed in a steel frame attached to the BOP stack consisting of all EHBS SPM valves mounted on a single manifold, two regulators, shuttle valves, and inlet check valves. All inputs, outputs and manual valves are labeled. All manifold valve functions are stamped on the manifold.
- Removed
- Illuminated pushbuttons are CCC mounted to control activation of the Deadman Circuit; "Normal Operation/ Test" function for simulation of communication loss before stack deployment.



## 18 Acoustic Emergency Backup Control

Acoustic Emergency Backup Control System provides remote closure of certain BOP Stack functions. Acoustic Emergency Back-Up to consist of two (2) sections of control, Acoustic and Electrohydraulic.

System is sized for 4,000 meter water depth and consists of an Acoustic Electronic Section and an Electro-Hydraulic Control section.

Acoustic Function List

- See Section 3.16

### ACOUSTIC ELECTRONIC SECTION

Kongsberg ACS 534 system, MF Version / 4000 Meter

#### 1 ACU 30 MF

Portable Surface Acoustic Command and Control Unit for two way communication and operation of the ACS 500 family BOP control system. Operates on medium frequency. Splash proof design, with easy operation from buttons and a small LCD display. Two hands operation of critical BOP functions. Connector for interface to transducer. Internal rechargeable battery for several days' normal operation. Charges from 100 – 220 VAC.

#### 1 TDD 301 MF Dunking Transducer, with 70M cable on drum +/- 15 degree cone beam-width. Transducer connector for interface to the Portable Acoustic Command and Control unit, ACU 30.

#### 1 SCU 34 Acoustic Control Subsea Unit ,

Medium frequency, 24-26.5 kHz. Depth rated to 4000-meter. Fully redundant subsea container, with built in dual lithium, two year operating, batteries and electronics. Each electronic section has interface to dedicated transducer connectors (one for each). The electronics/transducers communicate with the surface system with individual acoustic addresses. Removed

#### 2 Subsea Transducer, Type TD 30V Narrow beam ( $\pm$ 15 degree cone). Depth rated to 4000 meters. Inclusive of 15 meter cable with GISMA connector

#### 1 E.1- BOP Simulator for testing of ACS Tool for on-deck-testing of the ACS before the BOP enters the sea. Connector and interface cable simulating solenoid drivers and read backs are standard. The connector mates directly into the ACS interface cable (solenoid end).

### ELECTROHYDRAULIC CONTROL SECTION

Shaffer Model NEH 20 S Electro-hydraulic mini pod to interface between acoustic system and a primary hydraulic BOP control system. The modularly constructed pod will consist of the following:

#### A. One (1) Stainless steel pressure compensated chamber. The chamber is filled with DC-200 dielectric insulating fluid and compensated by a one (1) gallon pressure compensator complete with a 5-psi relief valve.

The chamber is to contain:

- Six (6) CCSV environmentally protected solenoid actuators with operating voltage of nominal 24 volt DC at 0.3 amp. (One dummy solenoid plug is also provided).
- One (1) 30-pin connector, which includes the flanged connector receptacle and the cable connector plug. The plug will be supplied to the acoustic system supplier for inclusion in the interconnect cable. Cable shall be supplied by acoustic system manufacturer.

#### B. Four (4) double-piloted SPM valves to provide the hydraulic supply pressure to the selected stack function. These valves are mounted on a common supply pressure manifold.

#### C. One (1) Double piloted 1" SPM valve as described above.

- D. One (1) ten micron filtration assembly, complete with (P/N 15 23035) 1/4" check valve, for a filtered pilot pressure to the CCSV valve.
- E. One (1) one-gallon bladder type accumulator for supply pressure storage to the CCSV valves. F. The above assemblies will be mounted on an stainless steel mounting base complete with all required stainless steel tubing, fittings, and related plumbing.
- G. Six (6) 1" stainless steel fitted shuttle valves, five (5) for use with control functions above and one (1) for use with acoustic charge valve.
- H. One(1) 1" Stainless steel manual regulator for reducing 5,000 psi supply to 3,000 psi
- I. Two (2) hydraulic cylinders to be mounted on BOP stack with receiving hydrophones so that hydrophones can be extended beyond BOP stack for optimum acoustic command operation.

## 19 High Pressure and High Temperature (HPHT) Sensor

3-1/16" 15,000 psi Pressure and Temperature Sensor.

Standard Range: 0-20,000 PSI, 4-20 MA Input

Voltage: 18-36VDC MAX

Static Accuracy: +/-1% FS Combined Linearity, Hysteresis and Repeatability

Insulation Res: Greater than 10K Megohms at 50VDC at 70 DEG F.

Temp Range: +32 DEG F to +350 DEG F, 4-20MA Loop

Compensated: -32 DEG TO +350 DEG F

Temp Accuracy: +/-1% FS

3-1/16-15M API Flange Interface; NACE MR-0175; PSL-3, CRA Ring Groove.

## 20 High Pressure Test Unit

The BOP Test Unit assembly is a Hydrostatic Test Unit for testing BOP's, Valves, Manifolds, Riser lines, etc. The unit is a dual unit, capable of testing two separate operations with individual test pressures. The unit consist of a 3 HP 70 GPM fill pump, Two each 25 HP Triplex pumps for working in tandem at test pressure of 15,000 Psi or one at 15,000 Psi and one at 22,500 Psi. This also provides the ability to test using a pump system when one is isolated for maintenance, thereby redundancy is provided.

