



Demonstrating the UK's Oil Spill Response Capability

Report on Exercise Sula Tier 2/3 Deployment Demonstration and the
Emergency Equipment Response Deployment Exercise

Summer 2011

Contact information:

For more information on the Exercise Sula Tier 2 / 3 Deployment Demonstration and the separate Emergency Equipment Response Deployment (EERD) exercise, you can contact Oil & Gas UK at the following address:

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Although several companies are named in this report, the inclusion of their details does not constitute approval, endorsement, or preference of these companies to carry out oil spill response activities.

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Section 1 - Background

The Oil Pollution Preparedness, Response and Cooperation Convention (OPRC Convention) came into force in the United Kingdom (UK) on 16 December 1997 and was implemented through OPRC Regulations in 1998.

The OPRC Convention requires that the UK has national and regional systems in place for oil pollution incident preparedness and response and that ships and operators of offshore installations under UK jurisdiction have Oil Pollution Emergency Plans (OPEPs) which are coordinated with the National Contingency Plan.

As the regulator responsible for the approval of OPEPs for offshore installations, DECC issued Guidance Notes to Operators of UK Offshore Oil and Gas Installations (including pipelines) on OPEP Requirements in 2009. This Guidance states:

Operators must ensure that their Tier 2/3 oil response equipment and resources are tested and deployed every five years.

It is recognised that many operators utilise the same response company and therefore each response company need only be tested once in every five years on behalf of each operator holding a contract with them. Results will be collated by the operator undertaking the exercise and feedback and learning will be shared with other operators contracted to the same response company. DECC's Offshore Inspectorate Unit must be made aware of exercises taking place and be provided with a copy of the final exercise report.

If applicable, this requirement may be completed at the time of a NCP exercise involving the Offshore Oil and Gas industry if within the five yearly interval period.

The concept of a 'Tiered Response' to oil pollution incidents is enshrined in the National Contingency Plan and is intended to allow a response to be escalated from Tier to Tier in response to an escalating (or diminishing) situation as follows:

Tier 1: A Tier 1 response is the lowest response level and requires resources to be available locally. Depending on the characteristics of the oil this may or may not include the use of dispersants. By definition these resources must be at or near the incident site. It is expected that these resources will be deployed as quickly as operational circumstances allow.

Tier 2: For larger pollution incidents, local resources may be insufficient to deliver a proper response. In these cases it may be that resources from a regional centre will be required. A key component of UK offshore Tier 2 response is that operators are expected to have this capability mobilised and applied within 2 to 6 hours of an oil pollution incident.

Tier 3: For very large pollution incidents, resources supplied from national and international sources may be required. A key component of UK offshore Tier 3 response is that operators are expected to have this capability mobilised and applied within 6 to 18 hours of an oil pollution incident.

In addition to this requirement, DECC have stated that any spill response techniques declared in an OPEP must have been subject to a deployment demonstration in the UK.

Section 2 - Exercise SULA

As a result of the oil spill from the Macondo incident in the Gulf of Mexico, UK Government decided to test the National Contingency Plan with a similar spill scenario on the UKCS. Exercise 'SULA' was developed to test the UK's capability to respond to a deepwater drilling related oil spill to the West of Shetland. As the focus would be in Shetland, the opportunity was taken to undertake a Tier 2 / 3 deployment demonstration in parallel with the formal exercise.

OSPRAG Toolkit

Through the OSPRAG review process it has been agreed that the response capability of the UK offshore industry should be enhanced into a toolkit of response options. The toolkit will comprise:

- Sub-surface dispersant application (for vapour control at surface)
- Sub-surface dispersant application (for environmental protection)
- Surface vessel dispersant application close to source
- Containment and recovery offshore
- In-situ burning
- Aerial dispersant application offshore
- Containment and recovery near shore
- Surface vessel dispersant application near shore
- Aerial dispersant application near shore
- Shoreline response
- Surveillance.

Operators will be able to deploy the entire toolkit, or select tools that are relevant to their particular operation and declare these in the OPEP prepared for that operation.

Some elements of the toolkit are not yet fully enabled, namely sub-surface application of dispersant (for environmental protection) and in-situ burning and hence these were not considered in the deployment demonstration carried out in summer 2011.

Emergency Equipment Response Deployment (EERD)

The EERD exercise was undertaken separately from the SULA exercise and was designed to test three critical areas in responding to a free flowing well:

- Dispersion of oil flowing from the well at source
- Clearing of the well head area of debris
- Placement of a capping device to close off the flow from the well.

The first of these elements satisfied the requirement to demonstrate the ability to apply dispersant subsea, for the purposes of vapour control at the sea surface and hence was not required to be demonstrated in the SULA deployment demonstration. The outcome of the EERD is reported in section 3.

Exercise SULA Tier 2 / 3 Deployment Demonstration

So that the demonstration could be witnessed, it was agreed that all deployments would be within Sullom Voe. Whilst this might be considered not to be representative of the offshore environment it provided challenging conditions and an effective test of the equipment.

The demonstration was designed to comply with both the requirement to undertake a five yearly exercise and the requirement to demonstrate any response options not previously demonstrated in the UK. The planned tasks were:

Tier 2 Surveillance

Deployment of the OSR Cessna surveillance aircraft

Tier 2 Aerial dispersant application (covers the 'aerial dispersant application near shore' element of the toolkit)

Deployment of the OSR Cessna 406 fitted with spray system and using water for a live demonstration

Tier 3 Aerial dispersant application (covers the 'aerial dispersant application offshore' element of the toolkit)

Deployment of the OSR Hercules loaded with the ADDS pack and using water for a live demonstration

Surface vessel dispersant application near shore

Deployment of a Sullom Voe Harbour Tug, representing a vessel of opportunity, fitted with a portable boat dispersant spray kit

Containment and recovery offshore

Deployment of a Ro-Boom system from the Briggs Marine vessel 'Kingdom of Fife' and utilising a fishing vessel as boom tender

Containment and recovery near shore

Deployment of a Current Buster boom system using two fishing vessels to tow the boom.

Shoreline Response

Deployment of a command and control facility; VHF and satellite communications; wildlife response equipment; shore guardian booms and skimmers

One of the key elements of the demonstration was to assess whether small vessels of opportunity could be used effectively.

The briefing document prepared for the exercise by OSR is provided as Appendix 1. Details of the vessels used during the deployment demonstration are provided in Appendix 2. Reports of the vessel operations are provided in Appendix 3. Reports of the aircraft operations are provided in Appendix 4. *Note that full risk assessments for all the elements of the deployment demonstration are available but not included in this report for the sake of brevity.*

Assessment of the Deployment Demonstration

An independent assessment of the deployments was made by George Franklin (Shell) and Joe Small (Marine Consultant and previously Head of Counter Pollution at MCA). Their report is provided at Appendix 5.

The two main conclusions are:

- **The ability to deploy all the equipment mobilised for the exercise was considered proven.**
- **All the (onshore) equipment was seen in a fully operational condition with the OSR team fully conversant with its use.**

The report makes several recommendations which are all being actively addressed through the Oil Spill Response Forum and its workgroups.

UK Equipment Inventory on the day of the deployment

Appendix 6 provides details of spill response equipment that would have been available on the day of the deployment from OSR and Briggs, should a real incident have required a response. In addition, there would have been a UK stockpile of 1,600m³ of dispersant available.

Section 3 - Emergency Equipment Response Deployment (EERD)

Introduction

The Department of Environment and Climate Change (DECC) requested Oil & Gas UK on behalf of industry to carry out a series of practical emergency equipment response deployment (EERD) demonstrations. These demonstrations would be evaluated in conjunction with the earlier testing of the National Contingency Plan (NCP) through exercise SULA. They were also intended to show how the UK has learned from the successful capping of the Macondo incident as well as prove up the ability to deploy the recently manufactured OSPRAG Capping Device.

Total Exploration and Production UK (TEPUK) kindly volunteered to work with the OSPRAG-TRG team and provide project management, engineering and operational delivery on behalf of industry. The exercise was carried out West of Shetland (WoS) in July 2011 on the TEPUK owned Edradour area (block 206/4) in a water depth of approximately 305 metres. The exercise was successfully completed on 27 July 2011.

The TEPUK team together with Brian Kinkead from Oil & Gas UK have reviewed and agreed the lessons learned report prepared by JP Kenny which is included in Appendix 7. This close-out report captures the learning from the planning stages through to completion of the operations and it will become the primary learning document to be shared with industry and regulators.

The final requirement of this document is to capture considerations of how the planning and execution of a future EERD or real scenario may vary depending upon water depth. A nominal water depth of 1,600m water depth is assumed as the deepest UKCS envisaged potential well.

EERD Close-out report

The EERD Close-out report is included in Appendix 7.

Considerations for Operations in 1600m water depth

It is worth highlighting that both Operators and Contractors will have a variety of views on how to carry out EERD operations. This variation of views is based upon meeting internal standards and preferences and also takes into account individual contracting strategies and equipment availability at the time of operation.

Individual company OPEPs will define how such operations will be conducted and in what time frame they can be deployed. Whatever the preferred method might be we are confident that solutions exist today should industry be called upon to mobilise for a loss of well control event from a subsea oil well in the UKCS.

This report makes no recommendation as to a best or preferred option and the inclusion information on vessels and on coiled tubing deployment of dispersant is purely to demonstrate industries ability to provide an immediate response option.

Vessel capability and availability

Any response will include the sourcing and use of multiple vessels and potentially rigs. The attached table in Appendix 8 has been compiled by Subsea 7 and shows the wide range of vessels that a single organization currently has in operation in the North Sea for deepwater environments.

Pumping Dispersant Subsea

Having reviewed the EERD exercise described in Appendix 7 the main area of operations that would be affected by up-scaling to a water depth of 1,600m is the pumping of dispersant subsea. This operation is required primarily to enhance a safe operating environment for vessels and rigs and their crews at surface by reducing hydrocarbons and volatile organic compounds (VOCs).

The recent Stena Carron west of Shetland operations considered the use of coiled tubing as the primary conveyance method. Coiled tubing, and its associated equipment for deployment and storage of pumping of dispersant, is readily available from a variety of contractors in the UKCS. It should be noted that Wild Well Control has also chosen Aberdeen as the storage and mobilization point for its global response and they have selected coiled tubing as their standard option.

During the research of this report we have been made aware other potential options that incorporate self supported or wire supported hose arrangement.

We believe therefore that the capability currently exists to carry out this operation and that Operators will state their preferred options at the time of submitting their OPEP for approval.

Seabed and Subsea Wellsite Clearance

The EERD demonstrated the successful cutting of a 21" riser and choke and kill lines. The UKCS is also one of the largest subsea well basins in the world with extensive project experience at installing and maintaining subsea architecture and infrastructure. There is a large inventory of equipment and expertise available in the UKCS to deal with a wide variety of anticipated situations.

The OSPRAG Capping Device and other devices

The UKCS has completed manufacturing and testing of the OSPRAG Capping Device which will be stored and maintained in the Aberdeen area. The specification and operating considerations are included in Appendix 9. This device has been specifically designed to meet the UKCS specific operating environment.

In addition to the OSPRAG Capping Device, other BOP based Capping Devices are also available or will arrive in the UK during 2011.

We believe the UK today is well placed to respond immediately to a loss of subsea oil well control.

Section 4 - Appendices

The following appendices comprise a series of reports that have been written on Exercise SULA and on the EERD. The table below summarises these appendices.

Summary of appendices		
1	Briefing Document (OSR)	Exercise SULA
2	Vessel Details (Briggs)	
3	Daily Reports 1 – 4 (Briggs)	
4	Aircraft Operations (OSR)	
5	Industry Independent Report	
6	Equipment Inventory (OSR & Briggs)	
7	EERD close-out report (JP Kenny)	EERD
8	Vessel availability table (Subsea7)	
9	OSPRAG capping device brief	OSPRAG capping device

Appendix 1 - Exercise SULA Briefing Document (OSR)

Practical Exercise Briefing document

Exercise:	Sula	Prepared By:	Zoe Beverley
Date:	13th May 2011	Exercise date:	18th May 2011

Exercise Information

Following events in the Gulf of Mexico in 2010 the UK government has identified the requirement to exercise the United Kingdom's response to a major oil spill resulting from a deep water offshore drilling incident. Exercise "SULA" will be a multi national, agency and industry exercise designed to test the UK's ability to react to a major incident threatening the UK offshore and shoreline environment. The exercise will take place over 2 days, testing command and control functions, multi agency interface arrangements, counter pollution response and the technical containment activities associated with controlling an ongoing oil spill. The exercise will initially simulate a realistic incident to allow the UK's extant response arrangements to be tested in real time. This will then be followed by a series of tabletop exercises to determine the response to a long term incident. In addition there will be a demonstration in Shetland of Industry and Local Authority counter pollution response equipment. This document is solely in reference to the practical demonstration element of exercise Sula. The purpose of this document is to provide participants and other interested parties with the essential information relating to the co-ordination and execution of the exercise.

Exercise Objectives

The exercise has the following objectives;

- Complete the 5 yearly industry deployment exercise.
- Ensure the demonstration is carried out safely.
- Manage co-ordinated response effort.
- Manage industry image and expectations

Planned Tasks

Tier 1

In a real incident would be provided by Chevron ERRV – however for the demo a SIC tug will be used to simulate tier 1 vessel dispersant spraying.

To utilise a VOO **Oil Spill Response** will provided a portable boat dispersant spray kit that can be fitted to the VOO and demonstrated. Or used for a shoreline demo if no boat available.

Tier 2 Surveillance

Legislation states must be on scene within 4-6 hours from the callout.

Bothe the MCAs and **Oil Spill Responses** surveillance aircraft will deploy, to complete surveillance demonstrations.

Oil Spill Response's aircraft (G-Body) will stay in the air on scene, to direct both the Tier 2 and the Tier 3 aerial dispersant aircraft, before finally departing scene and formulating its standard overflight report.

Tier 2 Spray

Legislation states must be on scene within 4-6 hours from the callout.

Oil Spill Response's Cessna 406 will be fitted with the UKCS Tier 2 spray system, and filled with water to complete a live demo of aerial spraying capability. This will be co-ordinated from G-Body (as above)

Tier 3 Spray

Legislation states must be on scene within 18 hours from the callout.

Oil Spill Response's Hercules will take off from East Midlands on the exercise day and fly direct to site, loaded with the ADDS (Aerial Dispersant Delivery System) and water.

With the co-ordination of the surveillance aircraft (G-Body), the Hercules will do a live demo of tier 3 spray operations. This consists of the Hercules dropping to spray altitude, opening the ramp door, deploying spray system, and spraying water. Once this is complete, all aircraft will leave scene.

Offshore Deployments

- Briggs Vessel and staff on Kingdom of Fyfe to deploy Briggs Offshore boom in a J configuration, with an offshore skimmer.
- A Vessel Of Opportunity (VOO), provided by Scottish Fishermen Federation will tow the other end of the J configuration made by the Briggs vessel Kingdom of Fyfe.
- SVT and Shetland Port & Harbour to deploy an Ocean Buster with harbour Tugs.
- BP SVT, Shetland Port & Harbour to deploy protection booming from fixed protection points in Sullom Voe utilising own SVT vessels, this will be boom site No 6.
- MCA Current Buster to be deployed from the Kingdom of Fyfe and picked up by 2 VOOs (again provided by Scottish Fishermen Federation) to use in formation. Breamar Howells personnel will be on the VOOs to aid with deployment.

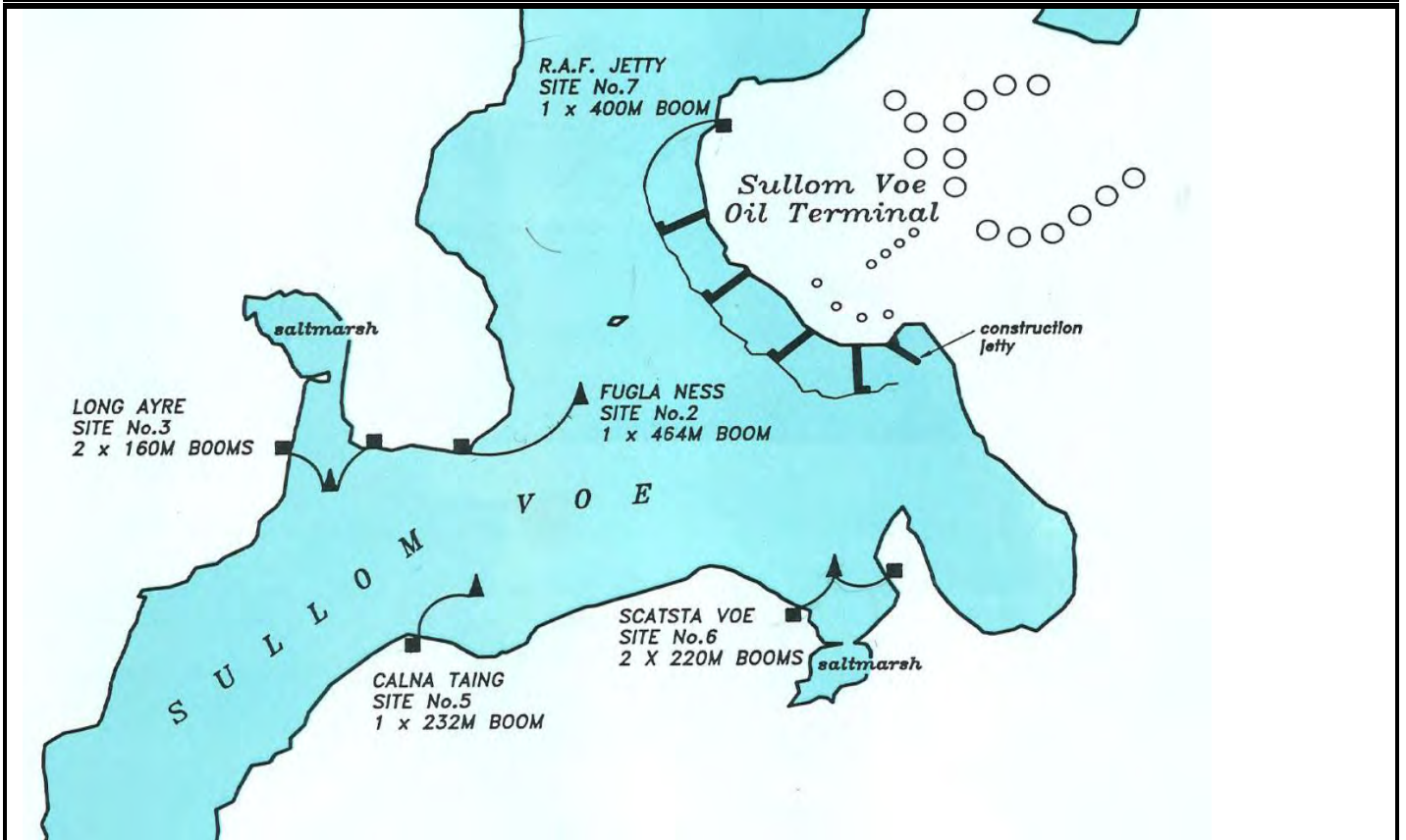
Shoreline deployments

- Oil Spill Response to set up and deploy a full shoreline demonstration. This will include boom, various skimmers, temporary storage, decontamination, communications and wildlife response. SVT/SIC to supply small vessel to aid with boom deployment if required.
- **Oil Spill Response** Harbour buster for onshore 'show and tell' along with other equipment, such as Alfredo nozzles for static display.

Throughout the entire day the demonstrations will be videoed.

Attached are rough maps of the suggested deployment areas.







