# MACONDO

## MC252-1

# Well Integrity Test

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# ATTACHMENTS



# REFERENCE DOCUMENTS

| | |
|---|---|
| Reference 1: | Q4000 procedure 4154 Sec 3.2 – Planned Short Term shut down |
| Reference 2: | HP-1 Normal Shutdown of the CDP System (procedure 4211, Sec 7.1.2) |
| Reference 3: | Capping Stack Close-In and Pressure Monitoring–ROV Procedures #4242 |
| Reference 4: | Enterprise Top Hat 7 (TH7) ops note |

| | |
|---|---|
| Reference 5: | 4242 Capping Stack ROV Procedures |
| Reference 6: | 4512 Capping Stack Integrity Monitoring Procedure |
| Reference 7: | Approved fieldwide production management schedule |
| Reference 8: | Offshore Air Monitoring Plan for Source Control, Doc. 4002 |

# 1 Well Integrity Test Procedure (Base Plan)

## 1.1. Introduction and Scope

This document covers the well integrity test once the 3 Ram Capping Stack is installed on the Horizon BOP stack. The configuration of the 3 RAM Capping Stack at the onset of this procedure is as shown in Figure 1 (choke open and outer valves are closed). After the well integrity test, the system will remain as is or vented at seawater ambient pressure to selected containment vessels. Flowrate ramp up will occur through an approved fieldwide production management schedule.

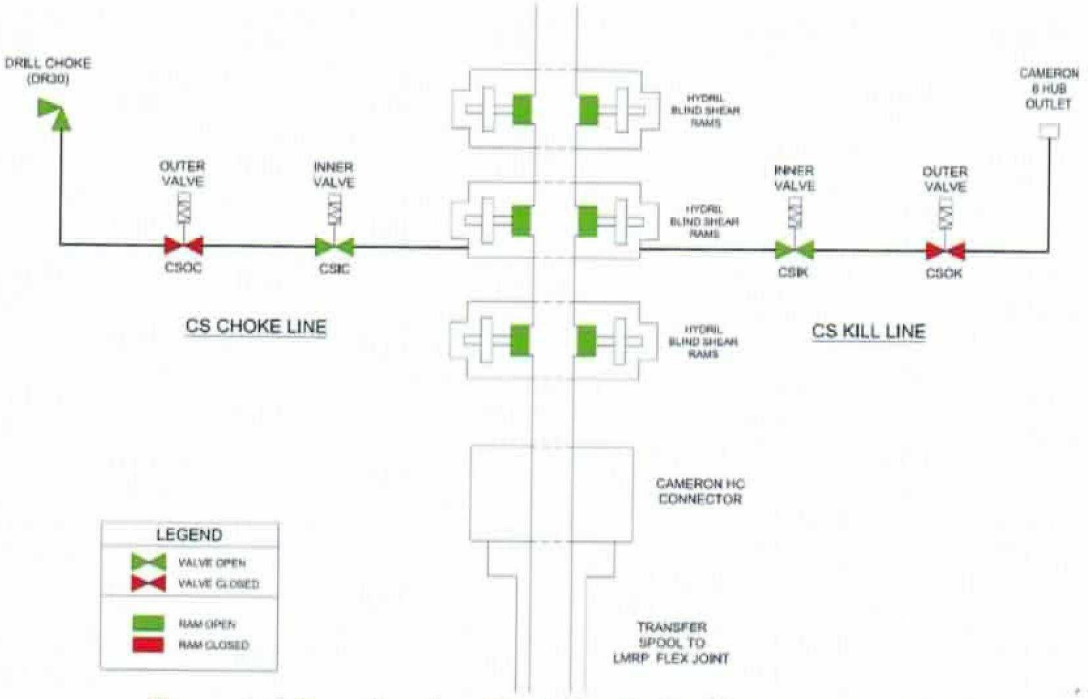



**Figure 1: 3 Ram Capping Stack Ready for Well Integrity Activity**

The scope of this procedure is:

- To ramp down the HP1 and Q4000 and leave these containment vessels on startup mode.
- To ramp down flow by choke increments and collect capping stack pressure data and respective choke size data.
- To collect pressure data from the Horizon BOP stack.
- To be prepared to reinitiate flow to containment vessels HP1, Enterprise, and the Q4000.

## 1.2. Assumptions / Well Status

1. 3 RAM capping stack (CS) has been installed as per Attachment 2 and is ready for the integrity test.
2. Capping stack running equipment including the perforated riser joint running tool and Cameron mini connector on the Capping stack kill line have been removed.
3. Outer choke and kill line valves on capping stack are both closed and CS RAMs are all open.
4. Drill choke (DR30) is installed on the end of the CS choke line and is in the open position.
5. Full flow exiting top of the CS.
6. The subsea accumulator package has been recharged as some hydraulics will have just been used to latch the capping stack via the HC connector and will further be used to function RAMs on the capping stack and operate the CS choke and kill valves.
7. Baseline seismic has been run.
8. Fire boats are on station and communication protocol has been established with all involved vessels.
9. Boats are ready for subsea and surface dispersant application to handle step rate increase in well flow.
10. Pressure gauges on CS are installed and functioning with surface readout.
11. Net Meeting valve position screen up and available.
12. ROV monitoring plan of stack and sea bed is in place and functioning.
13. The pressure gauge at bottom of Horizon BOP stack reads 966-psi too low.
14. **After seismic data runs ensure that all ROV's are on station gathering baseline data and that data is being transmitted via Process Net prior to initiating the Well Integrity Test.**
15. There is an ROV available with glycol injection.

## 1.3. Objectives

1. Shut-in well to determine Well Integrity status.
2. Collect data during the test that will facilitate the forward decision to extend or cease the tests.

## 1.4. HSSE Considerations

1. IMT SIMOPS director to be notified that the integrity test is going to commence and the HP1 and Q4000 are on standby for restart.
2. Confirm the fire boats are on station.

3. Make sure key personnel know their roles and are in place and ready to go, both onshore and offshore.
4. All considerations regarding protecting personnel have been addressed.
5. Follow proper incident notification plan.
6. Monitor VOCs/LELs per source control document 2200-T2-DO-PR-4002 and surface dispersant standing order for oil accumulations under and around containment or collection vessels from IMT Houston Safety office dated July 7, 2010.