The pump system consists of the following items:

- 2 each triplex pumps (proprietary design) to provide > 5.7 GPM @ 15,000 Psi (working in tandem). Working singularly the pump will produce > 2.5 GPM @ 15,000 Psi.
- 2 each 25 HP, 440/460 Volt, 3 PH, 60 Hz, explosion proof electric motors. Explosion protection is Class 1, Division 1 &2, Group C&D Critical areas, Nema 7R, and Class II, Division 1 & 2, Groups E, F, & G. Motors are color coded for control panel ID.
- Normal maximum Test Pressure is 15,000/22,500 Psi, side A/B respectively.
- Full 6" Liquid Filled Gauges including two (2) each High Pressure Gauges 20,000 Psi and 30,000 Psi for High Pressure Testing (reference API RP 53).
- Low Pressure valving/gauging for Low Pressure test (0-1000 Psi with pressure limiting device).
- Small footprint, 84" Long x 36" Wide x 85" High. Panel has hinged doors to open for the triplex pumps located in front, the fill pump located in back, and valving location in back.
- Centrifugal Fill Pump 3 HP rated for 70 GPM. (Fill only)
- Autoclave valving and fittings for all high pressure lines.
- Cabinet is all stainless steel.
- Redundant High Pressure valving for wash-out and leakage protection.
- Twin ports for dual chart recorders, separate-side operation.
- 3 each Chart Records, one 30K, one 20K, and one 1K will be provided. These are mechanical with single red pin, 4-12 hour and battery powered. These include stands for mounting.
- 4 each test unit test hose, 2 @ 50', 2 @ 15', 3/8" HP 30K. 4:1 rated safety burst pattern with type M swivels.
- All ports are side mounted (right hand side) for easy connections.
- Auxiliary fluid supply connection for direct quick fill port, rated for 5K.
- Complete valving and gauges for different operational modes.

- Jog-boost capability for small test applications.
- Graphic Hydraulic Schematic Operator Panel (Stainless Steel) etched and color coded to match motor colors.
- Safety interlocking motor cover doors (front—auto shut-off when opened).
- 4” cartridge elements for filtering supply fluid medium.
- Unitized stainless steel panel/channel construction including frame and body panels.
- Industrial coated parts (all those not stainless steel)
- Operations warning strobe light kit, Amber, explosion proof caution light top mounted for safety.
- Complete fourteen (14) piece adaptor set stainless steel for type M swivel connections to various sized test piece outlets.

## 21 Riser Angle Install Package

Riser Inclination Sensor Assy consists of two sensor assemblies to determine Riser inclination. Sensors are located directly above the lower flexjoint.

## 22 Dual MUX Cable & Hot Line Assy

Dual MUX Cable & Hot Line Assy Storm Loop Support

## 23 Dual MUX Cable & Hot Line Assy w/Bracket

Dual MUX Cable & Hot Line Assy w/Bracket Storm Loop Support

## 24 Transportation to the Port of Houston

Transportation to the Port of Houston

## 25 Subsea BOP Control System (WLY) Documentation & Certification

**Product package consists of:**

- A) Manufacturing Record Book - Subsea BOP Control System (WLY)
- B) Document, Subsea BOP Control System, Removed

### From Section 8.04 of Quote 115876 (Riser)

#### 14 Riser Spider/ Riser Running Tool Control Panel

Riser Spider/ Riser Running Tool Control Panel

The control panel is designed to be located on the rig floor and operate the riser tools used on the rig floor during the running and retrieval of the riser equipment. The panel is designed to be powered by the rig floor hydraulic ring circuit. The panel is equipped with gauges, selection valves, and a manifold pressure reducing valve. The panel is used to operate the following tools and accessories:

- Riser Spider- the panel will control the direction and the speed of the spider support dogs and is equipped with a flow control valve to control the speed of the spider dogs. Two 25 meter (82 feet) long non-fireproof interconnecting hoses with quick disconnects are supplied for connection to the riser spider.
- Hydraulic Riser Running Tool- the panel is designed to be used as the primary or a backup control system for the hydraulic riser running tool. The panel requires the operation of two functions (unlock and the pilot) to unlock the riser running tool. The connection hoses from the panel to the riser running tool are to be supplied by others.
- Riser Makeup/ Breakout Tools- the panel is equipped with ports to supply hydraulic power for two Riser Makeup/ Breakout Tools. The connection hoses are supplied with the Riser Makeup/ Breakout Tools

Note: The panel is equipped with an interlock which prevents the unlocking of the riser running tool (from this panel) while the riser spider support dogs are in the retract mode.

#### 17 Telescopic Joint/ Tensioner Ring Control Panel

The control panel is designed to be located in the moon pool area and operate the following riser components during the running and retrieval of the riser system. The panel is designed to be operated with BOP control fluid (from the BOP Control System HPU). All returned fluids used in operations are to be dumped to prevent unnecessary contamination of the BOP Control Fluid. The panel is equipped with gauges, selection valves, a pneumatic pressure reducing valve, and a hydraulic manifold pressure reducing valve. The panel is used to operate the following tools:

- Telescopic Joint- the panel will control the inner/ outer barrel lock (pneumatic).
- Tensioner Ring- the panel will control the tensioning ring lock to the diverter housing and the tensioning ring lock to the telescopic joint.

No umbilical hoses are supplied with this panel.