Exercise Timeline

0900	1000	1100	1200	1300	1400	1500	1600	1700
		Tier 1 Spray						
		Tier 2 Surveillance						
		Tier 2 Spray						
			Tier 3 Spray					
Offshore Deployments								
Shoreline Deployments								

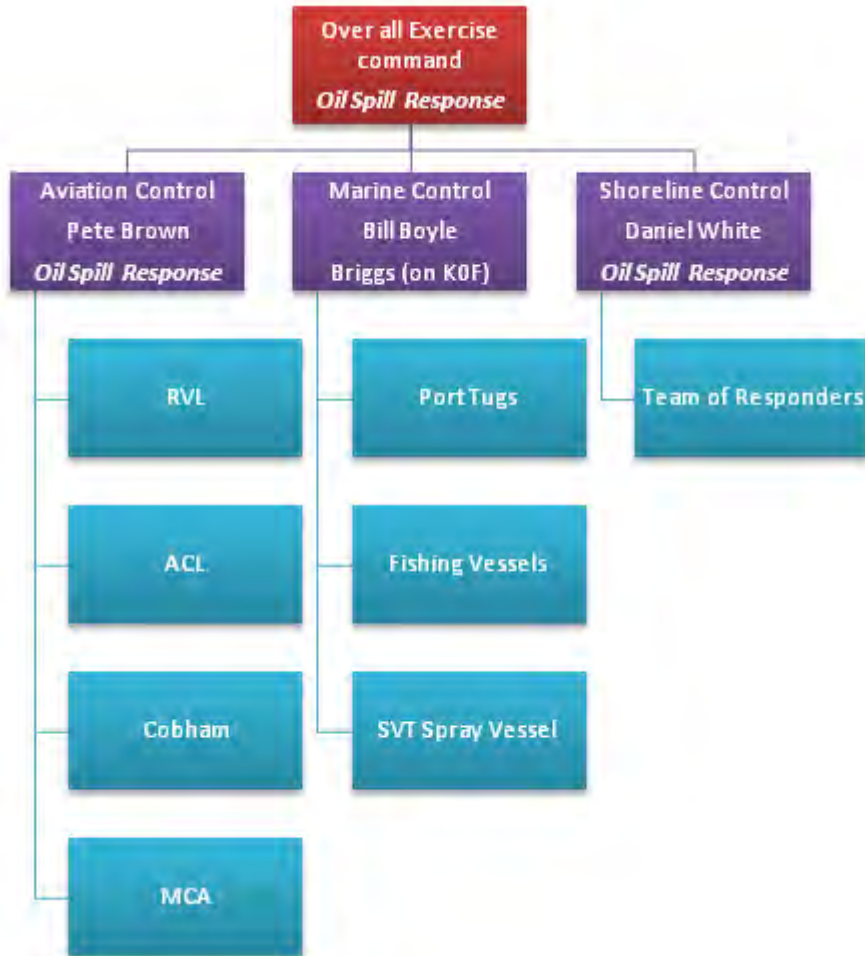
EMERGENCIES

Emergency termination:

Should a real emergency occur during the period of the exercise which affects any of the locations or participants, reports of the emergency should be passed to the Exercise Controllers using the following prefix: -“**DEMO END EX – DEMO END EX**” On receipt of a “Demo End Ex” message the exercise will cease. Aviation assets should move to a suitable holding area while the situation is assessed and the exercise will resume, be suspended or cancelled.

The exercise lead will then liaise with the appropriate emergency service via 999 or available hotline numbers, coordinated by the appropriate personnel involved.

Organisation



Communications

Attached to this document are;

- Detailed Communication Plan
- **Oil Spill Response's** risk assessments (Briggs specific assessments will be circulated to offshore players)
- Detailed Offshore deployment plan
- Detailed Aviation Plan

Appendix 2 - Exercise SULA Vessel Details (Briggs)

EXERCISE SULA
18th & 19th May 2011
SULLOM VOE
SHETLAND



KINGDOM OF FIFE
Oil Spill Response Equipment Deployment Vessel

Year Built:	2008
Length:	61.20mt
Breadth:	13.50mt
Draft:	4.750mt
Gross Tonnage:	1459mt
No Of Crew:	10 + 4 BMES Personnel

Mobilisation Day:

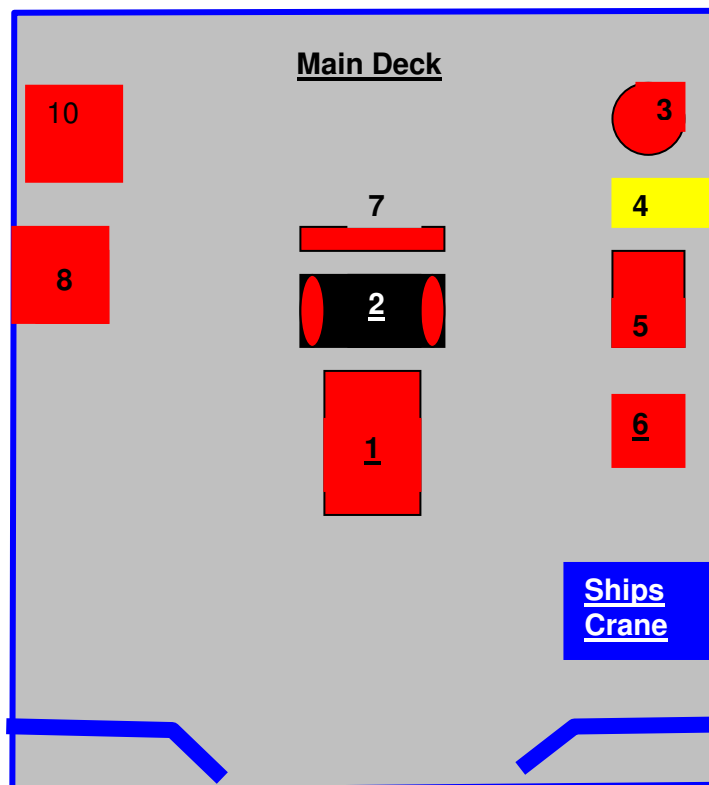
Kingdom of Fife will mobilise in Aberdeen on Monday 16/05/2011.

Berth to be confirmed.

08:30 Oil Spill Response Equipment will be transported from BMES base in Aberdeen to the harbour where it will be loaded by BMES personnel and ship's crew using the starboard aft crane.

Prior to loading the equipment a risk assessment will be carried out by the BMES Senior Technician on site and the Chief Officer.

The Oil Spill Response Equipment will be positioned and secured for sea as per the diagram below.



Numbers:

- | | |
|------------------------------|---|
| (1) Current Buster Container | (7) Transfer Pump |
| (2) Ro-Boom | (8) Service Stillage |
| (3) SS 50 Skimmer | (9) Rib Work Boat, Position to be confirmed |
| (4) Multi Purpose Power-Pack | (10) Service Container |
| (5) Ro-Boom Power-Pack | |
| (6) 8 Mop Rope Mop | |

Mobilisation Continued:

When the equipment is sea fastened it will be checked and tested prior to departing Aberdeen.

Spares and Tools are also to be checked

The Chief Officer will check all sea fastenings prior to the vessel sailing and confirm to the Master that all equipment is secure for sea.

The estimated time of departure for the Kingdom of Fife from Aberdeen will be 18:00 Monday 16/05/2011

ETA Sullom Voe: Tuesday 17/05/2011 16:00

4 hours prior to Kingdom of Fife arriving at Sullom Voe the Master will inform Sullom Voe Port Operations.

On arrival Sullom Voe Port Operations will confirm what berth / anchorage Kingdom of Fife can go to.

The three local Fishing Vessels, Radiant Star, Copious and Prolific will also inform Sullom Voe Port Operations of their ETA, the vessels are requested to be in Sullom Voe around the same time as Kingdom of Fife.

Fishing Vessels For Exercise Sula



RADIANT STAR LK 71

Home Port: Lerwick, Year Built 2007, Length 23.07mt Breadth 7.25mt Draft 4.16mt
GT 192tons Number of Crew 5

The Radiant Star, will work with Kingdom of Fife towing the Ro-Boom



COPIOUS LK 985

Home Port: Lerwick, Year Built 2008,
Length 19mt Breadth 7mt Draft 4.4mt
GT145ton No of Crew 4



PROLIFIC LK 986

Home Port: Lerwick, Year Built 2008,
Length 19mt Breadth 7mt Draft 4.15mt
GT145ton No of Crew 4

The Copious and the Prolific will work as a team towing the Current Buster

The above Fishing Vessels have load line exemptions and will undergo a full Safety Audit. Prior to Exercise Sula, Captain Bill Boyle, will conduct a safety and training session on Wednesday 18/05/2011

Training Day
Wednesday 18/05/2011
Location: Sullom Voe

- 08:00 All vessel crews will meet onboard Kingdom of Fife and Register
- 08:30 Safety Brief
- 08:45 Explanation of Oil Spill Response Equipment
Current Buster, Ro-Boom, Power-Packs and Skimmers
- 09:30 Explanation of Deployment, Recovery and Containment Boom Towing
Techniques.
- 10:30 Communications Brief
- 10:45 Questions and Answers
- 11:00 Walk-round Deck of Kingdom of Fife and view Oil Spill Response Equipment
- 11:30 Vessels move to deployment position.

When Master of Kingdom of Fife is happy with vessels position the Current Buster will be deployed. This usually takes approximately 15 to 20 minutes.

When the Current Buster is fully deployed and under tow the towing vessel will manoeuvre clear of Kingdom of Fife and pass one end of the Current Buster to her partner. When the towing lines are secure both vessels will slowly move off and take up a towing formation.

The Master of Kingdom of Fife will then position the vessel ready to deploy the Ro-Boom.

Note: Before the Ro-Boom can be deployed the Current Buster container will be moved sideways to give a clear deployment area on the stern of the Kingdom of Fife.

When the Master is happy of his vessels position he will give authorisation to deploy the 200mt Ro-Boom during deployment the towing vessel Radiant Star may be requested to assist with the deployment by just keeping strain on the boom.

When the Ro-Boom is fully deployed the inboard end of the boom will be taken up the starboard side of the Kingdom of Fife and secured.

When this task is completed and the BMES Senior Technician on-deck is happy with the position of the boom he will inform the bridge that the boom is secure in position, the Radiant Star will then be instructed to secure the boom to her stern and move into a "U" formation.

The "U" formation is the formation used to collect the oil.

After the vessels have held position for some time they will then be instructed to move into a "J" formation.

Training Day Continued:

The “J” formation is the formation used to recover oil from the apex of the boom. When both vessels have shown that they can hold position and only after the Master of the Kingdom of Fife has given authorisation will a skimmer be deployed over the starboard side using the Kingdom of Fife's starboard aft crane.

Note: Prior to operations starting a risk assessment will be completed by the BMES Senior Technician and checked by the vessels Chief Officer.

After the vessels have completed the oil recovery task, the skimmer will be brought onboard Kingdom of Fife and secured.

When the Master of Kingdom of Fife is happy with his vessels position he'll authorise the recovery of the Ro-Boom.

Only when instructed by the Master of Kingdom of Fife will the Radiant Star let go his end of the boom and move clear to enable Kingdom of Fife to manoeuvre and recover the boom.

Once the Ro-Boom is secured onboard Kingdom of Fife, the Current Buster Container will be repositioned and secured ready to recover the Current Buster.

When the Master is happy with the vessels position he will authorise one of the Current Buster towing vessels to pass the picking up line back to the Kingdom of Fife so recovery of the boom can begin, this usually takes approximately 15 minutes.

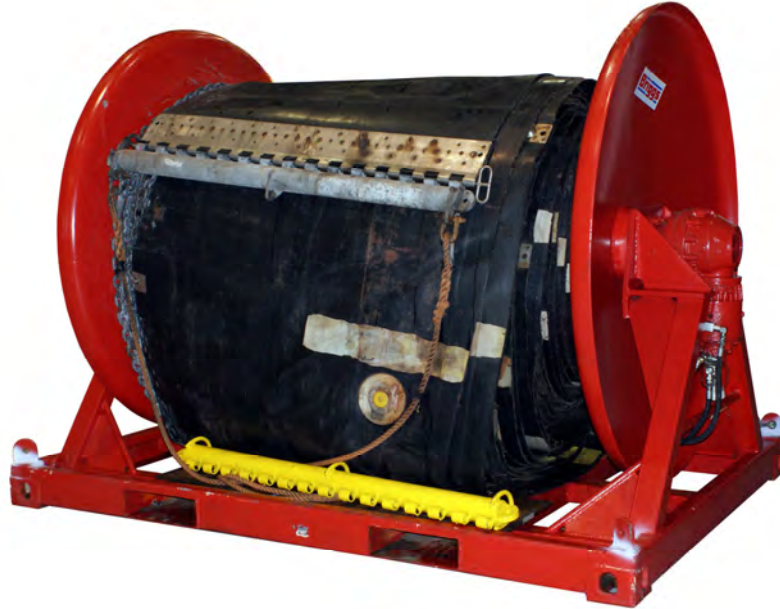
After all equipment is secure onboard Kingdom of Fife Captain Bill Boyle will hold a wash-up meeting to discuss all operational issues.

Oil Spill Response Equipment:

Current Buster (Oil Containment Boom for that can be towed at speeds of 3 to 4KTS)



Ro-Boom (Oil Containment Boom)



SS50 Oil Skimmer



Oil Spill Response Equipment Continued:

Sea Devil Oil Skimmer:



Rope-Mop (Foxtail)



Power-Pack



Work-Boat (FRC)



Stillage With Spares



Exercise SULA Training Attendees Register Form:

No	NAME	VESSEL / COMPANY	RANK	SIGN
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RISK ASSESSMENT FORMS:

- (1) Loading Oil Spill Response Equipment at BMES base for transportation to Aberdeen Harbour.**
- (2) Loading Oil Spill Response Equipment onboard Kingdom of Fife at Aberdeen Harbour.**
- (3) Deploying / Recovering Current Buster Oil Containment Boom**
- (4) Towing Current Buster Oil Containment Boom**
- (5) Deploying / Recovering Ro-Boom**
- (6) Towing Ro-Boom**
- (7) Deploying / Recovering Oil Skimmers**

Fishing Vessel Inspection Form:

Inspection & Specification Documents for Radiant Star, Copious and Prolific are attached. These documents will be updated before Exercise SULA

Chart Showing Exercise SULA Deployment Area:



SHETLAND ISLANDS SULLOM VOE CHART No 3297

Contact Details:

No	NAME	TELEPHONE No	Mobile No	VHF Channel
1	Captain Bill Boyle bboyle@briggsmarine.co.uk		07715-496068	
2	BMES Aberdeen	01224-898666		
	BMES Warehouse Aberdeen	01224-4891695		
3	BMES Burntisland	01592-872939		
4	BMES Emergency	0800-374348		
5	Aberdeen Port Operations	01224-597000		12 & 16
6	Aberdeen Pilots	01224-597000		12 & 16
7	Sullom Voe Port Operations	01806-242344		14
8	Sullom Voe VTS	01806-242344		14
9	Kingdom of Fife	07595-070262		
10	Kingdom of Fife Sat Phone			
11	Neil Marson BMES Rep Aberdeen (MRC) nmarson@briggsevenvironmental.com		07715-496053	
12	George Ross Senior OSR Technician gross@briggsevenvironmental.com		07815-957686	
13	Jamie Campbell OSR Technician / Mechanic jcampbell@briggsevenvironmental.com		07715-496067	
14	Radiant Star	01595-859693	07747-474626	
15	Copious	01595-860337	07795-487459	
16	Prolific	01806-577201	07500-442534	
17	John Watt SFF Operations		07876-450496	
18	Michael Sutherland SFF		07803-894733	
19	Steven Alexander SFF		07803-894734	
20	Natalie Lauder SFF		07738-643280	

Exercise Day
Thursday 19/05/2011
Location: Sullom Voe

08:00 All vessel crews will meet onboard Kingdom of Fife for an Exercise Brief by Captain Bill Boyle. A dedicated exercise VHF working channel will be agreed and all taking part in the exercise will be notified.

08:30 Safety Brief

08:50 Communications Check with Port Operations, "All" vessels taking part in Exercise Sula and MRC in Aberdeen.

09:00 Vessels will leave the jetty and proceed to exercise deployment area and await orders.

When Captain Bill Boyle receives confirmation to start the exercise he will inform all vessels.

Note: Detailed logs must be kept at all times, Weather, Wind-Speed, Visibility, Sea State, Equipment Deployment Times and Regular Vessel Position Checks must be recorded.

The deployment will be the same as the training day, first boom to be deployed will be the Current Buster and then the Ro-Boom.

All communications will be in plain "English" with no idle chatter over the VHF.

Any problems what so ever must be immediately communicated to Captain Boyle onboard Kingdom of Fife who in turn will notify the correct authorities.

Safety is of the uppermost importance Masters / Skippers will be responsible for the safe navigation of their vessels at "**All Times**"

The Exercise is expected to last until approximately 16:00 on Thursday 19/05/2011

All vessels will be informed by Captain Bill Boyle when the exercise is drawing to an end.

When the exercise is completed and all equipment is recovered / secured onboard Kingdom of Fife Captain Boyle will give the order to stand-down.

The Radiant Star, Copious and Prolific will return to their home port.

The Kingdom of Fife will proceed to Aberdeen and demob on arrival.

Note: Sullom Voe Harbour Master will have the overall authority to stop the exercise if he thinks the operation is unsafe or in the event of any other emergency situation arising.

Captain Bill Boyle MNI
General Manager BMES

Appendix 3 - Exercise SULA Daily Reports 1 – 4 (Briggs)

EXERCISE SULA

SULLOM VOE
SHETLAND

Date Monday 16/05/2011 Report: 001

Author: Captain Bill Boyle MNI Location: On Passage to Sullom Voe Shetland



Total No of Crew: 10

Total No of BMES Personnel: 4

BMES Personnel Onboard:

Bill Boyle (BB)
Jamie Campbell (JC)
George Ross (GR)
Davie Main (DM)

Weather At 18:00 Wind: Wly 4 to 5, Sea State: slight, Visibility: Good 10 miles
Pressure: 1007

Position: Lat 57° 41.1N Long: 001° 56.9W

08:00 Kingdom of Fife secure on No 1 berth Regent Quay starboard side to

08:30 BMES personnel arrive at KoF and carry out loading risk assesment and safety talk with ships crew.

09:00 start to load oil spill response equipment

12:00 oil spill response equipment loaded onboard apart from the Current Buster as team still waiting for the spreader bar.

13:15 Spreader bar arrives, Current Buster loaded and secured for sea

14:30 All Oil Spill Response Equipment checked and secured for sea

17:15 KoF departs Regents Quay

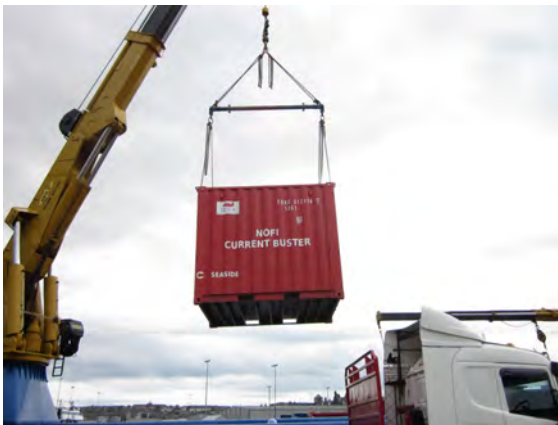
17:35 KoF clears Aberdeen fairway buoy proceeding to Sullom Voe



KoF Prior Loading OSR Equipment



KoF Loading OSR Equipment



Loading MCA Current Buster



OSR Equipment Secured for Sea



KoF Departing Aberdeen

Plan for Tuesday 17/05/2011:

BB (Bill Boyle) will brief officers and crew of KoF on Exercise Sula and operational procedures.

When KoF arrives at Sullom Voe all OSR Equipment will be checked and tested.

BB will brief Sullom Voe Harbour Master and Port Operations on Exercise Sula and operational procedures.

BB will inspect the three local fishing vessels on their arrival which will be approximately 17:00 Tuesday 17/05/2011.