### 1.5. Key Risks

1. Horizon stack integrity: Capping stack additional weight and higher Horizon BOP pressures.
2. Sea floor breach due to uncontained flow beyond the 18-in shoe.
3. Choke and kill valve and associated choke functions.
4. SIMOPS of the ROV vessels.
5. Visibility for ROV operations.
6. Battery life for the Horizon BOP stack and 3 RAM CS gauges.
7. Increased VOCs/LELs during capping stack operations.
8. CS middle RAM washout during RAM closure portion of Well Integrity Test Procedure.

## 2 Well Integrity Test

Start of execution of the well integrity test requires authorization of VP of Containment, Richard Lynch. Prior to starting implementation of this procedure, Well Integrity Test SPA, Trevor Hill, is in place and ready in the HIVE. Information to be disseminated per Attachment 1: ROV Roles and Responsibilities.

### 2.1. Isolate Q4000 and/or HP1

#### *2.1.1. Isolate Q4000*

1. Ramp down and stop Q4000 containment following the steps below,
   a. Shut down well test operations by closing the flow line wing valve (SDV-001) on the surface flow head.
   b. Follow "Normal Shutdown Procedure" to complete the Well Test Equipment shutdown in a controlled manner. Follow this step by step.
   c. Bypass PSLs:
2. At the master panel bypass the PSLs on the flowline segments downstream of the choke manifold.
3. Bypass the separators PSL at the separator ESD panel.

4. Raise the gas meter orifice plate:
5. Raise the orifice plate in the Daniels orifice meter.
6. Notify BP Rep. and control room of upcoming shut in:
7. Notify the BP Rep. of the planned shut in.
8. Notify the Dynamic Positioning Officer (DPO) of the planned shut in.
9. After completing long term shut-in procedure, close valve V2 and V3 on the choke/ kill manifold with ROV.

#### *2.1.2. Isolate HP-1*

1. Ramp down and stop HP-1 containment Reference HP-1 Normal Shutdown of the CDP System (procedure 2200-T2-DO-PR-4211, Section 7.1.2).
2. After completing 2200-T2-DO-PR-4211, close valve V7 and V8 on the choke/kill manifold with ROV.
3. Monitor subsea pressures.

**Note: At this point HP-1 Operations advisor should communicate directly with Well Integrity Test SPA, as well as Q4000 Wellsite Leader.**

### 2.2. Manipulate 3 Ram Capping Stack for Well Integrity Test

**Note: Reference procedure "2200-T2-DO-PR-4242 Capping Stack ROV Procedures" for any opening/closing of the choke line or kill line valves and operating CS Rams.**

1. Open outer choke line valve (CSOC) on 3 Ram Capping Stack.
2. Open outer kill line valve (CSOK) on 3 Ram Capping Stack.
3. Confirm DR30 choke on the choke line of the 3 Ram Capping Stack is fully open. Reference document 2200-T2-DO-PR-4242 for operating detail of the DR30 choke. The Capping Stack installation team will provide an Ops Note to ensure that Choke Valve is fully open during landing/installation.
4. Close the middle ram on 3 Ram Capping Stack, leaving uncollected hydrocarbons venting to sea through the 3-in CS choke and kill lines.
5. Record pressure in 3 Ram Capping Stack and base of Horizon BOP with CS ram closed.

**Note: Point forward, the duration of pressure measurements will be determined by Well Integrity Test SPA.**

6. Close the CS outer kill line valve (CSOK).
7. Use hose to fill 3 Ram CS kill line between outer isolation kill valve (CSOK) and 3-in Cameron connector with glycol.
8. Record pressure in 3 Ram Capping Stack before starting to close DR30 choke on choke line.

**Note:** **Pressure under closed CS ram could rise by up to 500-psi depending on flow rate. In this event containment start-up would occur above seabed ambient pressure.**

**Note:** **Prior to continuing this procedure, monitor and record pressure as per Well Integrity Test SPA.**

9. DR30 choke closure increments and timescales for subsequent progress to test well integrity will be provided by Well Integrity Test SPA observing build up of pressure at base of Horizon BOP and in 3 Ram Capping Stack (Record pressures at each location). See attachment 5 for DR30 choke diagram. Choke increments will be made in steps of one half turn, or of one full turn. The step amount will be followed by a request 'to open' or 'to close'.

10. Observe for any gross leakage on Horizon BOP, 3 Ram Capping Stack, or seabed. ROVs will be monitoring the Horizon BOP body, the capping stack, and the sea bed during the integrity testing period. Be prepared to open, as directed by Well Integrity Test SPA, the DR30 choke if any leakage occurs on Horizon BOP, 3 Ram Capping Stack, or seabed, or if pressure at base of Horizon BOP does not rise as expected. Ensure that ROV has good hold on 3 Ram Capping Stack at all times.

## 2.3. Monitoring Requirements Overview

The monitoring requirements associated with the Well Integrity Test involve four distinct areas of information collection and surveillance as follows:

- Sensor Data Collection and Transmission
- Seabed Condition Monitoring
- Activity Record Logging and Timekeeping
- Capping Stack and BOP Assembly Condition Monitoring

The specifics are summarized below with reference to attached detailed procedures. The initiation of the monitoring according to the detailed procedures is a prerequisite for the Well Integrity Test as highlighted in Section 1.2.

### *2.3.1. Sensor Data Collection and Transmission*

Pressure gauges on the Horizon BOP and 3-Ram Capping Stack will provide essential readings that will be transmitted acoustically to ROVs for onward transmission to the offshore network and back to Houston for viewing and historization on ProcessNet. One independent single pressure transmitter is integral to the BOP, whereas a dual pressure and a separate single pressure hot stab are installed on the 3-Ram Stack. Real-time information from ProcessNet will be continuously displayed in the ROV Room. Accurate and reliable pressure measurements are central to the entire Well Integrity Test activity.

### *2.3.2. Seabed Condition Monitoring*

Seabed monitoring is aimed at detecting broaches to sea, which although unlikely, could result from the Test.

A minimum of one seismic pass, is to be attempted by the Geco Topaz prior to the shut-in cap being closed. Data are to be acquired early enough to allow data to be sent ashore

for processing and provide a reasonable time to be able to see processed results prior to shut-in commencing. If the newly acquired seismic data, either immediately in the field from quality control displays or from processed results onshore, provide clear evidence of existing underground broaching then the decision to start commence shut-in shall be reviewed.

Procedures are in place to provide regular ROV Sonar search imagery from various points within a radius of 1500-ft of the BOP and periodically from ROVs at the BOP itself to check for indications of seafloor breakout. Any new anomalies identified will be investigated immediately unless this requires an ROV allocated to an essential task at the BOP leaving its station.