Captain Bill Boyle MNI

Monday 16/05/2011 22:15Hrs

EXERCISE SULA

SULLOM VOE
SHETLAND

Date Tuesday 17/05/2011 Report: 002

Author: Captain Bill Boyle MNI Location: Tug Jetty Sella Ness Sullom Voe Shetland



Total No of Crew: 10

Total No of BMES Personnel: 4

BMES Personnel Onboard:

Bill Boyle (BB)
Jamie Campbell (JC)
George Ross (GR)
Davie Main (DM)

BMES Aberdeen:

Neil Marson (NM)
Jackie Davidson (JD)

Weather At 18:00: Wind: Wly 2, Sea State: slight, Visibility: Good 10 miles
Pressure: 1001

Position: Lat 60°26.83N Long: 001° 16.41W Secured to Tug Jetty Sella Ness
Sullom Voe

08:00 BB updates NM (Neil Marson BMES Aberdeen)

11:30 Sullom Voe Pilot onboard

12:50 KoF all secure starboard side to Tug Jetty Salla Ness Sullom Voe

14:30 BB & Master of KoF meet with Sullom Voe Harbour Master to discuss operations.

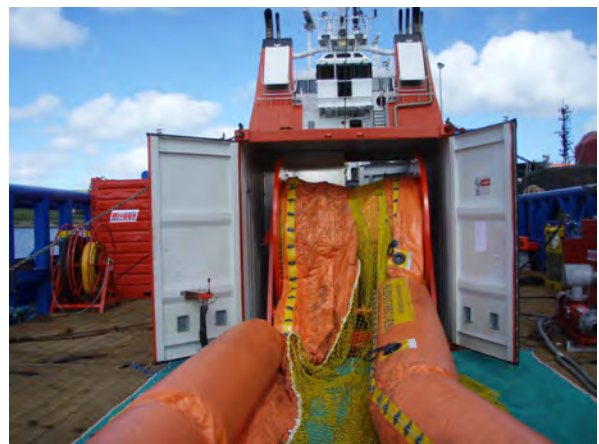
15:30 All Oil Spill Response Equipment rigged and tested onboard KoF

16:00 BB meets with crew of fishing vessels Prolific and Copious

19:00 BB meets with crew of fishing vessel Radiant Star



MCA Current Buster onboard Kingdom of Fife ready for deployment



Testing Oil Spill Response Equipment onboard Kingdom of Fife





Checking Oil Spill Response Equipment and Mobile Service Unit

Plan For Wednesday 18/05/2011:

08:00 BB to explain Exercise Sula to all on water participants

08:30 Start Training and Safety Sesion this will include a deck walkround talk to view the Oil Spill Response Equipment

11:30 Weather permitting, vessels will depart jetty for on water OSR equipment deployment Training

The day will end with a training wash-up meeting of all on water participants

Captain Bill Boyle BMES

Tuesday 17/05/2011 20:00

EXERCISE SULA

SULLOM VOE
SHETLAND

Date Wednesday 18/05/2011 Report: 003

Training Day

Author: Captain Bill Boyle MNI Location: Tug Jetty Sella Ness Sullom Voe Shetland



Total No of Crew: 10

Total No of BMES Personnel: 4

BMES Personnel Onboard:

Bill Boyle (BB)
Jamie Campbell (JC)
George Ross (GR)
Davie Main (DM)

BMES Aberdeen:

Neil Marson (NM)
Jackie Davidson (JD)

Weather At 08:00: Wind: SWxS 26 to 30kts, Sea State: Moderate, Visibility: Good
8 to 10 Miles, Pressure: 1000

Position: Lat 60°26.83N Long: 001° 16.41W Secured to Tug Jetty Sella Ness
Sullom Voe

08:00 BB updates NM (Neil Marson BMES Aberdeen)

08:15 BB chairs safety and training session with crews of Kingdom of Fife, Radiant Star, Prolific and Copius.

Training Session Covered the following points:

- (1) The reason for Exercise Sula
- (2) Current Buster deployment, towing and recovery procedures and techniques
- (3) Ro-Boom deployment, towing and recovery procedures and techniques
- (4) Oil Skimmer deployment and recovery procedures and techniques
- (5) Safety procedures for all of the above.

10:00 All onwater participants walk round deck of KoF and view Oil Spill Response equipment to give them an understanding of what the equipment does and how it works.

10:30 BB chairs a brief questions and answers session, agrees communication working VHF channels, with vessels (CH 10) Sullom Voe VTS (CH 14) and allocates each vessel a roll.

Prolific lead towing vessel working with Copius towing the MCA Current Buster

Kingdom of Fife, deployment vessel and lead towing vessel with Radiant Star towing the Ro-Boom

11:30 Communications check with all vessels and Sullom Voe VTS

11:05 Kingdom of Fife let go from Tug Jetty and proceeds to deployment area.

11:25 KoF holding position with Fugla Ness brg 292° 3 cables and Ungam brg 014° 4.5 cables, Lat 60° 26.79N 001° 18.84W

Wind SWxS 26 to 30kts

11:30 Prolific, Copius and Radiant Star holding position off KoF to check wind effect on vessels

12:00 Wind SSW 31kts vessels holding position, BB decides to deploy OSR equipment

12:10 Heaving line passed to Prolific and KoF starts deployment of Current Buster

12:26 Current Buster deployed and under tow by Prolific

12:38 Prolific and Copius towing Current Buster in formation

12:52 Move Current Buster container to Port side of KoF so Ro-Boom can be deployed

12:57 Ro-Boom ready for deployment

13:05 1 x BMES operator transferred to Radiant Star

13:10 Radiant Star holding position off stern of KoF

13:12 Start deploying Ro-Boom from KoF

Note: Due to strengthening winds BB instructs deck to deploy Ro-Boom slowly

Wind: SSW 30 to 35kts, Sea: Moderate with increasing short sea

13:53 Ro-Boom fully deployed

13:58 Ro-Boom manouvered up starboard side of KoF and secured in towing position

14:01 Radiant Star picks up Ro-Boom tow line and manouvers into "U" formation of starboard side of KoF

14:09 KoF and Radiant Star in "U" formation (Collection Formation)

14:14 KoF and Radiant Star in "J" formation (Recovery Formation)

14:17 Rop-Mop skimmer deployed (Wind SSW 35kts)

14:30 Rop-Mop skimmer recovered due to increasing winds

14:35 KoF and Radiant Star holding in "J" formation

14:50 BB decides to recover Ro-Boom

14:55 BB instructs Radiant Star to let go Ro-Boom tow line and move clear but remain on standby

15:02 Ro-Boom slackened off to stern of KoF and recovery begins

15:23 Ro-Boom recovered onboard KoF

15:27 Current Buster container repositioned and secured on stern of KoF

15:28 Copius passes Current Buster tow line to Prolific and Prolific holds position with Current Buster directly astern

15:36 KoF manouvers to Current Buster to connect picking up line to bridel

15:40 Current Buster picking up line connected to bridel and Prolific let go tow lines KoF swings back head to wind to start recovery.

15:47 KoF starts recovery of Current Buster (Wind SSW 35 to 36kts)

15:50 Prolific, Copius and Radiant Star instructed by BB to return to jetty

16:00 Current Buster fully recovered onboard KoF and secured

16:23 KoF returns to Tug Jetty

16:40 BB holds washup meeting onboard KoF with Skippers of Prolific, Copius and Radiant Star, Officers and crew of KoF and BMES personnel.

17:05 Washup meeting ends and all stood down, BB informs all participants to be onboard KoF at 08:30 Thursday 19/05/2011 for exercise deployment brief.

Note: Weather at 20:00 Wednesday 18/05/2011, Wind: SSW 22 to 25kts, Sea: Moderate, Pressure: 998, Visibility: 8 to 10 Miles



Meeting and equipment walk round onboard Kingdom of Fife



Current Buster being deployed from KoF



Current Buster being towed by Prolific and Copius



Vessels making Port turn



Recovering Current Buster



Deploying Ro-Boom



Ro-Boom in "U" Formation



Radiant Star Towing Ro-Boom with Kof



Deploying Rope-Mop Skimmer

Captain Bill Boyle MNI
Wednesday 18/05/2011 22:00Hrs

EXERCISE SULA

SULLOM VOE
SHETLAND

Date: Thursday 19/05/2011 Report: 004

Exercise Day

Author: Captain Bill Boyle MNI Location: Tug Jetty Sella Ness Sullom Voe Shetland



Total No of Crew: 10

Total No of BMES Personnel: 4

BMES Personnel Onboard:

Bill Boyle (BB)
Jamie Campbell (JC)
George Ross (GR)
Davie Main (DM)

BMES Aberdeen:

Neil Marson (NM)
Jackie Davidson (JD)

Weather At 08:00: Wind: WSW 35kts, Sea State: Moderate 0.5 to 1mt Visibility: Good
8 Miles, Pressure: 998

Position: Lat 60°26.83N Long: 001° 16.41W Secured to Tug Jetty Sella Ness
Sullom Voe

08:00 BB updates NM (Neil Marson BMES Aberdeen)

08:30 BB briefs Master and Officers of KoF, Radiant Star, Prolific and Copius plus team from Braemar Howells, George Franklin and Joe Small.

Points Covered:

- (1) Weather
- (2) Safety
- (3) Deployment and towing operations

09:00 Pre departure and communications checks

09:30 KoF departs jetty and proceeds to deployment location

09:50 KoF on location holding position on D.P.

10:00 BB instructs Radiant Star, Copius and Prolific to proceed to deployment location and remain on standby with KoF

Weather: Wind: WSW 38kts Gusting 42 in rain squalls, Sea 1.0mt increasing

10:40 BB requests Tug Solan to proceed to deployment area and deploy dispersant spray arms and test with sea water.

10:55 BB calls Peter Brown OSR Aviation Readiness Manager for weather forecast update

11:20 Tug Solan on location running lines up and down wind with dispersant arms deployed spraying sea water

12:00 Weather: Wind: WSW 38 to 40kts continuous, Sea 1 to 1.5mt Rain Squalls at times.

12:29 2 x Aircraft sighted on location but no ship to Aircraft communication

13:00 Wind decreased to 30kts BB decides to deploy Current Buster then Ro-Boom. Prolific approaches stern of KoF to take tow lines.

13:09 Lines passed to Prolific however wind increases and Prolific has difficulty holding position.

13:15 BB decides to abort deployment and towing lines passed back to KoF vessels instructed by BB to remain on location and standby for further orders.

13:47 BB instructs Tug Solan to recover dispersant spray arms and return to jetty at 14:00

14:30 Weather: Wind 40kts plus in squalls Sea: 1.5mt,

14:35 As weather is showing no signs of decreasing BB instructs all vessels to return to the jetty. BB also informs OSR Command shoreside Sullom Voe.

15:00 All vessels secured alongside Tug Jetty

15:30 BB holds a wash-up meeting with Master and Officers of Kingdom of Fife, Radiant Star, Prolific, Copius, Braemar Howells, BMES Team and John Watt representative of SFF based in Aberdeen.

Points Discussed:

- (1) Findings during the exercise this included participants views and suggestions.
- (2) Training, Did the fishermen think a training program would help for future exercises / incidents. The answer was a unanimous yes
- (3) Did all participants feel the exercise was worthwhile, the answer was a unanimous yes.
- (4) Safety, all felt that safety and deployment briefings went well however there was an issue that had been pointed out and taken care of re the movement of the MCA Current Buster container while onboard KoF.
Braemar Howells are also going to discuss with the MCA, lifting arrangements for equipment that has to be loaded and maybe moved while onboard vessels.
- (5) Communications, all felt that communications between vessels on location and Sullom Voe VTS were good.
However communications between Command vessel, Exercise Command Centre Sullom Voe and Aberdeen were none existant.
- (6) BB acknowledged that all felt a bit low as today we were beaten by the weather however also explained that this does happen during live incidents and although this was the case today everything went very well on the training day which was a good achievement.

BB closed the meeting at 16:20 by thanking all participants.

Note: Due to bad weather and a poor weather forecast over night the KoF will remain alongside to night and sail for Aberdeen at 08:00 Friday 20/05/2011 this will give her an ETA of 06:00 at Aberdeen Fairway Buoy Saturday 21/05/2011.



Wind Speed Gusting 40kts at Times



Sea Height 1 to 1.5mt



Tug Solan with deployed Dispersant Spray Arms



Tug Solan and Dispersant Spray Aircraft

Captain Bill Boyle MNI
Thursday 19/05/2011 22:30

Appendix 4 - Exercise SULA Aircraft Operations (OSR)

National Exercise Sula Report

Response Duration: 18th - 19th May 2011



Client:	Chevron
Response incident	Exercise Sula
Our reference	4566
Authors	
Date	
Approved by	
Date	



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1. Executive Summary

This report details the involvement of **Oil Spill Response** in Exercise Sula held on the 18th and 19th May 2011 in Aberdeen and Shetland.

Exercise Sula was a live multi-agency Emergency Response Exercise designed to test the United Kingdom (UK) National Contingency Plan. The exercise was driven by a request at Ministerial level to exercise the UK's response to a spill of a similar nature to the Gulf of Mexico incident which occurred in April 2010. Exercise Sula gave the UK an opportunity to assess its response capability to a release from a wellhead 1,000 metres below the surface, with a scenario centred around the deep water well operated by Chevron Upstream Europe at the Cambo Well Site, 86 miles West of Shetland.

The exercise comprised of two elements, a table top exercise aimed to test subsea well control response capability, command and control functions and the UK's National Contingency Plan, while a practical element demonstrated the counter pollution measures available to control an ongoing oil spill. To lend credence to the practical demonstration the weather and tides used in the table top scenario forced the oil to beach in Shetland

The exercise was co-ordinated by the Maritime and Coastguard Agency (MCA) and Department of Energy and Climate Change (DECC). Also participating in the exercise were Chevron, Stena Offshore, Briggs Environmental, Braemar Howells, BP (Sullom Voe terminal), Shetland Islands Council, Marine Scotland, Hess, Joint Nature Conservation Committee, Northern Constabulary, Scottish Natural Heritage, Foods Standards Agency, Scottish Fisheries Association, Oil & Gas UK, Scottish Environment Protection Agency, Sullom Voe Port & Harbour, Petrofac Training Services and **Oil Spill Response** (For contacts see Appendix 1). The exercise was designed in part to test the co-ordination of all organisations involved.

The objectives that were set for **Oil Spill Response** were to:

- Complete the 5 yearly Tier 2 & 3 industry deployment exercise.
- Ensure the demonstration was carried out safely.
- Manage a co-ordinated response effort.
- Manage industry image and expectations.
- Demonstrate spill response best practice and **Oil Spill Response** expertise base.

2. Exercise Summary

The purpose of this section of the report is to provide information relating to **Oil Spill Response's** influence and involvement with the co-ordination and execution of Exercise Sula. The exercise took place over a 2 day period with a series of table top exercises running over both days and the practical demonstration taking place on day 2.

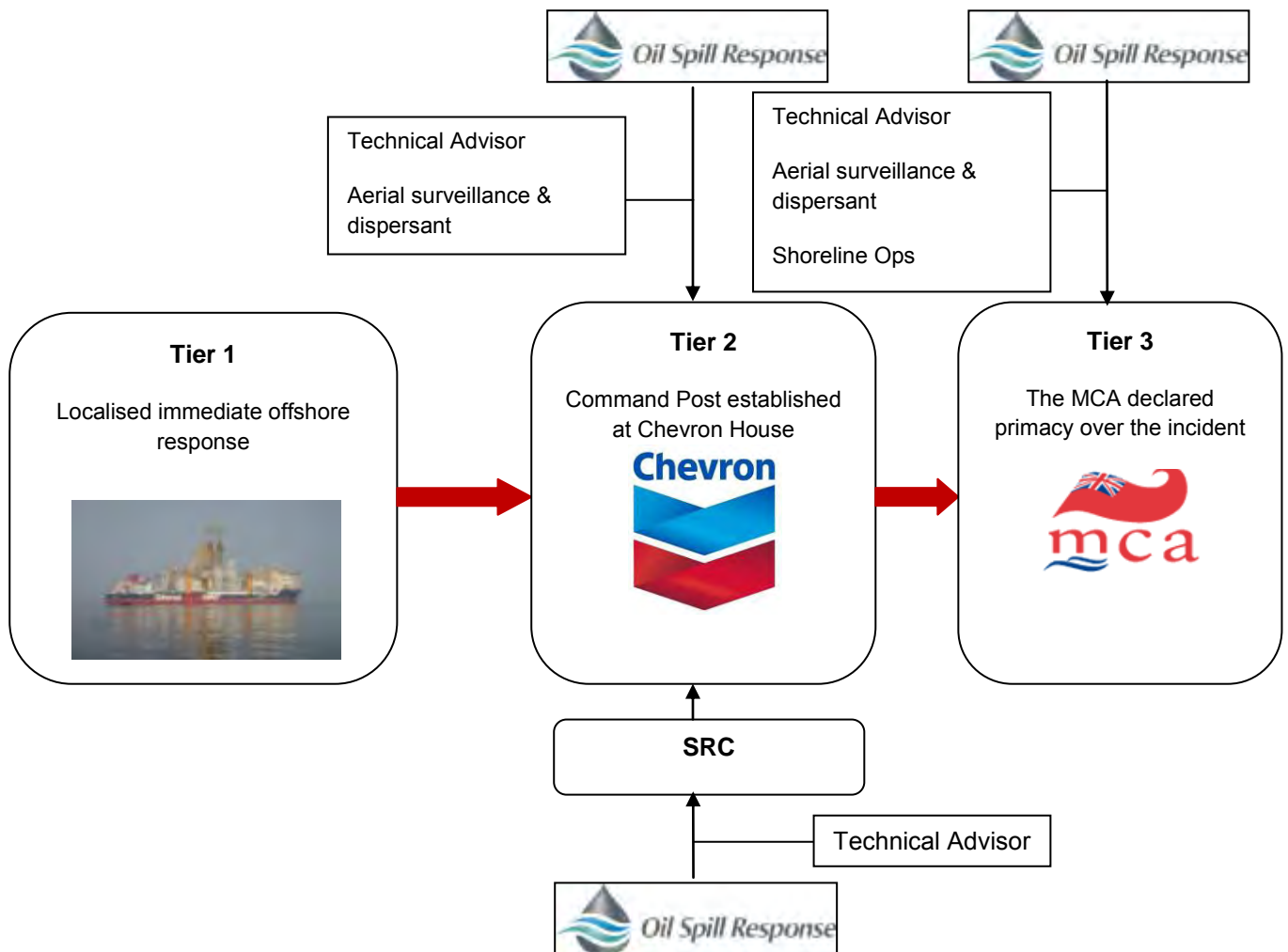
The tabletop exercise began as a Tier 1 response role-played by vessel owners, Chevron representatives and the OIM, with the MCA and Chevron House being notified of the incident. As the scenario evolved into a Tier 2 response, a Command Post was set-up at Chevron House in Aberdeen which contacted **Oil Spill Response** who in turn activated their mobilisation procedures. At this stage **Oil Spill Response** was requested to mobilise personnel to function within the Incident Command Structure (ICS) put in place for the



exercise. The **Oil Spill Response** Southampton base acted in a supporting role to the incident as an Emergency Operations Centre (EOC), and personnel were embedded within the Operations, Planning and Logistics sections.

As the table top exercise progressed to a Tier 3 response, the MCA and SOSREP declared primacy regarding overall control and co-ordination of the incident. At this point in the scenario the Marine Response Centre (MRC) and the Shoreline Response Centre (SRC) were activated and additional **Oil Spill Response** staff positioned within these centres. At this point it was not clear whether the MRC had taken control of the offshore response component of the incident leading into the final day of the exercise.

The training of **Oil Spill Response** staff became evident as the table top exercise progressed with personnel working effectively towards accomplishing their roles and carrying out their duties and responsibilities at all levels of the ICS structure and in all elements of the exercise/demonstration.



Flow diagram with the red arrows showing change in command of control throughout the scenario and the input **Oil Spill Response** had at each of the Tiered response levels.