### 2.3.3. *Activity Record Logging and Timekeeping*

Throughout the duration of the Well Integrity Test, an engineer will be positioned within the ROV Room to maintain a comprehensive log and time history of the operation. The objective will be to record all actions, observations, times, and parties associated with each step of the Test procedure. Principal information elements will include:

- Data system status and changes
- Data readings summary including notable changes
- Valve status
- Reports/information from seabed monitoring
- Reports/information from capping stack and BOP monitoring
- Hydrate issues and remediation
- Relevant printouts
- ROV assignments
- Containment vessels status/actions

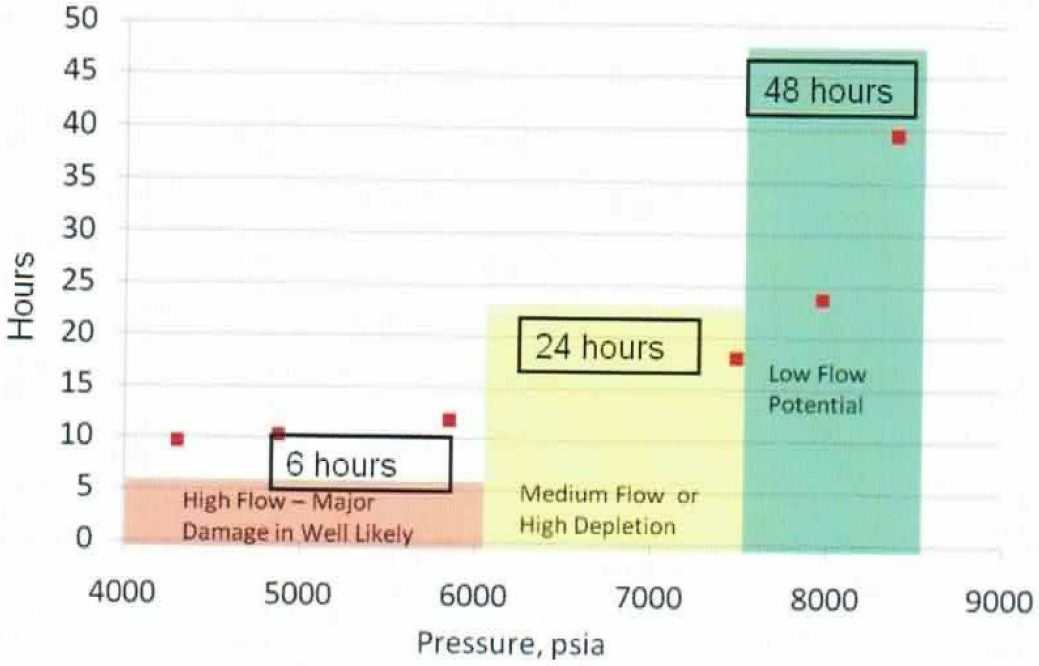
### 2.3.4. *Capping Stack and BOP Assembly Condition Monitoring*

Inspection and monitoring requirements for the 3-Ram Capping Stack and BOP Assembly are in place to confirm ongoing integrity after installation. This involves leak surveillance and the periodic checking of the Assembly's tilt angle. The required inspection and monitoring will take place by ROV according to "Capping Stack Integrity Monitoring Procedure," Doc. No. 2200-T2-DO-PR-4512.

## 2.4. Testing Well for Integrity

1. The duration of the integrity test will be determined in consultation with the DOE, DOI, Federal Scientific Technical Team, BOEMRE, USCG, and direct dialog with Secretary Salazar, Secretary Chu and their offices.
2. The duration will be guided by Figure 2 Well Integrity Test Duration. In the event that the pressure does not reach 6,000 psi then the test may be stopped within 6 hours.

3. The consultations with the above agencies will take place sometime before the end of the 6hours, 24hours or 48hours period as appropriate and the Well Integrity Test SPA will inform the team of the decision from that consultation.
4. Choking back the well will be undertaken gradually. The range of expected 3 Ram Capping Stack pressures, and the time to reach those pressures, is affected by the magnitude of reservoir pressure depletion, the flow rate prior to choking back, and the rate of choking back.
5. Potential Outcomes
   a. Guidance on allowable well integrity test duration has been developed in consultation with the DOE, DOI, Federal Scientific Technical Team, BOEMRE and the USCG. The guidance is represented in Figure 2.
   b. If the 3 Ram Capping Stack pressure appears to plateau in the red zone (Figure 2), which is less than 6,000-psi, ensure that the pressure is reduced to ambient within six hours from start of integrity test and be prepared to ramp back up production with the Q4000 and HP1. Pressure will be reduced to ambient by fully opening the DR30 choke on the CS choke line and the CSOK valve. Ramp up the flowrate through an approved fieldwide production management schedule.
   c. If the 3 Ram Capping Stack pressure appears to plateau in the yellow zone (Figure 2), which is between 6,000 to 7,500, a decision on how to proceed will be communicated through the Well Integrity Test SPA.
   d. If the 3 Ram Capping Stack pressure appears to plateau in the green zone, which is between 7,500 to 8,900, a decision on how long to test well integrity will be communicated through the Well Integrity Test SPA.
   e. If the 3 Ram Capping Stack pressure exceeds 8,900-psi, or at any time breaks over, operations will shift back to hydrocarbon recovery at Q4000 and HP1. Pressure will be reduced slowly by opening up the choke on the 3 Ram Capping Stack while preparing to ramp up the flowrate using the approved fieldwide production management schedule.
   f. If the well cannot be returned to ambient pressure by opening the choke and kill lines, open the Direct Vent on the CDP manifold. If HP1 has not been commissioned; the Q4000 will be the primary relief vessel to restart of containment efforts per the approved fieldwide production management schedule. If commissioned, the HP-1 will be the primary restart vessel.
   g. As a contingency if the choke will not open, the H4 connector option from the Enterprise would be to used to equalize pressure and allow the rams to be opened and pressure relieved to the Enterprise Flowback spread.
   h. If communications between Well Integrity Test SPA and field are lost during well integrity operations undertake no further choke movements until communication is restored.
6. Continue observation of nearby seabed (1500-ft radius) with ROVs for signs of breaching.




Duration (in hours) calculated by National Labs flow analysts using estimated leak flow rates at varying BOP (PT-B) pressures and maximum allowable flow into formation of 20,000 bbls.

**Figure 2:** Well Integrity Test Duration Guidance

7. At this stage the Well Integrity Test SPA and containment leadership will determine any necessary additional steps of the well integrity test procedure and/or steps to return to containment operations.

# 3 Re-initiation of Containment Operations

If there is a requirement to re-open the well, then the issue of sand control needs to be carefully managed.

A separate schedule will be provided for choke charges on re-opening. For plateau above 6,000-psi the time required to reopen fully may be more than a day.

Re-initiation steps assume operations at ambient seabed conditions. If conditions are not at ambient, please refer to Ops Note Restarting Containment Operations at Higher Than Ambient Pressure (2200-T2-DO-PR-4565) for restart instructions.

## 3.1. HP-1 Restart

1. Have ROV open V7 and V8 on CK Manifold
2. Initiate flow to HP-1 per procedure 2200-T2-DO-PR-4213 – Section 7.2 – Start-Up

### 3.2. Q4000 Restart

1. Open RIV on LDIS
2. Have ROV open V2 and V3 valve on CK Manifold
3. Initiate flow to the Q4000 per procedure 2200-T2-DO-PR-4154 – Section 3.4 – Restart After Shutdown

## Optional Plans

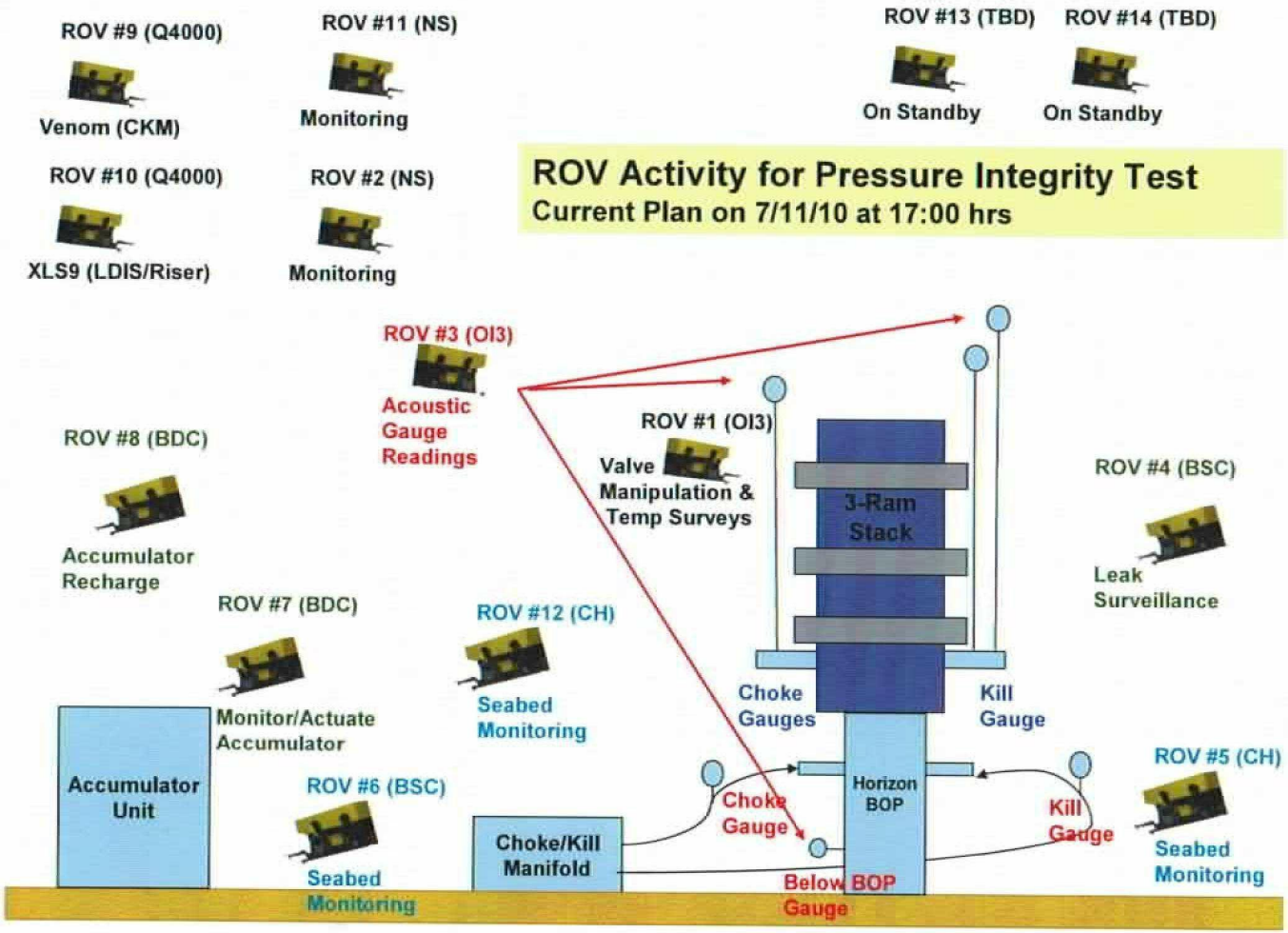
### 4.1. Backup Choke Plan

In the event the well integrity test cannot be successfully completed with the drilling choke (DR30) due to a mechanical failure, a backup production choke (CC40) will be installed by ROV on the CS kill line Cameron #6 Hub. The remaining steps of the well integrity test will then take place on the CS Kill Line via the production choke (CC40)

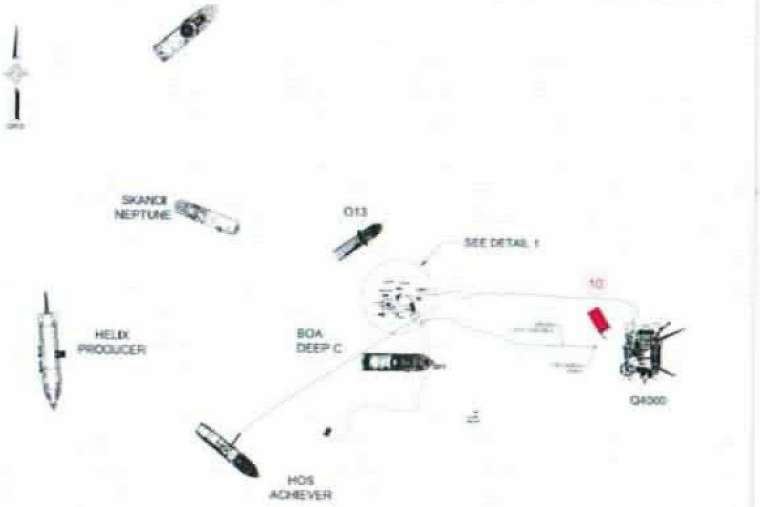
### 4.2. Total Flow Measurement

If HP1 commissioning is completed in parallel with 3 Ram Capping Stack installation, or in the event of any difficulties with completing that installation, it may be possible to measure the total flow rate with HP1, Q4000 and Enterprise prior to completing the well integrity test. Enterprise is currently planning to use Top Hat 7 (TH7) to complete this activity.