2.1. Table Top Exercise

2.1.1. Emergency Operations Centre (EOC) *Oil Spill Response* Southampton

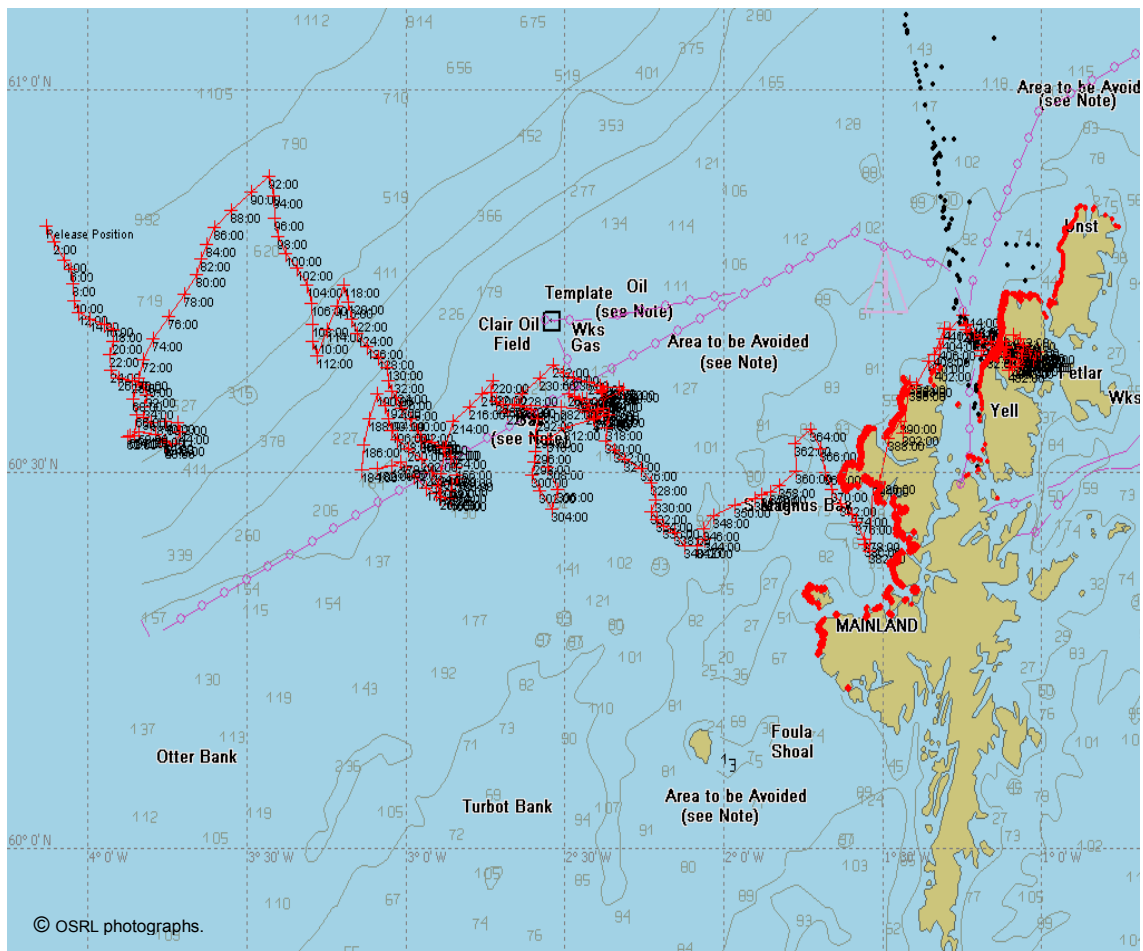
At 08:45 Wednesday 18th May 2011 the Duty Manager at ***Oil Spill Response*** at the EOC in Southampton was contacted by Peter Oliver of Chevron in relation to a potential incident. It was reported that there had been an emergency disconnect due to riser tension issues, the drill ship was stable but had started moving North. No oil had been observed in the water and no injuries were reported. Mobilisation and Notification Forms arrived at the EOC promptly, although more information could have been filled in on the notification form. In the initial phases ***Oil Spill Response*** dealt with specific requests from Chevron such as completing and sending work orders for the use of Tier 2 surveillance and dispersant aircraft.

Notification and mobilisation forms were received by the Duty Manager signed by a nominated callout authority, in this case Stephen Conner, the Incident Commander at Chevron. The Notification Form confirmed that there was currently no oil on the sea surface but there was an uncontrolled subsea release of Cambo crude at the wellhead in the location of Cambo 4, Block 204/10.

A Technical Advisor (TA) from ***Oil Spill Response*** was requested and activated to integrate within the Chevron ICS at Chevron House in Aberdeen, shortly followed by the mobilisation of additional manpower to assist within the Logistics, Planning, Incident Manager, and Operation sections in Chevron's ICS structure.

Following mobilisation trajectory oil spill modelling using OSIS software was requested and begun at the EOC Southampton using all available data for spill location, oil type, estimated spill flow rate, sea and weather conditions. Model results predicted the spill would initially head in an easterly direction, through the Clair oilfield, then towards the western coastline of the Shetland Islands. As further data became available, such as longer range weather forecasts, the model was updated and the prediction extended to at least 1st June 2011 [14 days]. The results of the OSIS modelling were e-mailed in report form to the Command Centre in Aberdeen. Overlays of the modelling were also available for incorporation into GIS packages and Google Earth®.





Screenshot from OSIS software showing the spill trajectory for notional day 6 of Exercise Sula.

2.1.2. Operations, Chevron House, Aberdeen

Oil Spill Response mobilised an Incident Manager (IM)/Advisor to the command centre at Chevron House to manage and co-ordinate the response effort. Within the command centre the IM had direct contact with **Oil Spill Response's** TA as well as **Oil Spill Response's** personnel in the Logistics, Planning, and Operation sections. Further afield the IM was in communication with **Oil Spill Response's** staff situated in the MRC at Marine House, Aberdeen, and at the SRC located at Sella Ness.

Working closely with the Operations Section Chief and the Planning Section Chief and supporting them in their roles wherever possible, the IM reported directly to Chevron. Additionally the IM provided input into technical decisions and liaised between Chevron and the EOC at Southampton. These activities promoted cohesion and communications between all the sections of the ICS and developed a sense of direction throughout the response. The IM provided assistance to the MCA regarding the control of air traffic on scene, and also responded quickly and efficiently to queries regarding resources and assets particularly those of **Oil Spill Response**.

The IM ensured **Oil Spill Response's** dispersant assets were mobilised as a priority and were staged in Inverness awaiting final permissions as approval had only been provided for a test spray from vessel mounted systems. A significant amount of debate then ensued between the Environment Group and the MCA before other UK dispersant assets were tasked for operations. Slickgone NS was approved for use by the Environment Group however, despite requests Corexit 9500 remained unapproved for use. Further global stocks were requested as part of the exercise and many of these requests came back with successful responses, such as those to NOFO and CCA.

2.1.3.Planning, Chevron House, Aberdeen

Within the Planning Section an **Oil Spill Response** specialist was tasked to assist in the development of the Incident Action Plan (IAP).

Following a significant amount of work completed by the **Oil Spill Response** specialist in the Planning Section, approval was given for in-situ burning to commence. A test burn was set to be scheduled should the appropriate conditions arise offshore. This was to be completed in a defined area and a full plan was developed for the conduct of the trial and the necessary monitoring associated with it. Requests for equipment were placed and responses from a number of sources including Elastec Marine, were successful in providing several potential sources.

Subsea Dispersant Injection gained tacit approval however it was not fully explored with the regulators and the final approval signatures were not gained.

2.1.4.Logistics, Chevron House Aberdeen

As part of the Logistics Section based in Chevron House an **Oil Spill Response** specialist offered recommendations on offshore equipment sourcing, providing information on dispersant resupply to the Planning Section, and giving guidance to the Logistics team on future logistical requirements. The initial tasks for the **Oil Spill Response** specialist concentrated on processing ICS213's (used as resource request forms), planning for dispersant resupply for 20 days and liaising with **Oil Spill Response** at the EOC Southampton to ensure only 50% of the equipment and personnel stockpile were utilised as per the Service Level Agreement (SLA). Further into the exercise the **Oil Spill Response** specialist focused on a dispersant worst case scenario resupply for 90 days requested by the MCA and gave recommendations to the logistics team on supply of shoreline equipment and site set up.

The **Oil Spill Response** specialist ensured offshore containment and recovery equipment was mobilised from the EOC Southampton towards Invergordon for loading, vessels and other infrastructure were theoretically mobilised but the scenario could not really be pushed any further due to the bounds of the exercise.





A scene from inside the Command Centre at Chevron House, Aberdeen.

2.1.5. Marine Response Centre (MRC) Marine House, Aberdeen

Oil Spill Response provided two specialists to assist within the MRC. Their integration into the MRC could be better planned to ensure job roles and utilisation of their specialist skills, knowledge and expertise provided best value to the response. Additionally the management of the MRC lack effectiveness and direction as most functions were working as individuals rather than a co-ordinated team.

The OSR Staff took on the responsibility to provide technical advice to members of the MRC and to report on what equipment **Oil Spill Response** could supply. In particular they advised on dispersant resupply, equipment logistics and the types of equipment and their effectiveness and limitations, largely with reference to the weather conditions. The main focus was dispersants, the sourcing of additional Tier 3 spray aircraft and systems and calculating the potential volumes of dispersant that could be required. The flow of information through the MRC was affected by a lack of displayed data which led to instances of duplication of effort. The advisors also liaised with Chevron for subsea dispersant application requests, and were tasked with formulating a plan that could be supplied to the authorities in order to request permissions. The activities in the MRC were hampered by confusion surrounding when the MRC took over command of the incident and what role it should play post activation.

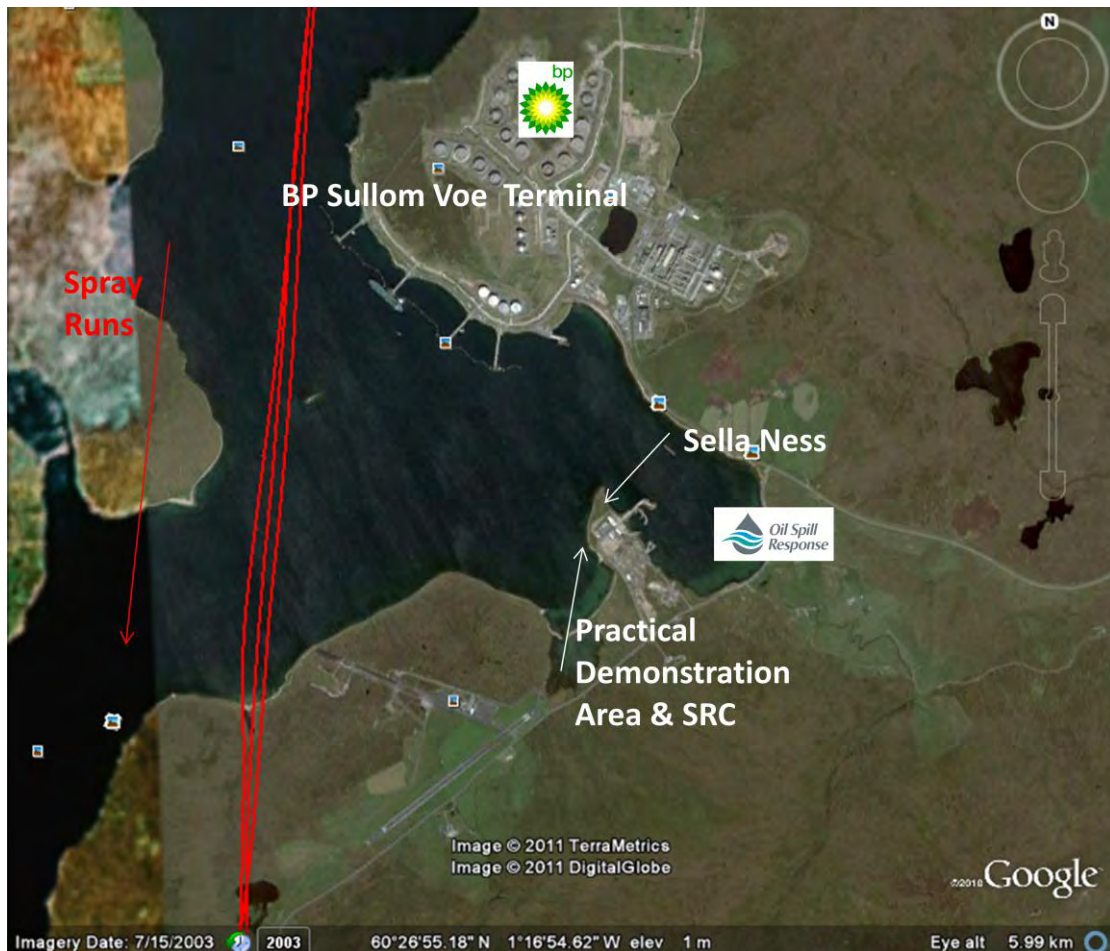
2.1.6. Shoreline Response Centre (SRC) Sella Ness, Shetland

Oil Spill Response activated a specialist to the Technical group within the SRC. The group consisted of Shetland Police, Shetland Ports and Harbours, Shetland Island Council, SEPA (Scottish Environment Protection Agency), SNH (Scottish National Heritage), WRCC (Wildlife Response Co-ordinating Committee), BP Sullom Voe Terminal.

The **Oil Spill response** Manager supported the group's primary objective by looking at the possible shoreline cleanup sites that had road access, generating booming plans for both containment/recovery and protection booming of sensitive areas (environmental and Industrial), primary equipment storage site, forward equipment lay down areas, temporary storage sites, intermediate storage sites, waste hierarchy, and waste management/disposal.

The Manager also assisted the environmental groups in the SRC with practical advice covering containment and recovery sites, with additional advice on issues that could affect the island during a spill. These issues were wide ranging and covered power generators, food supplies, portable water supplies, human waste generations, personnel accommodation, vehicle requirements (equipment and personnel), and hospital facilities. Several areas that could be considered in future responses were raised and are listed in the Lessons Learnt section of this report.

2.2. Practical Demonstration, Shetland



Aerial imagery over Shetland depicting the spray runs performed by the Hercules (L382) and the locations of the practical demonstration area, SRC, and the BP Sullom Voe Terminal.

2.2.1. Aerial Operations, Shetland

In order to reflect as closely as possible the progress expected in a counter pollution response **Oil Spill Response** mobilised 5 aircraft through the EOC Southampton. Aircraft deployments were pre-planned nevertheless the EOC Southampton regenerated all work orders and risk assessments in real time during the exercise. The aircraft mobilised were:

- MCA surveillance aircraft – Cessna 404 – Tier 2 surveillance.



- Light dispersant aircraft – Cessna 406 – Tier 2 spray with POD.
- Aerial surveillance aircraft - Cessna 310 – Tier 3 surveillance and spotting.
- Hercules - Lockheed L382 – Tier 3 spray with **Oil Spill Response's** Aerial Dispersant Delivery System (ADDS).
- Islander A/C – Provided by Cobham to capture video of the practical demonstration. This was fed live to the **Oil Spill Response** practical demonstration command tent in Shetland.



Below shows an image of the live video feed performed by the Islander A/C

An operational deployment of this type would normally occur at least 1 mile offshore in water depths of at least 20m. For the purposes of Exercise Sula the location chosen for the aerial demonstration was to all intents and purposes over land with the attendant risks related to this. The weather on the day itself was also challenging with hazards posed by adverse weather including heavy rain squalls associated with the tail end of a passing depression.

The aerial demonstration combining surveillance and spray demonstrations was carried out successfully as a result of extensive pre-planning. Preparation included pre-exercise low-level flights through the area and meetings at Scatsta airport with local marine and aviation managers. Workable solutions were agreed by all parties and with risk assessments generated and a viable aviation exercise plan constructed. The plan was heavily reliant on cooperation by all participants, good coordination throughout the event, and weather on the day being within agreed limits. All aerial operations were co-ordinated through an **Oil Spill Response** manager in the command tent in Shetland.





Hercules (L382) spraying with **Oil Spill Response's** ADDS pack in Sullom Voe, Shetland.

2.2.2. Shoreline Deployment, Sella Ness

An **Oil Spill Response** team was deployed to Sella Ness, Shetland to carry out a practical demonstration of technical capability and equipment shipped from the EOC in Southampton. In particularly windy conditions the team established a command post with communications system and a display of recovery equipment and techniques including a simulated containment area for beached oil. Throughout the practical demonstration **Oil Spill Personnel** put in place standard response safety measures including Site Response Plans (SRP), risk assessments and toolbox safety briefs.

Recovery equipment assembled for demonstration included: an Afedo Nozzle spray system, a Terminator skimmer, a Mini Vac system, a Komara 12k and 7k skimmer and a pressure washer. A Ro-Mop and High Volume Low Pressure flushing system was also demonstrated in the containment area. The demonstration included several pieces of new equipment including the Trelleborg command tent and several pumps all of which proved extremely effective.

The command tent provided shelter for various **Oil Spill Response** operations including aerial operations co-ordination, radio communications with offshore operations and demonstrations in Fluorometry and gas monitoring.

During the demonstration **Oil Spill Response** personnel interacted with media and industry observers, giving site safety briefs, practical displays and answering any questions put to them, all with excellent feedback. Throughout the demonstration **Oil Spill Response** was well supported by Shetland Island Council, Williams Shipping and BP (Sullom Voe).



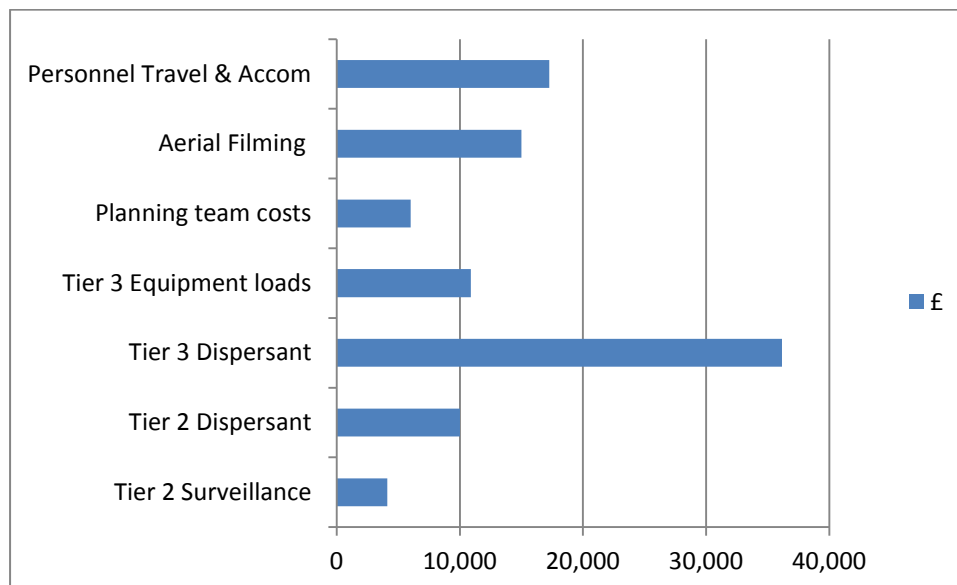
A shoreline boom is erected on shore at Sella Ness while the media watch on.

3. Safety

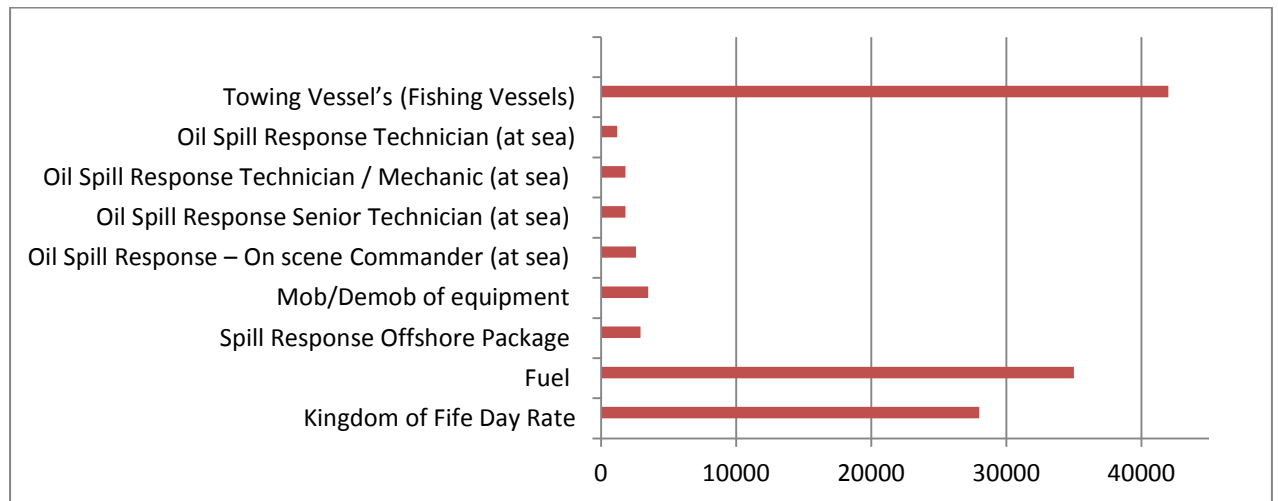
- There were no incidents or near misses during the exercise.
- Safety briefs were carried out prior to all practical elements with regular toolbox talks during operations.
- Risk assessments for each element were made site specific and recorded with the MCA.
- A practical demonstration of site entry protocols and gas monitoring was given by **Oil Spill Response** personnel at Sella Ness.