## Attachment 1 – ROV Roles and Responsibilities



# ROV ACTIVITY FOR PRESSURE INTEGRITY TEST

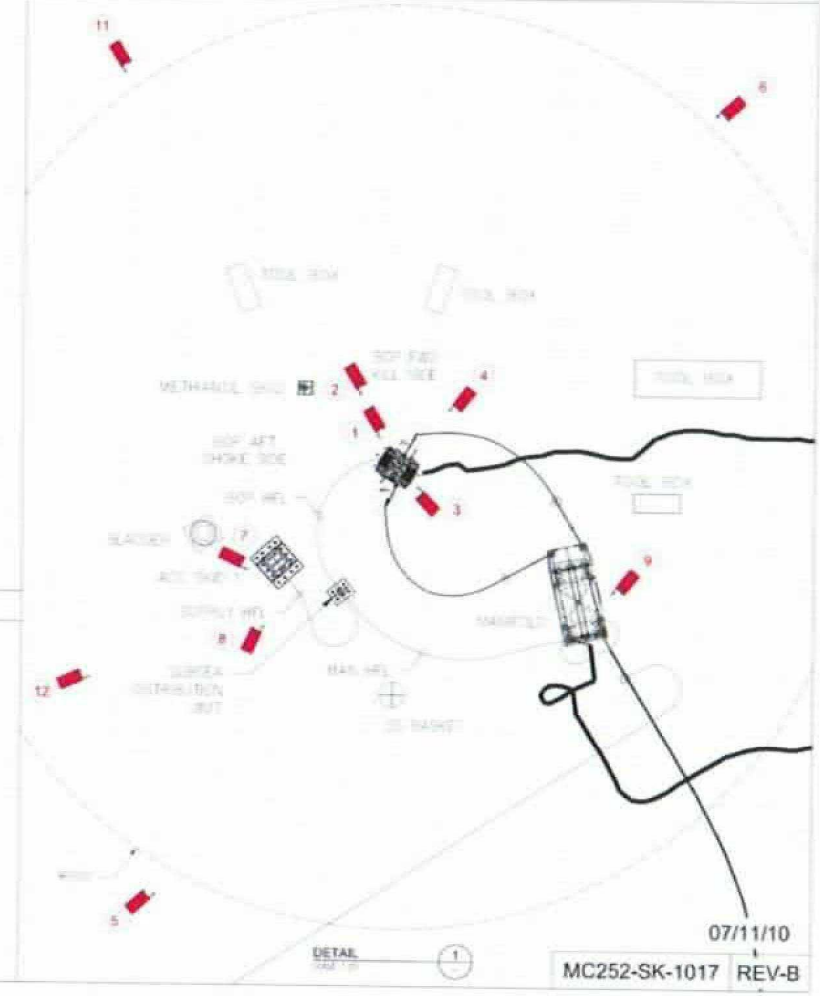



PLAN VIEW

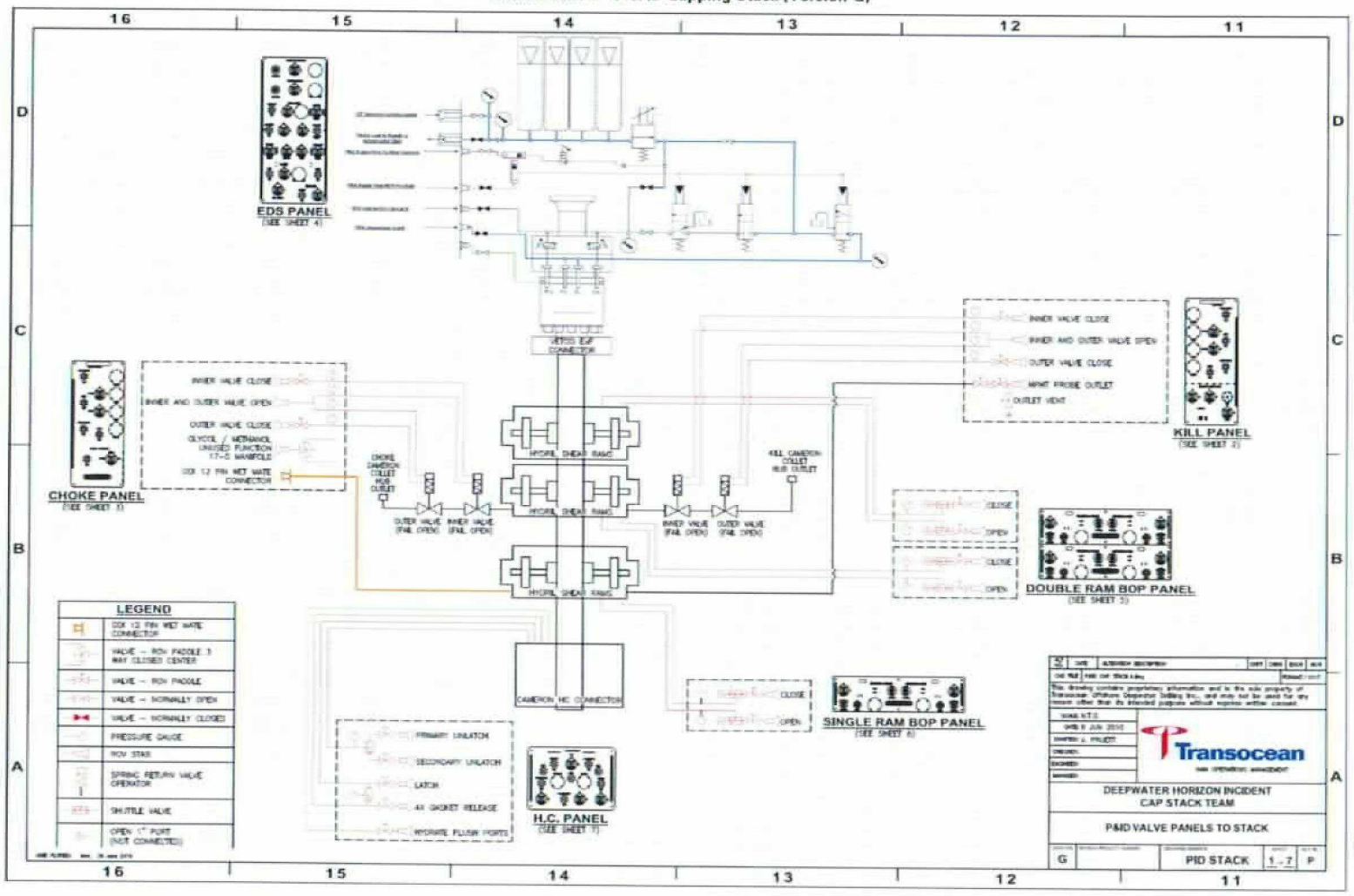
LEGEND

| ROV # | VESSEL |
|---|---|
| 1 | O13 |
| 2 | SKANDI NEPTUNE |
| 3 | O13 |
| 4 | BOA SUB C |
| 5 | OLYMPIC CHALLENGER |
| 6 | BOA SUB C |
| 7 | BOA DEEP C |
| 8 | BOA DEEP C |
| 9 | Q4000 |
| 10 | Q4000 |
| 11 | SKANDI NEPTUNE |
| 12 | OLYMPIC CHALLENGER |
| 13 | TBD |
| 14 | TBD |

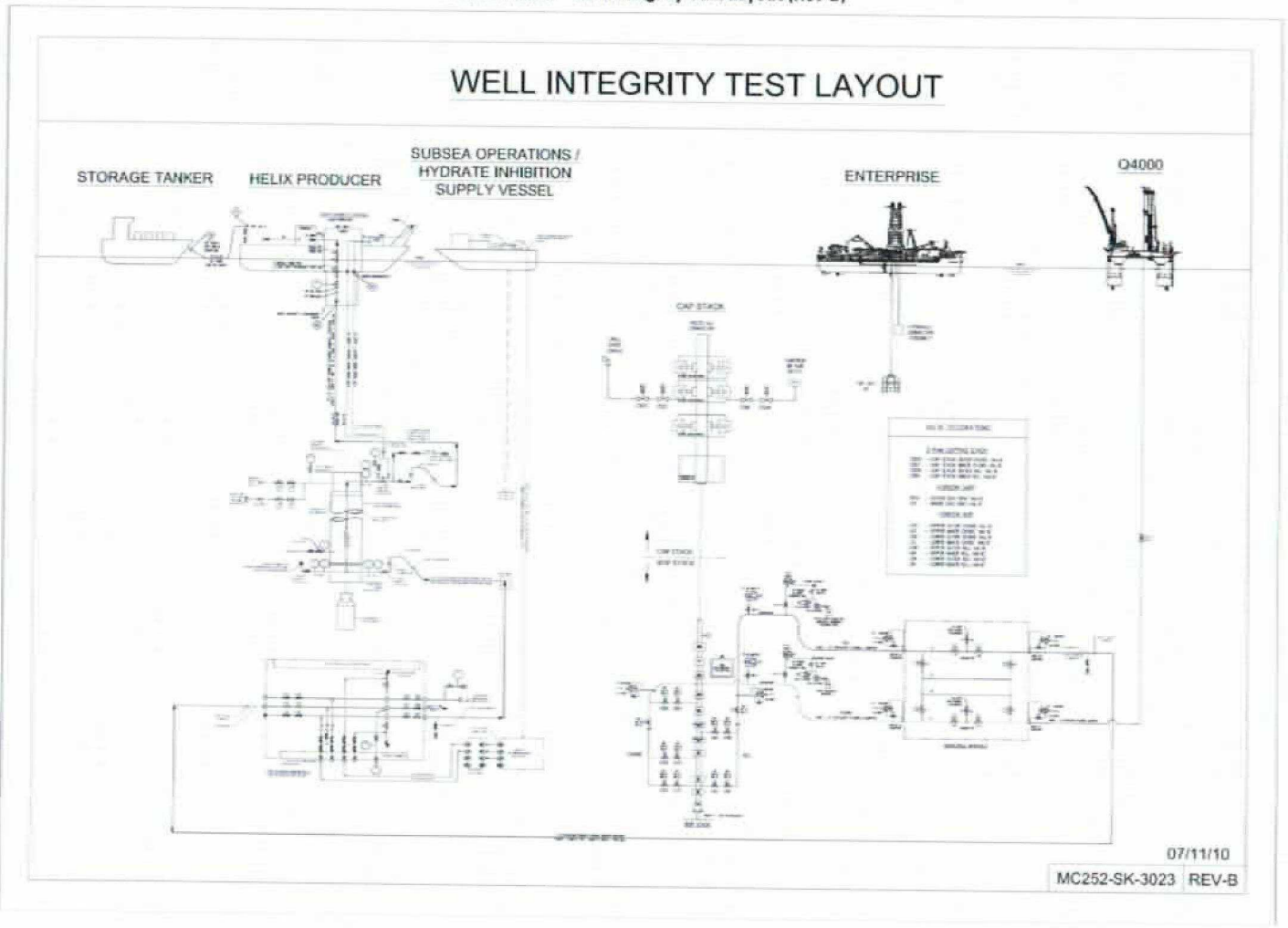
ROV



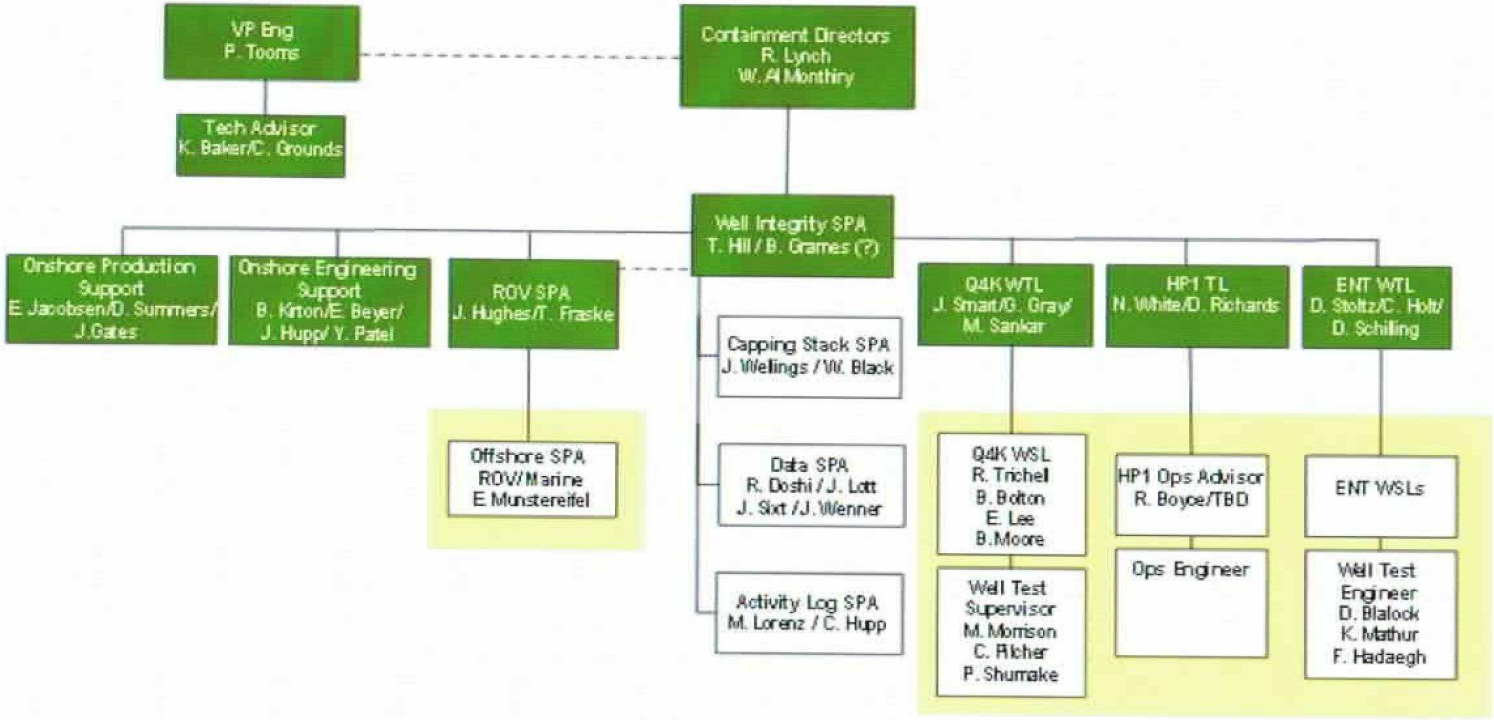
**Attachment 2 – P & ID Capping Stack (Version G)**



**Attachment 3 – Well Integrity Test Layout (Rev B)**



**Attachment 4 – Well Integrity Test Organization Chart**



## Attachment 5 – Cameron DR30 Choke