4. Cost Summary

Estimated OSR Costs



Estimated Briggs Costs



5. Lessons Learnt

As in every exercise there were things which were carried out well and which should be carried forward, these were as follows:

- Pre-exercise visits by key players were extremely comprehensive and gave all parties a thorough understanding of how the exercise was to run. The exercise itself demonstrated that industry (competitors) could come together when required.
- The exercise plan was very well structured, with a sensible scenario and constructive injects allowing all exercise objectives to be tested. The exercise was well conducted and managed by Petrofac. The quality of the briefings was consistently of high quality and the facilitators provided good briefings at the beginning and close of each day.
- Exercise Sula highlights some gaps in current levels of capability. In particular issues surrounding industry proficiency with the UK National Contingency Plan, Command and Control structures, dispersant application permissions and incident management systems were raised. These are provided in detail in the Lessons Learnt section of this report. Some very good work was carried out in trying to get a number of these issues resolved during the exercise.
- A good sense of direction and focus was maintained by all at Chevron House despite room being limited in the command post. In particular the communications between the Operation and Planning sections were well conducted, however communications to the MRC and SRC struggled with the limited connectivity available.
- Excellent exercise support was provided to exercise participants by the EOC in Southampton despite other exercises and commitments being carried out by **Oil Spill Response**.

- **Oil Spill Response** staff involved in the planning and execution of Exercise Sula showed a real willingness to solve problems and get into the exercise scenario. This was reflected in Chevron's reliance on **Oil Spill Response** at all levels and shows that **Oil Spill Response** is held in high regard within industry.
- The community of Shetland pulled together extremely well with all parties offering and providing assistance. In particular Shetland Council was proactive in supporting their work force with medical screening, gas monitoring, PPE supply and providing further support. There were issues (Working Time Directive) over long working days during summer months but a process of double shifting was suggested as a solution to this. Shetland ports and Harbours worked a very good access control and gave a thorough safety briefing with a hand out for the office building.
- The **Oil Spill Response** specialist in the SRC recommended the future use of the local Shetland workforce as not only do they already have accommodation and transport but the spiller would be assisting the local economy.
- The forward thinking of the Environment Group was excellent with lessons obviously learnt from the Braer incident. Good plans for bird hazing and sheep and livestock relocation were put in place very efficiently.
- The **Oil Spill Response** shoreline demonstration team had very good on site support at the Sella Ness facility specifically the main contact Simon Skinner who met all their requirements. In addition William's Shipping were a great help delivering equipment to Shetland and once there with the drivers performing as an integral part of the team.
- Some of the newer equipment that **Oil Spill Response** has purchased over the last few years was ideal for the shoreline practical show and tell. The new Ranger ATV drastically reduced manual handling issues and sped up the response, the new command tent is vastly superior to its predecessor and in conjunction with the new VHF masts and other assets demonstrated the range of equipment available for response.
- The **Oil Spill Response** shoreline demonstration team performed extremely well under taxing weather conditions for booming and beach cleanup. While the airborne element of the exercise was completed with all of the aircraft successfully demonstrating their capability without interruption or delay.



Appendix 1: Key Participants

Key Participants	Contact Name
MCA	Murray Milligan
DECC	Mike Reid
Chevron Upstream Europe	Ken Gillan
Chevron	Steven Conner
Stenna Offshore	Joe Higgins
Briggs Environmental	Neil Marson
Braemar Howells	Neil Lloyd
BP (Sullom Voe terminal)	Richard Hurding
Shetland Islands Council	John Taylor
Marine Scotland	Derek Moore
Hess	John Watson
Petrofac Training Services	Andy Lang
Joint Nature Conservation Committee	Findlay Bennett
Northern Constabulary	Inspector Steve Mardon
Scottish Natural Heritage	John Baxter
Foods Standards Agency Scotland	Peter Midgley
Scottish Fisheries Association	
Oil & Gas UK	Brian Kinhead
Scottish Environment Protection Agency	Graham Low (Aberdeen) Philip Dinsdale (Shetland)
Sullom Voe Port & Harbour	Roger Moore
Oil Spill Response	Zoe Beverley
Highlands & Islands Strategic Coordinating Group	Jonathon Hart
ASCO Freight Management	Ed Arnott
Stewart Group Ltd	Bruce Robertson
The Craig Group	Marc Johnston



Appendix 5 - Exercise SULA Industry Independent Report

Exercise Sula – Industry Independent Report.

Date : 18 – 19 May 2011.

Location : Sullom Voe, Shetland.

Industry Reps : George Franklin - Shell
Joe Small - Gorton Consultancy Ltd.

Client : Ken Gillan - Chevron

TOR : See attachment.

Background : To satisfy the requirement that North Sea Oil and Gas Operators must ensure that both their response plans and oil spill response equipment/resources are tested and deployed every 5 years, Chevron organised a Tier 3 mobilisation exercise for the 18th– 19th May 2011 in Sullom Voe, Shetland.

Operations Witnessed.

- Sullom Voe Harbour Tug – Dispersant spraying.
- Tier 2 aerial surveillance by Cessna aircraft.
- Tier 2/3 dispersant spraying by OSR Hercules and Cessna.
- Tier 2/3 containment and recovery. This operations witnessed included the following:-
 1. Current Buster deployment, towing and recovery procedures and techniques. Vessels utilized were the Kingdom of Fife and the fishing vessels Prolific and Copius.
 2. Ro-Boom deployment, towing and recovery procedures and techniques. Vessels utilized were the Kingdom of Fife and the fishing vessel Radiant Star.
 3. Oil Skimmer deployment and recovery procedures and techniques.

Note: Although not part of the terms of reference, due to the inclement weather, the observers also took the opportunity of viewing the land based oil spill response assets that were being demonstrated in an operational condition. These included:-

- The command and control tent.
- The VHF base station and repeater. (Incorporating both the marine and aviation bands.)
- The Bgan satellite communications system.
- Use of a fluorometer.
- The wildlife response equipment.
- Rigging and deployment of a shore guardian boom.
- A selection of skimmers rigged for demonstration purposes.
- A boat spray system.
- ATV system.

All the equipment was seen in a fully operational condition with the OSR team fully conversant with its use.

Programme.

The assessors arrived in Sullom Voe early morning on Wednesday 18th May and, after a brief overview of the OSRL equipment being mobilized to test the shoreline capabilities, both assessors boarded the Briggs owned and operated offshore support vessel Kingdom of Fife. An early morning briefing of the vessels crew and the masters of the fishing vessels had apparently taken place, this focusing on the safety, training and familiarization with the operations in the proposed work program.

The intention was to deploy the equipment on Wednesday for training and familiarization with the full exercise taking place on Thursday 19th. The containers with the current buster and ro-boom were already positioned on the main-deck of the Kingdom of Fife with the crew preparing them for deployment.

Weather conditions were marginal with overcast conditions and WSW wind 30 – 35 knots. It should be noted that these are at the upper end of conditions considered favorable for deployment of oil spill recovery equipment.

Notwithstanding the weather conditions, all the vessels proceeded offshore into the sound where conditions were monitored until a decision was taken to carry out deployment of the equipment at 1200hrs.

Between 1200 – 1600 hrs all the equipment was successfully deployed and recovered with all the vessels back alongside by 1630hrs.

At 1700hrs a wash-up meeting with all parties was held on board the Kingdom of Fife where all were encouraged to provide feedback on the day's exercise.

Unfortunately, on Thursday 19th, the weather conditions were worse than the previous day with wind speed gusting WSW 40 – 45 knots. All the vessels proceeded offshore but conditions at no stage improved sufficiently to safely deploy/operate the equipment.

However, the opportunity was taken to board one of the fishing vessels for familiarization purposes as well as discussions with the masters and a representative of the SFF. (Scottish Fisheries Federation.)

Comments/Observations.

1. The deployment, handling and recovery of the offshore equipment was carried out in a safe, professional manner.
2. Co-ordination of the offshore recovery fleet was handled well by the Exercise Co-ordinator onboard the Kingdom of Fife especially in view of the marginal weather conditions and the decision to proceed or abort the exercise.
3. It was reassuring to observe just how quickly the fishing vessels mastered the art of handling the deployed equipment, both the current buster and the ro-boom. Considering this was the first time they had handled this equipment and, having received minimal training, this is a credit to the professionalism and competence of the Masters of these vessels. (See Briggs report 003 for full details of work carried out.)
4. The ability to deploy all the equipment mobilized for the exercise was considered proven. (Even in the marginal conditions.)
5. **The only negative aspect of the exercise was with respect to the lifting slings on the MCA/Braemar Howells supplied container with the ro-boom. This was mobilised to the quay and then loaded on to the Kingdom of Fife without the correct, fully certified, pre-rigged lifting slings or tag lines. When the container needed to be moved across the deck of the Kingdom of Fife, crew were then required to climb on top of the container to rig slings. In the offshore industry, this is totally unacceptable and the unit should not have been received at the quayside. (It was noted that this had been rectified by 0800hrs on Thursday 19th by the crew of the Kingdom of Fife.)**

Recommendations

1. All OSR service providers and associated contractors should be made fully aware of the safety requirements for mobilizing equipment offshore, particularly with respect to the packaging, loads and lifting slings/ancillary equipment.
2. Consideration should be given to developing a data bank of fishing vessels that could be utilized in the event of a major offshore incident.
3. In addition to item 2 above, consideration should be given to determining the both the type and the standard of fishing vessels that could be used i.e. Certification, horse power, communication equipment, safety standard etc. This is especially critical when Loadline Exemptions and compliance with M1663 are relevant.
4. Concurrent with items 2 and 3 above, a simple oil spill response training aide could be developed and circulated within the fishing vessel community as a learning tool for awareness of what would be required by them in the event that they assisted in a major incident.
5. It is recognized that the UK is fortunate in having a number of professional oil spill responders, each with areas of specialty and expertise. In order to harness this to best effective it is recommended that a forum be established to bring together these responders to ensure better co-ordination and integration in exercises and response operations.

G. J. Franklin

J. Small

Appendix;

Appendix 6 - Exercise SULA Equipment Inventory (OSR & Briggs)

OSR Equipment Inventory

			Quantity				
			Global Stockpile**				
			Total Number	Total Manufacturers' Rated Capacity (t/hr)/ Length	Total Derated Capacity (t/hr)*	Total Derated Capacity or length (t/hr or m) You Are Able To Mobilise (i.e. 50% of global stockpile)	
Equipment	Skimmers	Oleophilic	Onshore	42	545	109	54
			Offshore	8	340	68	34
		Weir	Onshore	14	452	90	45
			Offshore	13	685	137	69
		Other	Onshore	65	790	158	79
			Offshore	21	1695	339	170
		Total (t/hr)	163	4507	901	450	
	Boom	Offshore Active Boom	Ro-skim system , tandem, 120tph skimmer, without power pack (can be used in conjunction with additional 200m boom on reel)	4	480m		240m
			2 pump weir boom capacity (120 tph) – for use in conjunction with Roboom units excluding power systems	1	120m		120m
			Nofi Harbour Buster	2	200m		100m
		Offshore Boom	Roboom 200 metres Bay Boom, on reel without power pack	19	3800m		1900m
			Roboom 400 metres Bay boom in container without power pack	1	400m		400m
			Roboom 200 metres Ocean boom on reel without power pack	3	600m		400m
			Vikoma Ocean 500 metres boom without power pack	3	1500m		1000m
			Hi Sprint 950 rapid boom with reel (300 metres long without power pack)	7	2100m		900m
			Total Offshore Boom (m)	40	9000m		5060m
		Onshore	Sea Sentinel boom 10 metres air/skirt for coastal areas	247	2470m		1235m
			Sea Sentinel boom 20 metres air/skirt for coastal areas	337	6740m		3360m
			Sea Sentinel boom air/skirt 200 metres on reel with power pack for coastal area	4	1600m		800m
			Shore Guardian boom 10 metres for beach sealing capability	174	1740m		870m
			Shore Guardian boom 20 metres for beach sealing capability	152	3040m		1520m
Troil Boom GP 750 (price per 200 metres)			2	400m	200m		
Troil Boom GP1100 (price per 200 metres)	3		600m	200m			
Sea Curtain - Foam filled in 50 metre sections	14		700m	350m			
	Total Shoreline Boom (m)	937	31690m	8535m			
Aviation	C-130/ADDS Pack		1 (2 could be made available, 1 from the UK, 1 from Singapore)				

Briggs Equipment Inventory

Base	Group	Series	Storage Location	Category	Equipment Description
Aberdeen	01	001	Yard	Booms Marine	Ro-Boom 2000
Aberdeen	01	002	Yard	Booms Marine	Ro-boom 1500
Aberdeen	01	003	Yard	Booms Marine	Ro-boom 1300
Aberdeen	01	004	Yard	Booms Marine	Fence boom
Aberdeen	01	005	Yard	Booms Marine	Ro-Boom 2000
Aberdeen	01	006	Yard	Booms Marine	Ro-boom 1500
Aberdeen	01	007	Yard	Booms Marine	Ro-boom 1300
Aberdeen	01	008	Yard	Booms Marine	Ro-boom 1500
Aberdeen	01	009	Yard	Booms Marine	Fence boom
Aberdeen	02	001	warehouse	Skimmers	Walosep W2
Burntisland	02	002	Finnart	Skimmers	Komara 15K
Aberdeen	02	003	warehouse	Skimmers	Drum Skimmer
Aberdeen	02	004	Dundee	Skimmers	Komara 12K
Aberdeen	02	005	warehouse	Skimmers	Skim Pack
Aberdeen	02	006	warehouse	Skimmers	9k Disc skimmer head
Aberdeen	02	007	warehouse	Skimmers	Komara 15K
Aberdeen	02	008	warehouse	Skimmers	Minifly
Aberdeen	02	009	warehouse	Skimmers	Minifly
Aberdeen	02	010	warehouse	Skimmers	Komara 12K
Hinderwell	02	011	Lowestoft	Skimmers	Komara 12K
Aberdeen	02	012	warehouse	Skimmers	Rope Mop barrell top
Burntisland	02	013	warehouse	Skimmers	Rope Mop barrell top
Aberdeen	02	014	warehouse	Skimmers	Kebab
Aberdeen	02	015	warehouse	Skimmers	Termite
Aberdeen	02	016	warehouse	Skimmers	9k Disc skimmer head
Aberdeen	02	017	warehouse	Skimmers	Roto Drum 70
Aberdeen	02	018	warehouse	Skimmers	Sea Devil
Aberdeen	02	019	warehouse	Skimmers	Foxtail rope 8 mop
Aberdeen	02	020	warehouse	Skimmers	SS 50 disc skimmer
Aberdeen	02	021	warehouse	Skimmers	Terminator
Aberdeen	02	022	warehouse	Skimmers	Delta head
Aberdeen	02	023	Yard	Skimmers	Trailer Oil Mop
Aberdeen	02	024	warehouse	Skimmers	GT 185
Aberdeen	02	025	warehouse	Skimmers	Norvac
Aberdeen	02	026	warehouse	Skimmers	T Disc kebab
Aberdeen	02	027	warehouse	Skimmers	Oil Mop free standing
Hinderwell	02	028	Warehouse	Skimmers	Komara 12k
Hinderwell	02	029	Immingham (ogto)	Skimmers	Komara 12k
Hinderwell	02	030	Lowestoft (fendercare)	Skimmers	Komara 12k
Hinderwell	02	031	Lowestoft (spt)	Skimmers	Komara 12k
Hinderwell	02	032	Warehouse	Skimmers	Ropemope 110v
Hinderwell	02	033	Warehouse	Skimmers	Drum skimmer
Aberdeen	02	034	warehouse	Skimmers	foxtail rope 4 mop
Aberdeen	02	035	warehouse	Skimmers	SS 50 disc skimmer
Aberdeen	02	036	warehouse	Skimmers	Sea Devil control
Hinderwell	02	037	warehouse	Skimmers	Desmi mini max weir skimmer
Aberdeen	02	038	Warehouse	Skimmers	Ro-disc 15
Aberdeen	02	039	warehouse	Skimmers	Drum skimmer c/w spate pump
Aberdeen	03	001	warehouse	Powerpacks	Kommara powerpack
Aberdeen	03	003	warehouse	Powerpacks	Spencer Carter Mini Power Pack
Aberdeen	03	004	warehouse	Powerpacks	Costal powerpack
Aberdeen	03	005	warehouse	Powerpacks	Spencer Carter Mini Power Pack
Aberdeen	03	006	warehouse	Powerpacks	Split
Aberdeen	03	007	warehouse	Powerpacks	Ro-Clean Powerpack
Aberdeen	03	008	warehouse	Powerpacks	multi purpose powerpack YELLOW
Aberdeen	03	009	Salvage container	Powerpacks	Marflex
Aberdeen	03	010	warehouse	Powerpacks	multi purpose powerpack RED
Aberdeen	03	011	warehouse	Powerpacks	Costal powerpack

Briggs Equipment Inventory

Aberdeen	03	012	warehouse	Powerpacks	Volvo powerpack
Hinderwell	03	013	Immingham (ogto)	Powerpacks	Kommara powerpack
Hinderwell	03	014	Lowestoft (fendercare)	Powerpacks	Kommara powerpack
Hinderwell	03	015	Lowestoft (spt)	Powerpacks	Kommara powerpack
Hinderwell	03	016	Warehouse	Powerpacks	Yanmar powerpack
Aberdeen	03	017	Dundee	Powerpacks	Komara powerpack
Aberdeen	03	018	Aberdeen	Powerpacks	ro-clean red powerpack
Aberdeen	04	001	warehouse	Lifting gear	2,000 Kg Pallet Truck
Hinderwell	04	002	Warehouse	Lifting gear	2000kg pallet truck
Hinderwell	04	003	Warehouse	Lifting gear	2000kg pallet truck
Aberdeen	04	004	warehouse	Lifting gear	2000kg trolley jack
Aberdeen	04	005	warehouse	Lifting gear	Axle stand
Aberdeen	04	006	warehouse	Lifting gear	2 tonne forklift
Aberdeen	04	007	warehouse	Lifting gear	bottle jack
Aberdeen	04	008	warehouse	Lifting gear	forklift jack
Aberdeen	05	001	warehouse	Pumps	Spate
Aberdeen	05	002	warehouse	Pumps	Spate
Aberdeen	05	004	warehouse	Pumps	Cargo transfer
Aberdeen	05	005	warehouse	Pumps	Cargo transfer
Aberdeen	05	006	warehouse	Pumps	Peristeltic
Aberdeen	05	007	warehouse	Pumps	Hydraulic Spirit
Aberdeen	05	008	warehouse	Pumps	Air Diaphragm Pump
Aberdeen	05	009	warehouse	Pumps	Air Diaphragm Pump chemical
Aberdeen	05	010	warehouse	Pumps	Cargo transfer
Aberdeen	05	011	warehouse	Pumps	Hydraulic Submersible
Aberdeen	05	012	Salvage container	Pumps	Cargo transfer
Aberdeen	05	013	Salvage container	Pumps	marflex pump
Aberdeen	05	014	Response vehicle	Pumps	Peristeltic
Aberdeen	05	015	warehouse	Pumps	Spate
Aberdeen	05	016	warehouse	Pumps	Air Diaphragm Pump
Aberdeen	05	017	warehouse	Pumps	Air Diaphragm Pump
Aberdeen	05	018	warehouse	Pumps	Air Diaphragm Pump
Aberdeen	05	019	warehouse	Pumps	Air diaphragm pump
Aberdeen	05	020	warehouse	Pumps	2" SUB PUMP
Aberdeen	05	021	warehouse	Pumps	Air Diaphragm Pump
Aberdeen	05	022	warehouse	Pumps	Cargo transfer screw
Aberdeen	05	023	warehouse	Pumps	3" positive displacement pump
Aberdeen	05	024	warehouse	Pumps	4" positive displacement pump
Aberdeen	05	025	warehouse	Pumps	1" 110v Sub pump
Aberdeen	05	026	warehouse	Pumps	1" 110v transfer pump
Aberdeen	05	027	Warehouse	Pumps	Peristeltic 2"
Hinderwell	05	028	Warehouse	Pumps	Perastaltic pump
Hinderwell	05	029	Warehouse	Pumps	honda 2" water pump
Hinderwell	05	030	Warehouse	Pumps	3" air pump
Hinderwell	05	031	Warehouse	Pumps	2" 110v sub pump
Hinderwell	05	032	Warehouse	Pumps	2" 110v sub pump
Aberdeen	05	033	Shoreline package A/1	Pumps	Koshin 2" water pump
Aberdeen	05	034	Shoreline package B/1	Pumps	Koshin 2" water pump
Aberdeen	05	035	warehouse	Pumps	2" hydraulic bredell pump
Aberdeen	05	036	warehouse	Pumps	4" landbruck hydraulic pump
Aberdeen	05	037	warehouse	Pumps	4" allweiler screw pump
Aberdeen	05	038	warehouse	Pumps	2" honda water pump
Aberdeen	05	039	Yard	Pumps	4" nocchi bore hole pump
Aberdeen	05	040	Yard	Pumps	2" nocchi bore hole pump
Aberdeen	05	041	Yard	Pumps	6" centrifugal pump
Aberdeen	05	042	Yard	Pumps	6" centrifugal pump
Aberdeen	05	043	Yard	Pumps	4" centrifugal pump
Aberdeen	05	044	Yard	Pumps	4" centrifugal pump
Hinderwell	05	045	Warehouse	Pumps	2" diesel yanmar spate pump

Briggs Equipment Inventory

Aberdeen	06	001	Yard	Trailer and Containers	iforwilliams
Aberdeen	06	002	Yard	Trailer and Containers	iforwilliams
Aberdeen	06	003	Yard	Trailer and Containers	Container 20ft x 8ft sorbent
Aberdeen	06	004	Yard	Trailer and Containers	Container 20ft x 8ft sorbent
Aberdeen	06	005	Yard	Trailer and Containers	Container 20ft x 8ft sorbent
Aberdeen	06	006	Yard	Trailer and Containers	Container 20ft x 8ft helipod
Aberdeen	06	007	Yard	Trailer and Containers	Container 20ft x 8ft spray arm
Aberdeen	06	008	Yard	Trailer and Containers	Container 20ft x 8ft
Aberdeen	06	009	Yard	Trailer and Containers	Container 20ft x 8ft
Aberdeen	06	010	Yard	Trailer and Containers	Container 20ft x 8ft archive
Aberdeen	06	011	Yard	Trailer and Containers	Container 20ft x 8ft workshop
Aberdeen	06	012	Yard	Trailer and Containers	Container 10ft x 8ft Ro-skim 2000
Aberdeen	06	013	Yard	Trailer and Containers	Container 6ft x 6ft rigging
Aberdeen	06	014	Salvage container	Trailer and Containers	Container 10ft x 8ft salvage
Aberdeen	06	015	Yard	Trailer and Containers	6 x 6 mini offshore container
Hinderwell	06	016	Lowestoft (fendercare)	Trailer and Containers	6 x 6 sts container
Hinderwell	06	017	Lowestoft (spt)	Trailer and Containers	6 x 6 sts container
Hinderwell	06	018	Lowestoft (spt)	Trailer and Containers	6 x 6 sts container
Hinderwell	06	019	Warehouse	Trailer and Containers	Twin axle 1 tonne trailer
Hinderwell	06	020	Immingham (ogto)	Trailer and Containers	Twin axle box trailer
Hinderwell	06	021	Immingham (ogto)	Trailer and Containers	20 x 8 container
Aberdeen	06	022	Yard	Trailer and Containers	Container 10ft x 8ft Ro-skim 2000
Aberdeen	06	023	Yard	Trailer and Containers	Container 10ft x 8ft paint
Aberdeen	06	024	Dundee	Trailer and Containers	inshore box trailer
Aberdeen	06	025	Yard	Trailer and Containers	Container 10ft x 8ft misc
Aberdeen	06	026	Yard	Trailer and Containers	Container 10ft x 8ft Ro-skim 1500
Aberdeen	06	027	Yard	Trailer and Containers	inshore box trailer
Aberdeen	07	001	Yard	Spraying Equipment	pressure washer
Hinderwell	07	002	Warehouse	Spraying equipment	petrol driven powerwasher
Aberdeen	07	003	Yard	Spraying equipment	Diesel driven powerwasher
Aberdeen	07	004	warehouse	Spraying equipment	Electric pressure washer
Aberdeen	07	005	warehouse	Spraying equipment	Rigid pressure tester
Aberdeen	08	001	warehouse	Vehicles and Boats	Inflatable Dinghy
Aberdeen	08	002	Yard	Vehicles and Boats	Chinook rib 60hp
Aberdeen	08	003	Yard	Vehicles and Boats	Camperdown 85hp
Aberdeen	08	004	Yard	Vehicles and Boats	Carson 500 semi rigid
Aberdeen	08	005	Yard	Vehicles and Boats	Argocat
Hinderwell	08	006	Warehouse	Vehicles and Boats	3.5m suzamar inflatable boat
Hinderwell	08	007	Warehouse	Vehicles and Boats	2m zodiac inflatable
Hinderwell	08	008	Warehouse	Vehicles and Boats	3m semi rigid inflatable
Hinderwell	08	009	Warehouse	Vehicles and Boats	cat 2.5 tonne forklift
Aberdeen	10	001	warehouse	Storage Tanks	Rapide tank
Aberdeen	10	002	warehouse	Storage Tanks	Pillow Tank
Aberdeen	10	003	warehouse	Storage Tanks	Pillow Tank
Aberdeen	10	004	warehouse	Storage Tanks	Pillow Tank
Aberdeen	10	005	warehouse	Storage Tanks	Pillow Tank
Aberdeen	10	006	warehouse	Storage Tanks	Fastank
Aberdeen	10	007	warehouse	Storage Tanks	Fastank
Burntisland	10	009	warehouse	Storage Tanks	Fastank
Hinderwell	10	010	Warehouse	Storage Tanks	2000 gallon fastank + liner
Hinderwell	10	011	Warehouse	Storage Tanks	2000 gallon fastank
Hinderwell	10	012	Immingham (ogto)	Storage Tanks	2000 gallon fastank + liner
Hinderwell	10	013	Dundee	Storage Tanks	2000 gallon fastank
Hinderwell	10	014	Warehouse	Storage Tanks	2000 gallon fastank
Hinderwell	10	015	Warehouse	Storage Tanks	2000 gallon fastank
Aberdeen	11	001	warehouse	Generator/lighting	Generator
Hinderwell	11	002	Warehouse	Generator/lighting	110/240v generator
Hinderwell	11	003	Warehouse	Generator/lighting	110v-240v honda generator
Aberdeen	11	004	Warehouse	Generator/lighting	110/240v honda generator

Briggs Equipment Inventory

Aberdeen	12	001	Shoreline package A/1	Air Blowers	hydraulic air blower
Aberdeen	12	002	warehouse	Air Blowers	Hydraulic (Ro-Boom)
Aberdeen	12	003	warehouse	Air Blowers	Hydraulic (Ro-Boom)
Aberdeen	12	004	warehouse	Air Blowers	Honda 4 stroke
Hinderwell	12	005	Warehouse	Air blowers	Echo air blower
Hinderwell	12	006	Lowestoft (fendercare)	Air blowers	Echo air blower
Hinderwell	12	007	Lowestoft (spt)	Air blowers	Echo air blower
Aberdeen	12	008	Shoreline package B/1	Air blower	Sthil air blower
Aberdeen	12	009	Warehouse	Air blower	Echo air blower
Aberdeen	12	010	Dundee	Air blower	Echo air blower
Aberdeen	12	011	warehouse river stillage	Air blower	Sthil air blower
Hinderwell	12	012	Warehouse	Air blower	
Hinderwell	12	013	Warehouse	Air blower	
Hinderwell	13	001	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	002	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	003	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	004	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	005	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	006	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	007	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	008	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	009	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	010	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	011	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	012	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	013	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	014	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	015	Warehouse	Booms inshore	15m 600 sentinal
Hinderwell	13	016	Immingham (ogto)	Booms inshore	15m 600 sentinal
Hinderwell	13	017	Immingham (ogto)	Booms inshore	15m 600 sentinal
Hinderwell	13	018	Immingham (ogto)	Booms inshore	15m 600 sentinal
Hinderwell	13	019	Immingham (ogto)	Booms inshore	15m 600 sentinal
Hinderwell	13	020	Immingham (ogto)	Booms inshore	15m 600 sentinal
Hinderwell	13	021	Immingham (ogto)	Booms inshore	15m 600 sentinal
Hinderwell	13	022	Immingham (ogto)	Booms inshore	15m 600 sentinal
Hinderwell	13	023	Immingham (ogto)	Booms inshore	15m 600 sentinal
Hinderwell	13	024	Immingham (ogto)	Booms inshore	15m 600 sentinal
Hinderwell	13	025	Immingham (ogto)	Booms inshore	15m 600 sentinal
Hinderwell	13	026	Warehouse	Booms inshore	Red pvc 50cm x 3m
Hinderwell	13	027	Warehouse	Booms inshore	Red pvc 50cm x 3m
Hinderwell	13	028	Warehouse	Booms inshore	Red pvc 50cm x 3m
Hinderwell	13	029	Warehouse	Booms inshore	Yellow pvc 70cm x 5m
Hinderwell	13	030	Warehouse	Booms inshore	Orange pvc 70cm x 5m
Hinderwell	13	031	Warehouse	Booms inshore	Orange pvc 70cm x 5m
Hinderwell	13	032	Warehouse	Booms inshore	Troil boom 70cm x 5m
Hinderwell	13	033	Warehouse	Booms inshore	Troil boom 70cm x 5m
Aberdeen	13	034	Dundee	Booms inshore	25m 600 sentinal
Aberdeen	13	035	Dundee	Booms inshore	25m 600 sentinal
Aberdeen	13	036	Dundee	Booms inshore	25m 600 sentinal
Aberdeen	13	037	Dundee	Booms inshore	25m 600 sentinal
Aberdeen	13	038	Dundee	Booms inshore	25m 600 sentinal
Aberdeen	13	039	warehouse river stillage	Booms inshore	10m 450 sentinal
Aberdeen	13	040	warehouse river stillage	Booms inshore	10m 450 sentinal
Aberdeen	13	041	warehouse river stillage	Booms inshore	10m 450 sentinal
Aberdeen	13	042	warehouse river stillage	Booms inshore	10m 450 sentinal
Aberdeen	13	043	warehouse river stillage	Booms inshore	10m 450 sentinal
Aberdeen	13	044	warehouse river stillage	Booms inshore	10m 450 sentinal
Aberdeen	13	045	warehouse river stillage	Booms inshore	10m 450 sentinal
Aberdeen	13	046	warehouse river stillage	Booms inshore	10m 450 sentinal

Briggs Equipment Inventory

Aberdeen	13	047	warehouse river stillage	Booms inshore	10m 450 sentinal
Aberdeen	13	048	warehouse river stillage	Booms inshore	10m 450 sentinal
Aberdeen	13	049	warehouse river stillage	Booms inshore	10m 450 sentinal
Aberdeen	13	050	warehouse river stillage	Booms inshore	10m 450 sentinal
Aberdeen	13	051	warehouse river stillage	Booms inshore	10m 450 sentinal
Aberdeen	13	052	Shoreline package B/2	Booms inshore	25m 600 sentinal
Aberdeen	13	053	Shoreline package B/2	Booms inshore	25m 600 sentinal
Aberdeen	13	054	Shoreline package B/2	Booms inshore	25m 600 sentinal
Aberdeen	13	055	Shoreline package B/2	Booms inshore	25m 600 sentinal
Aberdeen	13	056	Shoreline package B/2	Booms inshore	20m 600 shore gaurdian
Aberdeen	13	057	Shoreline package B/2	Booms inshore	20m 600 shore gaurdian
Aberdeen	13	058	Shoreline package B/1	Booms inshore	20m 600 shore gaurdian
Aberdeen	13	059	Shoreline package B/1	Booms inshore	20m 600 sentinal
Aberdeen	13	060	Shoreline package A/2	Booms inshore	20m 600 sentinal
Aberdeen	13	061	Shoreline package A/2	Booms inshore	20m 600 sentinal
Aberdeen	13	062	Shoreline package A/2	Booms inshore	25m 600 sentinal
Aberdeen	13	063	Shoreline package A/2	Booms inshore	25m 600 sentinal
Aberdeen	13	064	Shoreline package A/2	Booms inshore	20m 600 shore gaurdian
Aberdeen	13	065	Shoreline package A/2	Booms inshore	20m 600 shore gaurdian
Aberdeen	13	066	Shoreline Package A/1	Booms inshore	10m 600 shore gaurdian
Aberdeen	13	067	Shoreline Package A/1	Booms inshore	10m 600 shore gaurdian
Aberdeen	13	068	Shoreline Package A/1	Booms inshore	10m 600 shore gaurdian
Aberdeen	13	069	Shoreline Package A/1	Booms inshore	20m 600 sentinal
Aberdeen	13	070	Shoreline Package B/1	Booms inshore	20m 600 shore gaurdian
Hinderwell	13	071	Warehouse	Booms inshore	Shore gaurdian
Hinderwell	13	072	Warehouse	Booms inshore	Shore gaurdian
Hinderwell	13	073	Warehouse	Booms inshore	Shore gaurdian
Hinderwell	13	074	Warehouse	Booms inshore	Shore gaurdian
Hinderwell	13	075	Warehouse	Booms inshore	Shore gaurdian
Hinderwell	13	076	Warehouse	Booms inshore	Shore gaurdian
Hinderwell	13	077	Warehouse	Booms inshore	Shore gaurdian
Hinderwell	13	078	Warehouse	Booms inshore	Shore gaurdian
Hinderwell	13	079	Warehouse	Booms inshore	Shore gaurdian
Hinderwell	13	080	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	081	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	082	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	083	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	084	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	085	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	086	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	087	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	088	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	089	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	090	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	091	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	092	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	093	Warehouse	Booms inshore	sea sentinal
Hinderwell	13	094	Warehouse	Booms inshore	sea sentinal
Aberdeen	14	001	warehouse	Miscellaneous	overtum box
Aberdeen	14	002	warehouse	Miscellaneous	training equipment
Aberdeen	14	003	warehouse	Miscellaneous	50l air compressor electric
Aberdeen	14	004	warehouse	Miscellaneous	overtum/uplift spares box
Aberdeen	14	005	warehouse	Miscellaneous	4hp outboard
Aberdeen	14	006	warehouse	Miscellaneous	plasma cutter
Aberdeen	14	007	Workshop	Miscellaneous	Mig welder
Aberdeen	14	008	warehouse	Miscellaneous	space heater
Aberdeen	14	009	warehouse	Miscellaneous	hydraulic floor press
Aberdeen	14	010	warehouse	Miscellaneous	Parts cleaner
Aberdeen	14	011	Yard	Miscellaneous	fence boom on trailer reel 75m

Briggs Equipment Inventory

Aberdeen	14	012	Workshop	Miscellaneous	Oxy/ Acei Regulators
Aberdeen	14	013	Workshop	Miscellaneous	Tylarc 453 Arc welder
Aberdeen	14	014	warehouse	Miscellaneous	Lathe
Aberdeen	14	015	Yard	Miscellaneous	Interceptor tank
Aberdeen	14	016	Yard	Miscellaneous	6" hose reel
Aberdeen	14	017	warehouse	Miscellaneous	Bunded fuel tank trailer
Aberdeen	14	019	warehouse	Miscellaneous	Hose reel for hydraulics
Aberdeen	14	020	warehouse	Miscellaneous	Sand Blaster
Aberdeen	14	021	Yard	Miscellaneous	Test tank for pumps
Aberdeen	14	022	warehouse	Miscellaneous	overturn training tank
Hinderwell	14	023	Warehouse	Miscellaneous	Selva 9.9hp outboard
Aberdeen	14	024	Warehouse	Miscellaneous	Atlas copco trailer compressor
Aberdeen	14	025	Warehouse	Miscellaneous	Walosep hydraulic control valve
Aberdeen	14	026	warehouse	Miscellaneous	Split reel
Aberdeen	14	027	warehouse	Miscellaneous	hydraulic pump control eureka
Aberdeen	14	028	warehouse	Miscellaneous	air lubricator
Aberdeen	14	029	warehouse	Miscellaneous	air lubricator
Aberdeen	14	030	Warehouse	Miscellaneous	8hp outboard
Aberdeen	14	031	warehouse	Miscellaneous	Parts cleaner
Aberdeen	14	032	warehouse	Miscellaneous	Bench drill
Aberdeen	14	033	warehouse	Miscellaneous	Bench vice
Aberdeen	14	034	Warehouse	Miscellaneous	Bench grinder
Aberdeen	14	035	Warehouse	Miscellaneous	chop saw
Aberdeen	14	036	Warehouse	Miscellaneous	battery booster
Aberdeen	14	037	Warehouse	Miscellaneous	Pipe bender
Aberdeen	14	038	Salvage container	Miscellaneous	hydraulic control valve
Aberdeen	14	039	Yard	Miscellaneous	Diesel filter unit
Aberdeen	14	040	Yard	Miscellaneous	nordan transfer reel
Aberdeen	14	041	Yard	Miscellaneous	transfer reel
Aberdeen	14	042	warehouse	Miscellaneous	Sack trolley
Aberdeen	14	043	warehouse	Miscellaneous	hydraulic grab
Hinderwell	14	044	Warehouse	Miscellaneous	4hp mariner outboard
Aberdeen	15	001	warehouse	Calibrated equipment	Salter Scales
Aberdeen	15	005	warehouse	Calibrated equipment	overturn bath/training equipment
Hinderwell	16	001	Warehouse	Calibrated equipment	Draeger 9 litre back pack
Hinderwell	16	002	Warehouse	Calibrated equipment	Draeger 9 litre back pack
Hinderwell	16	003	Warehouse	Calibrated equipment	Draeger 9 litre back pack
Hinderwell	16	004	Warehouse	Calibrated equipment	Draeger 9 litre back pack

Appendix 7 – EERD Close-Out Report (JP Kenny)