Assembly

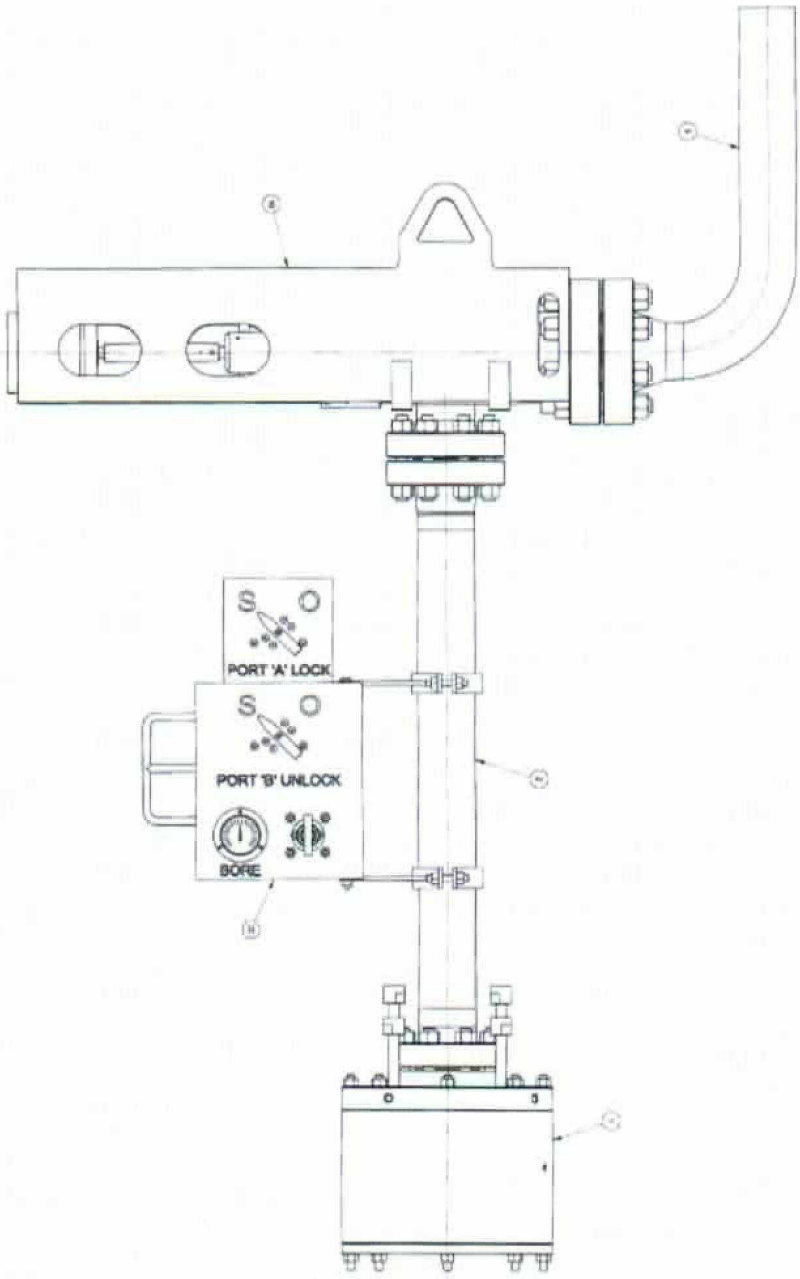
### DR30 Choke Assembly

Description D30 Choke Assembly

The choke is a Cameron Willis Model DR30 drilling choke. This is a surface drilling choke which was modified with an ROV torque interface bucket, Cameron 3"Mini Connector and associated ROV panel.