Report

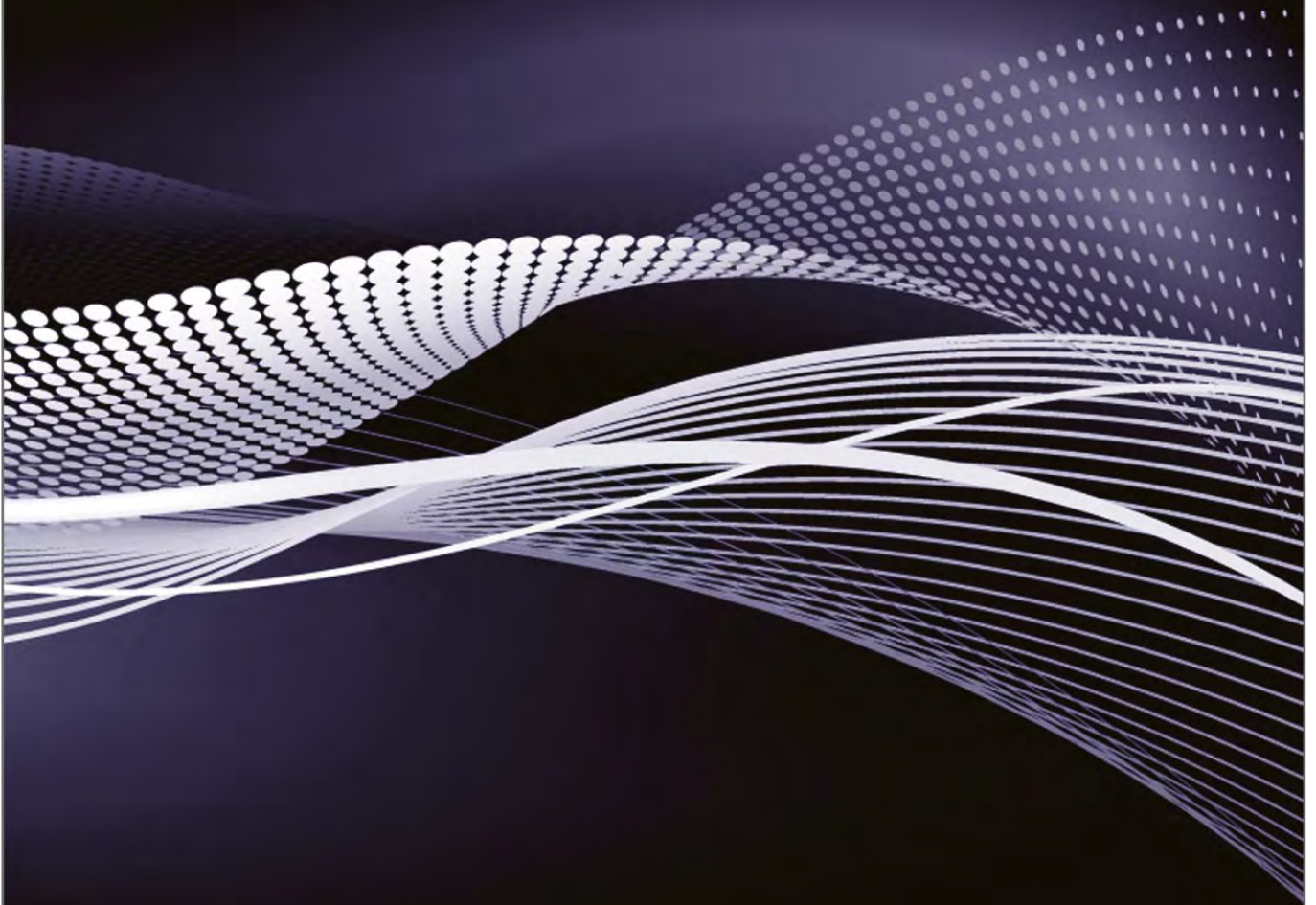
Experience that Delivers



Prepared for: TOTAL

EERD Close-Out Report

August, 2011



Experience that Delivers



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TOTAL

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EERD PROJECT

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R01	18/08/2011	ISSUED FOR COMMENT	ND	EOL	ND	CBN	

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Date

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Client Approval

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1.0 INTRODUCTION

1.1 General

The Department of Energy and Climate Control (DECC) requested that the Offshore Oil and Gas industry demonstrate its emergency response capability by conducting an offshore trial of emergency response equipment West of Shetland.

JPK was subsequently engaged by Oil & Gas UK Ltd to provide technical support and project management for the Emergency Equipment Response Demonstration (EERD) exercise.

The EERD comprises the following key activities:

1. Demonstrate capability to pump oil dispersant chemicals at approx 300m water depth;
2. Demonstrate cutting of a marine riser and recovery of cut section;
3. Demonstrate installation of a well capping device on a simulated wellhead – EERD Cap.

The OSPRAG capping device completed its SIT at Cameron Ltd., Leeds in August 2011 and will be placed into long term storage at Cameron Ltd., Badentoy. The main focus of the EERD is to demonstrate that such a Cap could be deployed on wire from a LWI/MSV or similar type of vessel in a WoS environment.

The project kicked off in Aberdeen on the 7th February 2011 following award of Contract to JPK. Following completion of all onshore trials and SIT's, the MSV 'Well Enhancer' mobilised on the 10th of July from Aberdeen for an offshore demonstration which took place WoS at the Total Exploration and Production UK (TEPUK) owned Edradour area (206/4) in a water depth of approximately 305 metres. The exercise was successfully completed on 27th July 2011.

1.2 Purpose of Document

The purpose of this document is to detail the planning and execution operations undertaken during the EERD exercise.

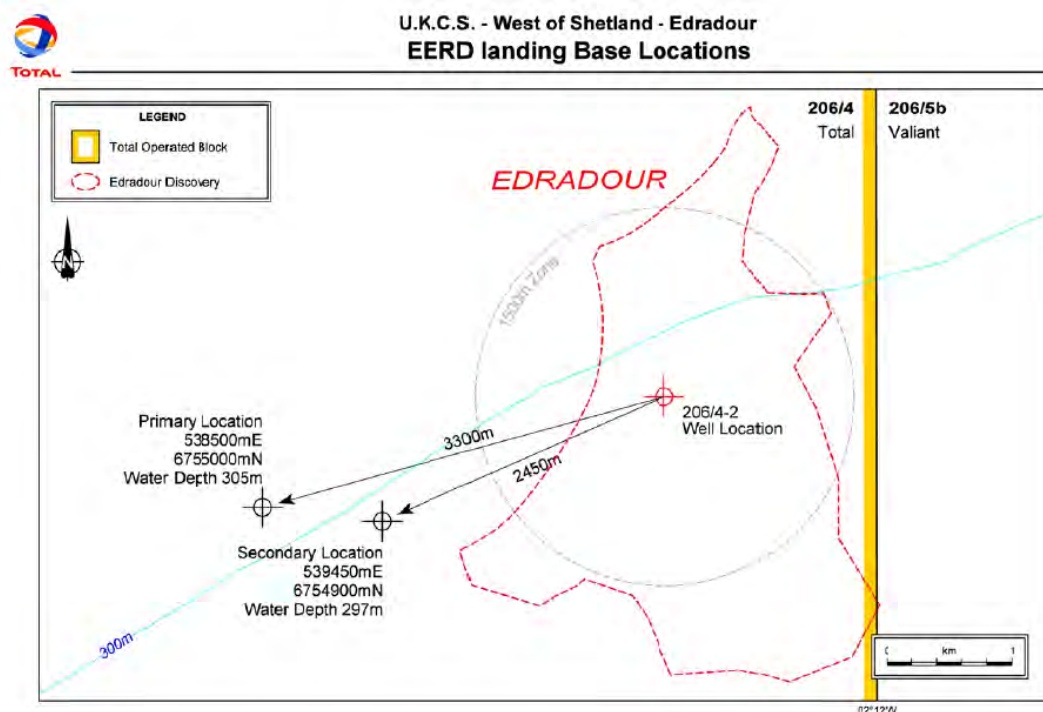
The report captures the lessons learned throughout the project with a view to ensuring that key lessons are available in the event of future demonstration trials and also in the event of a UKCS/WoS blowout.

It is expected that this report will provide a reference document to assist Operators with any future emergency equipment demonstrations and will also assist with emergency preparedness planning operations as part of the drilling consent process.

1.3 EERD Location

The location of the EERD was on an existing TEPUK operated Block (206/4) close to the proposed Edradour development. This site was chosen as it was in the water depth range required by the project and TEPUK had some historical seabed data for this area. Primary and secondary locations were identified. The secondary area was considered necessary in the event there were problems associated with landing the structures at the primary location. Both locations were in approximately the same water depth at 305m and 297m respectively. The exact location is shown in Figure 1-1.

Figure 1-1 EERD Location



1.4 Reference Documentation

The following table references the major documentation produced for the EERD.

Table 1-1 Key Project Documentation

DOCUMENT TITLE	DOCUMENT NUMBER
Oil Dispersal Equipment	1347/PROC/ODE - 1
EERD Cap Deployment & Recovery	11347/PROC/EERD CAP – 2
EERD Shear Exercise procedure	11347/PROC/SHEAR EXERCISE – 3
Bridging Document	11347/MAN1/SIMS1
Project Risk Management System	11347/MAN2/PRMS
HAZID Document	11347/PRMS/HAZ-1
Lift Plans	11347/001 – 11347/007
Port Call Plan Mob (Aberdeen)	11347/PROC/PCP
Port Call Plan (Lerwick)	11347/PROC/PCP
Port Call Plan Demob (Lerwick)	11347/PROC/PCP
Vessel Scope of Work	LAT-GEN-00-L-RP-90001-001
Cap Scope of Work	LAT-GEN-00-L-RP-90001-002
Shears Scope of Work	LAT-GEN-00-L-RP-90001-003
ODE Scope of Work	LAT-GEN-00-L-RP-90001-004
ROV Tooling Scope of Work	LAT-GEN-00-L-RP-90001-005
Vessel Scope of Work – Well Ops	LAT-GEN-00-L-RP-90001-006

1.5 Abbreviations

The following abbreviations have been used in this document:

AHC	Active Heave Compensation
CFD	Computational Fluid Dynamics
CT	Coil Tubing
DECC	Department of Energy and Climate Control
DMA	Dead Man Anchor
DWOP	Drill the Well on Paper
EERD	Emergency Equipment Response Demonstration
EIA	Environmental Impact Assessment
E&P	Exploration and Production
GoM	Gulf of Mexico
GPM	Gallons per Minute
GSI	Gulf Stream International
HAZID	Hazard Identification
HPU	Hydraulic Power Unit
Hs	Significant Wave Height
HSSE	Health Safety Security Environment
HTT	High Torque Tool
HXT	Horizontal Xmas Tree
LED	Light Emitting Diode
LH	Left Hand
LTT	Low Torque Tool
LWI	Light Well Intervention
m	metres
MPI	Magnetic particle Inspection
MSL	Mean Sea Level
MSV	Multi Service Vessel
MWS	Marine Warranty Surveyor
ODE	Oil Dispersal Equipment
OROV	Observation Remotely Operated Vehicle
OSPRAG	Oil Spill Prevention and Response Advisory Group
OSRL	Oil Spill Response Limited
PMV	Production Master Valve
ppm	parts per million

PWV	Production Wing Valve
RH	Right Hand
ROV	Remotely Operated Vehicle
SHPU	Subsea Hydraulic Power Unit
SIT	System Integration Testing
SOR	Statement of Requirements
SOW	Scope of Work
TBT	Tool Box Talk
TCT	Tungsten Carbide Tip
TDU	Tool Deployment Unit
TEPUK	Total Exploration and Production United Kingdom
TMS	Tether Management System
TRG	Technical Review Group
UKCS	United Kingdom Continental Shelf
WoS	West of Shetland
WOUK	Well Ops UK
WROV	Work Class Remotely Operated Vehicle
WWC	Wild Well Control
XT	Xmas Tree

2.0 SUMMARY

The EERD Exercise was completed within the anticipated operational timing, within budget and without incident. All the equipment performed well in the 305m water depth in a WoS environment. The exercise demonstrated that the EERD Cap could be deployed using wire from either a vessel crane or through the moonpool of a LWI/MSV style of vessel.

The subsea shears and subsea HPU worked well and confirmed that it was possible to deploy and operate such a system from a monohull vessel.

The ODE equipment, based on existing pumping spread technology using a 2" supply hose, demonstrated that such a system works well.

Conditions were generally favourable with only 1/2 day lost to waiting on weather throughout the campaign. The sea state varied typically from Hs 1.8m to Hs 2.5m and typically equipment was deployed and operated in Hs<2m. Currents experienced were typically around 1 knot.

3.0 CONCLUSIONS

- 1) The EERD confirmed that it is possible to install a Cap, of similar weight and configuration to the OSPRAG Cap, on wire using either a vessel crane or through a vessel moonpool handling system in water depths of 305m WoS from a monohull vessel onto a non flowing well;
- 2) The EERD confirmed that it is possible to pump simulated oil dispersal chemicals in water depths of 305m using a supply hose, subsea manifold with an ROV and lance arrangement system from a monohull vessel;
- 3) The EERD confirmed that it is possible to deploy a subsea shearing system and cut a section of 21" marine riser and recover it in water depths of 305m from a monohull vessel;
- 4) The EERD confirmed that it is possible to use a super grinder mounted to the WROV and cut-out sections of a choke and kill lines and recover them in water depths of 305m from a monohull vessel.

4.0 RECOMMENDATIONS

In the event of conducting a future EERD exercise the following recommendations should be considered:

- 1) Source a single vessel suitable for the complete workscope at outset;
- 2) Vessel should ideally have a fully rated AHC crane at depth;
- 3) Consider landing subsea HPU on seabed – to minimise number of lines within a congested moonpool;
- 4) Consider dispensing with subsea HPU and use direct hydraulics;
- 5) Consider 2 sets of rigging to minimise manual handling (vessel specific);
- 6) Consider alternative to MPI requirement for seafastening;
- 7) Consider use of a 16"/18" blade for choke and kill line cutting;
- 8) Ensure subsea shears have an ROV grab handle incorporated to assist with hot stab engagement.

For emergency response planning purposes the following recommendations should be considered in addition to those listed above:

- 9) Determine what subsea oil dispersal equipment is available to match water depth and operational requirement. This should be done in advance to determine what if any equipment would be readily available or would require sourcing;
- 10) Generate a Scope of Work / Specification for above ODE scope;
- 11) Ensure a suitable set of shears and a 16" super grinder is available as part of a tool pool;
- 12) Verify in advance that the OSPRAG Cap can be deployed over a given flowing well by conducting an uplift force analysis and CFD modeling;
- 13) A minimum criteria and subsequent list of suitable vessels should be produced to be utilised in the event of a future well capping operation. The EERD operation was carried out in the summer season. A recommendation would be to carry out research into historical weather trends for the relevant areas which can be referenced when producing a minimum vessel specification

5.0 PROJECT PLANNING

5.1 Scope of Exercise

JPK was approached by Oil and Gas UK Ltd in January 2011 to provide support for a proposed oil response demonstration exercise that the industry was planning for summer 2011. The exercise would be conducted offshore West of Shetland in water depths of around 300 – 400m.

The original scope of the exercise was limited to demonstrating that the EERD Cap could be deployed on wire from a vessel crane West of Shetland. The scope was subsequently increased by Oil & Gas UK to include a demonstration of well site clean-up and subsea oil dispersal capability as such a scope may form part of operators drilling consent process.

JPK created various Scopes of Work associated with the above programme as listed in Table 1-1 namely:

- EERD Cap SOW;
- Shears System SOW;
- ODE Equipment SOW;
- ROV Services SOW;
- Vessel SOW.

5.2 Demonstration Overview

The demonstration comprises the following key activities:

- Deployment of Cap landing base structure on seabed and landing of pipe support structure on the seabed;
- Landing of overburden weight onto Cap landing base;
- Recovery of the overburden weights;
- Simulation of subsea oil dispersant supply above the landing base structure;
- Deployment of ROV shears and the cutting of a section of pipe on the pipe support structure;
- Recovery of subsea shears and pipe support structure;
- Deployment of the EERD Cap onto the landing base and Cap operated by ROV;
- Recovery of the oil dispersal equipment;
- Recovery of the EERD Cap;
- Recovery of the EERD Cap Landing Base.

5.3 Overview of the Cap Landing Base Installation

The Cap landing base was deployed from the vessel at a pre-determined seabed location. The structure was verified level within the verticality required for the landing and recovery of the EERD Cap as described in the equipment Contractor procedure.

An overburden weight arrangement was deployed on wire on top of the landing base and left in place for an agreed period of time to preload the landing base. The overburden

weight was configured to be representative of the EERD Cap weight. The overburden weight was recovered prior to deploying the EERD Cap.

5.4 Overview of the Oil Dispersal Equipment Demonstration

The oil dispersal equipment demonstration was conducted following the placement of the Cap landing base. The demonstration was performed following recovery of the overburden weights.

The oil dispersal equipment demonstration involved overboarding a fluid supply hose adjacent to the landing base followed by the pumping of dyed fluid from the support vessel via an ROV mounted lance used to direct the fluid at a location just above the landing base. The dispersal equipment was then be recovered to the vessel.

5.5 Overview of the EERD Cap Installation

The EERD Cap was deployed on wire through the vessel moonpool. The Cap was landed out on the Cap landing base. The Cap was then locked to the base and several valves operated by ROV to simulate OSPRAG Cap installation and operation.

5.6 Overview of the EERD Cap Recovery

The EERD Cap was recovered on wire and set down on deck. The Cap was then be picked up by the vessel crane and deployed over the side of the vessel to a depth of 30m to simulate deploying the cap using a vessel crane. The Cap was then be picked up and set down on deck.

5.7 Overview of the Cutting of Pipe

A pipe cutting support base was landed on the seabed at a predetermined location.

An ROV super grinder was used to cut a section of choke and kill line from both choke and kill lines on the pipe cutting base.

A set of subsea shears was then deployed from the vessel and used to take a horizontal cut on the pipe section forming part of the pipe cutting support structure. The cut sections of choke and kill lines were recovered to the vessel. The cutting base was then recovered.

All equipment was recovered from the seabed at the end of the demonstration.

5.8 Planning

A significant effort by all parties resulted in a comprehensive onshore testing and verification programme being undertaken. The time and effort expended during the onshore contributed to a successful offshore campaign.

5.8.1 Management

TEPUK organised the weekly project meetings throughout the planning phase of the project. Minutes were recorded by TEPUK and distributed weekly. TEPUK also created and managed the weekly action list. The EERD was treated as a 'live' subsea operation and treated no different from any other subsea workscope.

5.8.2 Schedule

A detailed schedule was created for all activities from planning, manufacturing and testing in addition to the offshore element. The schedule is attached in Appendix 2. The schedule was revised weekly and distributed to key project personnel.

5.8.3 Project Milestones Achieved

1. 04th February 2011, Project Kick – Off with Oil & Gas UK and JPK;
2. 04th March 2011, TEPUK ‘volunteer’ to act as Operator (reporting to Oil & Gas UK);
3. 23rd June 2011 - Shear Trial took place in a Dry Dock, Peterhead;
4. 27th & 28th June 2011 - EERD Cap SIT took place at Neptune DeepTech, Stonehaven;
5. 30th June 2011 - ODE Trail took place in Qserv, Portlethen;
6. 08th July – WROV Super Grinder Trials at Oceaneering’s Lower Yard Pitmedden Road Dyce;
7. 14th July 2011 - Mobilisation of the Well Enhancer from Aberdeen with the EERD Cap, Landing Base, Overburden Weight and ODE;
8. 17th July 2011 – Mobilisation of the GSI Subsea Shears and Pipe Cutting Base at Lerwick;
9. 19th July 2011 – Completion of the ODE subsea Trail;
10. 21st July 2011 – Completion of the EERD Cap Deployment and interfacing with Landing Base;
11. 21st July 2011 – Demobilisation of the EERD Cap, Overburden Weight, Cap Landing Base and ODE at Lerwick;
12. 24th July 2011 - Mobilisation of the Subsea Shears, SHPU and Pipe Cutting Base at Lerwick;
13. 26th July 2011 - Completion of Subsea Cutting Trials;
14. 27th July 2011 - Well Enhancer completed demobilisation of remaining EERD spread in Lerwick.

5.8.4 Cost Reporting

Cost estimates for all activities was prepared and issued prior to project sanction by Oil & Gas UK. The cost estimates were updated as the offshore element was firmed up and vessel costs were finalised. Weekly project spend was tracked and reported through the weekly reporting programme.

5.9 Cap Selection

Early on in the planning phase it was evident that the OSPRAG Cap, being built by Cameron’s in Leeds and directed and managed by BP, would not be ready in time for the demonstration. The industry required that an exercise capping device be developed to avoid any possible damage to the OSPRAG Capping Device. It was therefore necessary to source an alternative Capping device that would simulate the OSPRAG Cap.