This Choke is not fitted with a position indicator; position will need to be managed by counting turns.


Modified DR30 Choke Assembly




Arrangement Modified DR30 Choke Assembly.

Cameron Part No. 2330236-09
Cameron Drawing Number SK-171594-09
Weight (Choke complete assembly including Spool and Mini Connector) = 4015 pounds
Pressure rating 15,000 PSI (Or Flange rating if lower)
Trim Design Gate & Seat

Max orifice size 3.0 inch or 192/64 and maximum Cv = 185
Inlet flange 3-1/16" x 15,000 psi
Outlet flange 4-1/16 x 15000 psi
Gate travel 2.3 Inches
Turns 18-3/4 Turns, fully open to closed.
ROV Interface Manipulator Only No Torque Tools.

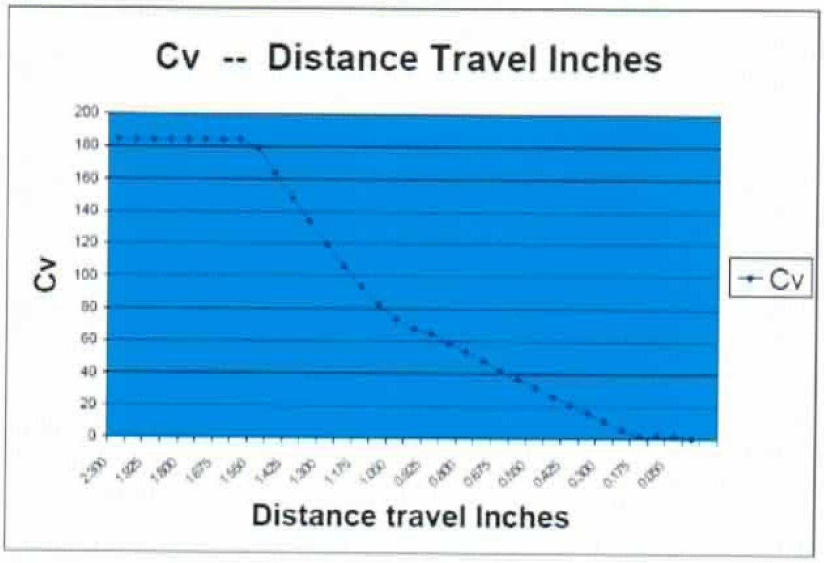
Standard Class 1 or 2 ROV interface (Class 1 and 2 are the same) The end effector is 3/4 inch square In order to limit torque applied to choke the actuator is fitted with a "T" handle, this is the preferred method of actuating the choke.

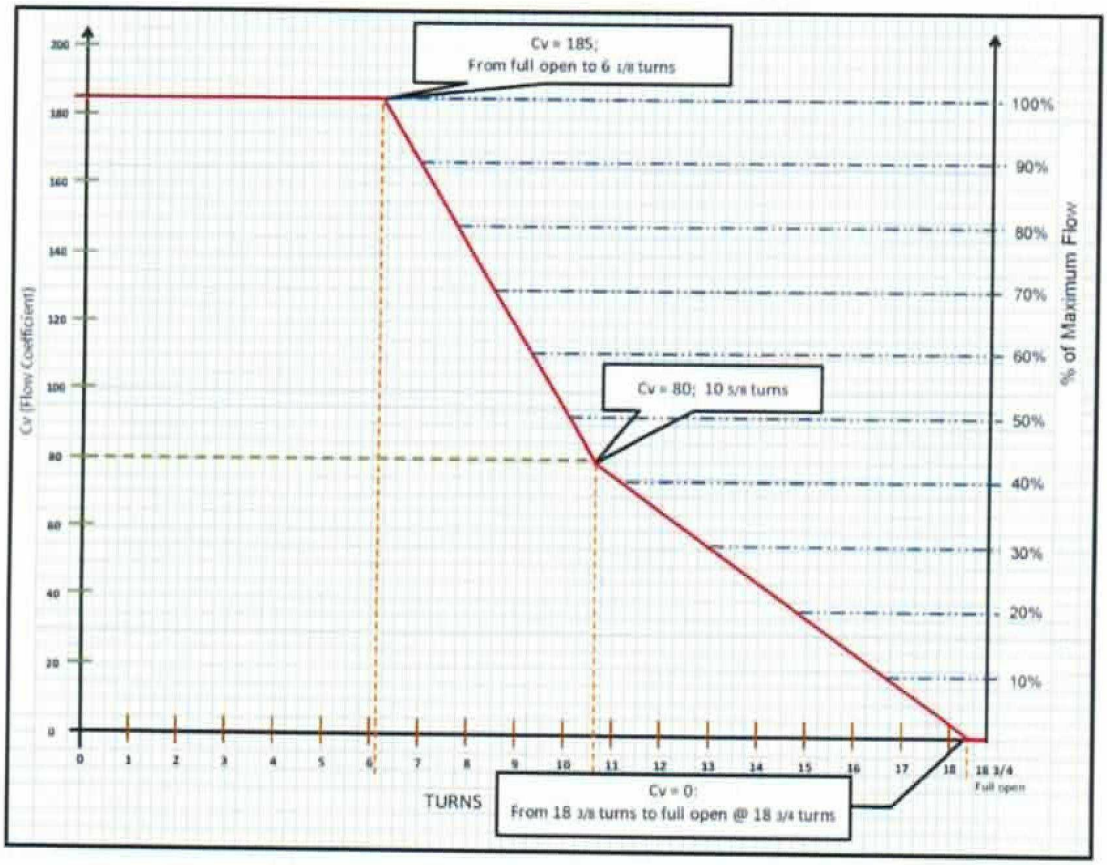
Close Clockwise
Open Counter Clockwise
Operating Torque 120 Foot Pounds
Maximum Torque 250 Foot pounds


ROV Interface


ROV "T" Handle

"T" Handle fitted to ROV actuator



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| | Bill Kirton **Surface Engineer Team Lead** | Bill Kirton | 11/08/10 |
| | George Gray / Mannie Sankar / John Smart **Operations WTL** | John C Smart | 11 July 10 |
| | Mike Byrd / John Hughes / Troy Fraske **Manager BOP / ROV ops** | | July 11, 2010 |
| | Eric Jacobsen / Dawn Summers **Operations Manager** | Dawn Summers | July 11, 2010 |
| | Trevor Hill **Well Integrity Test SPA** | Trevor J Hill | JULY, 11, 2010 |
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