Various options were investigated and Total offered a 5” HXT that had recently been returned from the field and was available as a donor Cap. The HXT was adopted as the EERD Cap and would be used in lieu of the OSPRAG Cap. The HXT was modified to best replicate the weight and basic functionality of the OSPRAG Cap. The main criteria used for cap selection was as follows:

- Could be deployed on wire from a LWI style of vessel;
- Had an in air weight of approx 40t;

- Had a similar footprint/general configuration to the OSPRAG Cap;
- Had both actuated and manual barrier valves;
- Could be operated by hot stab, manipulator and TDU;
- Had a wellhead connector capable of being locked and unlocked by ROV.

5.10 Shears Selection

It was decided that a horizontal cut on a vertical pipe would best replicate the cutting of a marine riser above the BOP flex joint. A Pipe Cutting Base was configured comprising of a support base and a section of 21" marine riser pipe c/w choke and kill lines. It was considered prudent to demonstrate that the choke and kill lines could be cut prior to cutting the main pipe with the subsea shears.

A number of Companies were approached and Oceaneering and Wild Well Control submitted bids for the SOW. Oceaneering was subsequently awarded the contract for the supply of the shearing system.

5.11 ODE Selection

Wild Well Control and OSRL were approached to provide the ODE scope. OSRL declined to bid. WWC proposed a CT based solution with a subsea manifold. The CT proposal was evaluated by the project but was discounted on the basis of complexity, cost and project risk associated with mobilising equipment and personnel from Houston solely for a demonstration exercise. The project agreed that a hose based system would be better suited for the demonstration and proposed the use of the existing vessel based injection skid. TEPUK had experience of using this arrangement on well interventions from the selected vessel. The system comprised a 2" hose, Kamat pump and a simple subsea manifold.

5.12 ROV Services Selection

There was a requirement to demonstrate operation of the Cap using a TDU. Oceaneering had a TEPUK owned TDU available and were already providing the EERD shears and HPU system. To minimise the number of contracts and interfaces it was also considered prudent to engage Oceaneering to supply the support tooling generally comprising:

- Torque tools;
- Hot Stabs and valve panels;
- Dummy ROV;
- LED lights;
- Fluid Skid;
- Super Grinder;
- ROV Dredge.

5.13 Structures Selection

Due to the fast track nature of the project and the need for a Company that could engineer, manufacture, test and perform SIT activities and had a track record of fast turnaround projects of similar content, it was decided that Neptune Deeptech Ltd was best suited for the workscope. A scope of work was created to cover the landing base, shear cutting base and the Cap modifications required on the donor XT.

5.14 Vessel Selection - Planned

As part of the early project planning JPK created a shortlist of possible vessels that could be used for the EERD. The preliminary vessel list generated is shown in Appendix 6.

TEPUK volunteered in response to Oil & Gas UK's request for a WoS Operator to project manage, engineer and complete the EERD exercise acting as a typical 'Operator'.

JPK prepared a Vessel Scope of Work document describing the minimum requirements of the vessel and the proposed workscope to be conducted. TEPUK approached a number of possible vessel suppliers. TEPUK identified Subsea 7 and Well Ops as the most likely vessel suppliers.

Early on in the planning operation it was clear that it would be advantageous to install the subsea structures in advance of conducting the actual demonstration. It was also identified that placement of the structures carried a project risk i.e.

- Preliminary soils data only available;
- Topography of general area limited knowledge;
- Requirement for wellhead verticality within 1.5 degrees.

It was critical that the structure was level to ensure the Cap could be installed and recovered was considered paramount. It was also expected that media may be present during the exercise and public perception would not be favourable in event of issues arising with the structure deployment.

Due to such uncertainty it was considered prudent to install the structures in advance, up to 10 days to increase weather window, of the official exercise. The structures were classed as enabling devices only and as such did not form part of the capability demonstration. From the work done during the planning it was considered advantageous to source a suitable vessel that would have the capability to install the structures then return to port to be demobilised. The main vessel carrying the Cap and the shears equipment would then undertake the main EERD workscope.

Subsea 7 offered the Seven Oceans pipelay vessel and Well Ops offered the Well Enhancer light well intervention vessel as both vessels had availability when required and also had the advantage of existing contracts with TEPUK.

Vessel selection was dictated primarily by availability of a vessel for the July requirement and the relatively short duration required.

5.15 Vessel Selection – Actual

Late on in the project TEPUK was advised by Subsea 7 that the Seven Oceans vessel would no longer be made available. Subsea 7 offered to source a replacement vessel but this was declined by the project due to the limited timeframe to work up interfaces and vessel assurance programme. The Well Enhancer scope was increased to allow all operations to be conducted from this single vessel although an interim port call would be required.

5.16 Wellhead Selection

At the outset of the project it was hopeful that a donor wellhead would be made available to dispense with the need for the fabrication of a dummy wellhead structure. TEPUK continued to investigate use of a wellhead but this proved problematic primarily due to consequence of wellhead damage and time issues with partner approval process. Early on in the project the decision was taken to manufacture the bespoke Cap landing base.

5.17 ROV Tooling Selection

The tooling required for use on the Well Enhancer ROV is shown in Table 5-1. The Pluminator, Blue view and Current Meter were not used offshore.

5.17.1 TDU

The TDU was required to demonstrate that the ROV could dock on and operate a valve on the Cap as the OSPRAG Cap is configured for TDU operation.

5.17.2 Fluid Skid

An underslung skid was selected as the TDU would be mounted on the rear of the vehicle. The skid provided a fluid supply and pumping arrangement to allow operation of the connector and actuated valves. The skid was also configured to allow it to pump seawater to assist with break out of the seabed structures should it be required.

5.17.3 Subsea Dredge

A subsea dredge was considered necessary to help prepare the seabed should it be needed and also to locally excavate around the skirt of the subsea structures to assist with break-out from the seabed as part of a contingency recovery option. The dredge operation did not require to be used during the EERD.

5.17.4 High Torque Tool

This was required to over-ride the manual valve on the Cap. The Cap valve only required a low torque to operate and the unit was therefore fitted with a low torque motor.

5.17.5 Low Torque Tool

This was required to operate the paddle interfaces in event of any issues with using the ROV manipulator.

5.17.6 Super Grinder

This was used to cut the 2 off choke and kill lines on the marine riser joint prior to conducting the shear exercise.

5.17.7 LED Lights

These were used to detect the fluorescent dye from the ROV lance. A green light source was found to work best. A camera was fitted to the Observation ROV to allow capture of footage from the WROV operating the lance.

Table 5-1 ROV Tooling for Well Enhancer Vessel

DESCRIPTION	COMPANY	QTY
Tool Deployment Unit (TDU)	Free Issue from Total	1
Fluid Skid	Oceaneering	1
Subsea Dredge (Back Mounted)	Oceaneering	1
High Torque Tool (HTT) – low torque motor	Oceaneering	1
Low Torque Tool (LTT) manipulator deployed	Oceaneering	1
1" High Flow Hot Stab	Oceaneering	4
Super Grinder	Oceaneering	2
LED lights for dye detection	Oceaneering	2 sets

5.18 Contract Award

TEPUK and JPK performed evaluation of the Shears and ODE worksopes. TEPUK performed evaluation of the Vessel and Fabrication proposals. Successful Contractors were subsequently awarded contracts following completion of the approval process, namely:

- Well Ops UK, (Vessel Scope, Shearing and ODE Services Scope);
- Oceaneering, (ROV Tooling Services Scope);
- Neptune Deeptech, (Structures Supply).

WOUK engaged Oceaneering for the shear system services direct. Oceaneering supplied all the equipment and services other than the subsea shear which was subcontracted by Oceaneering to Gulf Stream International (GSI).

5.19 Project Assurance

The following project assurance work was conducted as part of the EERD planning activities:

- Level 1 HAZID;
- Level 2 HAZID;
- DWOP;
- Lift Assurance;
- Vessel Audit;
- Equipment SIT's.

5.20 Permits and Authorisations

A combined Marine Application and EIA was submitted by JPK to DECC. DECC considered the exercise as a scientific experiment and authorised the application on 04 July 2011, Ref MCAA/017/2011.

A copy of the application and the corresponding authorisation are contained within Appendix 1.

5.21 Timeframe for the EERD

Loadout of the equipment was forecast to start on 10 July 2011. It was expected that the complete EERD exercise would take approximately 15 days from start of mobilisation to end of demobilisation, including 5 days waiting on weather allowance.

5.22 Mobilisation

The base case was to mobilise the vessel from Aberdeen with all equipment on board other than the pipe cutting support equipment as there was insufficient space for all equipment in a single mobilisation. The pipe cutting equipment would be transported to Lerwick when the vessel makes an interim port call following completion of the Cap and ODE scope. The vessel will then transit back to location and conduct the shear demonstration.

6.0 ONSHORE PHASE

6.1 SHPU / Subsea Shear Cutting Trials

6.1.1 General

The trials for the SHPU and Subsea Cutting Shears took place at the Peterhead Dry Dock, approximately 50km north of Aberdeen. On arrival all personnel were given a site safety briefing. Oceaneering also conducted a comprehensive TBT prior to operations commencing to ensure all operations were fully understood. A view of the dry dock and the proposed equipment layout is shown in Figures 6-1 and 6-2 respectively.

Figure 6-1 View of Dry Dock

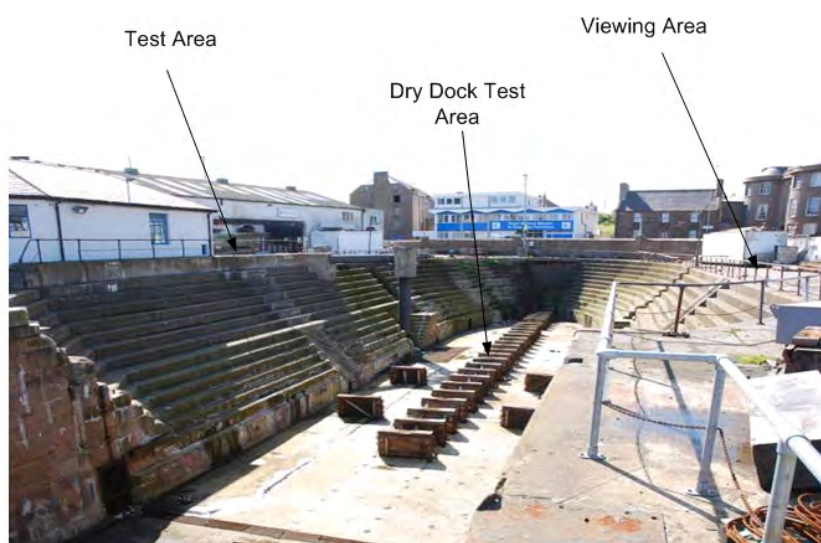
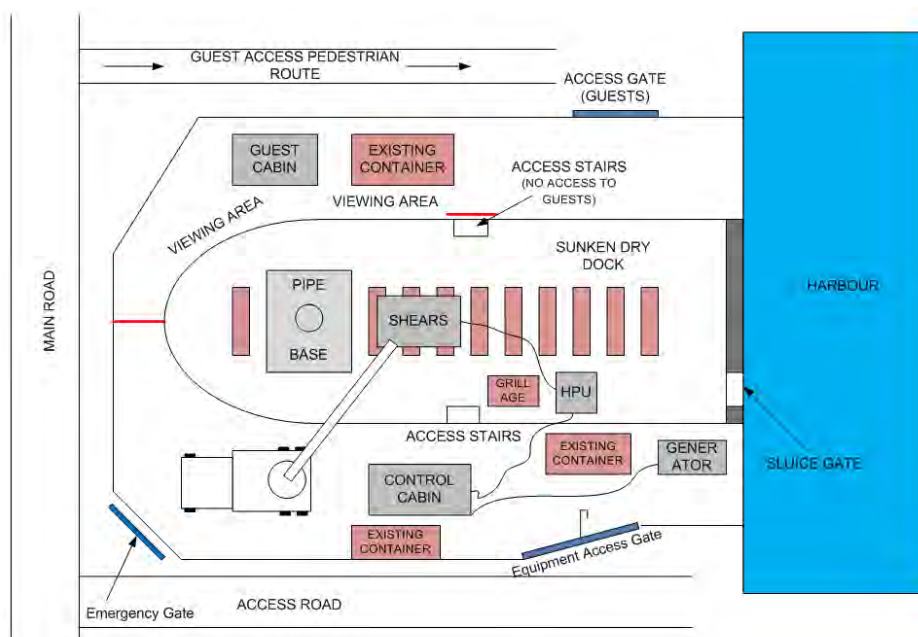


Figure 6-2 Dry Dock Test Layout



6.1.2 Overview of Test

A subsea shear was used to cut a section of marine riser pipe, 21" OD x ½" wall thickness. The pipe was a section of marine riser that was made available to the project. The shears were operated via the Oceaneering subsea HPU connected to the shears by a ROV hydraulic hose arrangement. The top section of the riser was rigged to the crane to prevent it colliding with the dock following the cut. A view of the shears resting on the dock supports is shown in Figure 6-3.

Figure 6-3 GSI Subsea Shear in Dry Dock, Peterhead



The following steps will provide an overview of the operations that took place during the shear trials:

- 1) Open dry dock gates to semi submerge SHPU for cooling requirements;
- 2) Lift shear into position for cutting marine riser;
- 3) Commence functioning shear jaws for cutting operations;
- 4) Complete cutting marine riser - circa 5mins;
- 5) Fully open shear jaws;
- 6) Land shears on dry dock sleepers;
- 7) Empty dry dock.

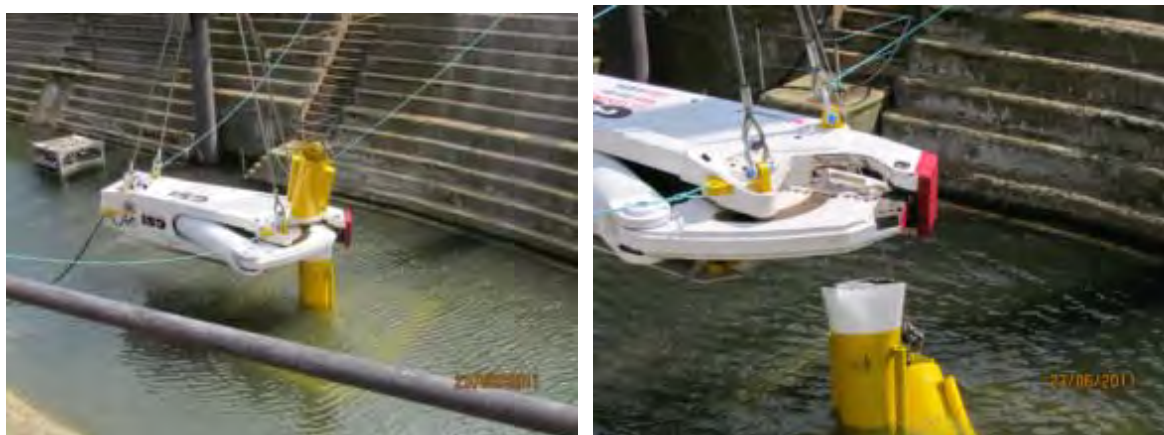
Figures 6-4 and 6-5 show a step by step story of the shear operations, not seen in any photographs is the electrical generator (this was not needed for the offshore phase) and the Oceaneering control cabin where all operations were controlled from, the control line from the cabin was connected to the SHPU.

Data Sheets for the all equipment used can be found in Appendix 5.

Figure 6-4 Oceaneering SHPU, GSI Subsea Shears, Rigging and Marine Riser



Figure 6-5 GSI Subsea Shears – Cutting Sequence



6.1.3 Positives

Several positives can be drawn from the trial;

- Very effective – complete cut circa 5mins;
- Very little equipment needed to function the shear;
- Proven track record with no failures;
- It was a very well run and safe demonstration by Oceaneering and GSI.

6.1.4 Issues

No major issues were seen during the operation.

6.1.5 Conclusion

This was an ideal opportunity for all the project team to see this equipment in action and work successfully. It also gave the offshore team an understanding of the magnitude of the

equipment being mobilised for the exercise and a clear understanding of how it was configured which would be very useful when explaining to the offshore crew. The entire SIT was carried out by GSI and Oceaneering safely and on time.

6.2 EERD Cap SIT

6.2.1 Summary of activities

The EERD Cap SIT took place at Neptune Deeptech, Stonehaven (approx 23km South of Aberdeen). This exercise was very informative for all parties (JPK, Neptune, TEPUK & Oceaneering) during the two day SIT a lot of useful information was acquired, The activities were as follows with reference to Figures 6-6 and 6-7.

Day 1

1. Land the overburden weight structure onto the EERD cap landing base;
2. Land the overburden weight structure with the landing base at a 2° incline;
3. Land and lock the EERD Cap onto the landing base;
4. Function of PMV & PWV using hot stabs;
5. Function of MPIV using TDU.

Day 2

1. Land and lock the EERD Cap with the landing base at a 2° incline;
2. Removal of the EERD Cap from the landing base when it is at the 2° incline;
3. Land EERD cap with landing base in an off centre position;
4. Interface a Mock ROV to all the ROV operated functions within the Cap and landing base;
5. Function test EERD cap contingency removal frame;
6. Interface EERD cap with shipping skid (only one was available);
7. Interface ROV super grinder with Marine riser.

6.2.2 Positives

- Actual weights of equipment established;
- Time made available for all participants to become familiar with equipment and procedures;
- To assist with safe transportation, the cap was landed and locked onto a dedicated tree shipping skid, two of these skids would be mobilised. By doing this we gave the vessel more options by storing the cap on the forward pallet close to the moonpool tower and being able to land it from the crane on the aft man deck. This greatly enhanced the safety of operations offshore.

Figure 6-6 ROV Interfacing with EERD Cap and EERD Cap Landing Base



Figure 6-7 Interfacing the pre-loading Structure to the EERD Cap Landing Base



6.2.3 Issues

- EERD Hang Up

During the SIT, the cap hung up on a shoulder within the H4 connector arrangement, following repeated interface trials the issue was resolved. Figure 6-8 shows clearly the hang up distance that was evident between the base of the cap and the landing base. The RH image shows the cap in its landed position. There was uncertainty as to whether the cap had actually landed out correctly as shown in the LH image.

The project team had previously requested that the Cap should be landed out on the structure prior to SIT, confirm correct operation and identify the land out markers.

Figure 6-8 EERD Cap caught up on an internal shoulder & fully landed



- **Debris on Mandrel**

The Landing Base was dirty and had not been lubricated. This may have contributed to problem with unlocking of Cap from Base. Following clean up and removal of rust debris the Cap subsequently unlocked more readily.
- **Shipping Skid Guide Posts**

During the interface test between shipping skid and EERD cap it was evident that both guide posts would clash with the cap with it sitting square in location. Guide posts had to be removed from each shipping skid to allow the cap to sit in a square position on the shipping skid.

Guideposts should have been removed prior to engagement as they were not required for the application, Figure 6-9.
- **ROV Interfaces**

During the mock up ROV trials (Supplied by Oceaneering) possible compatibility issues with other contractors ROV's with the TDU and hot stab skid were discussed. No issues were foreseen by the technicians onsite. ROV personnel from Canyon (WOUK) should have been present at the SIT to discuss and subsequently highlight any ROV equipment compatibility issues.

Figure 6-9 EERD Cap shipping skid with and without guide post clash



6.2.4 Conclusion

The EERD SIT was deemed a success, by the end of the second day all equipment had worked as required. There were some very important actions gathered that required to be amended prior to the project mobilising. Neptune and Oceaneering did well to close them all out in time for mobilisation.

6.3 ODE SIT

6.3.1 Summary of activities

The ODE trials took place in Aker Qserv's operational site in Portlethen, approximately 12km south of Aberdeen. The test was a pre-cursor to the actual operation planned on the Well Enhancer.

The objective of this trial was to identify that the correct equipment interfaces were in place and that the fluid could be pumped subsea through the water column to the work site.

The activities consisted of the following;

- 1) SIT briefing;
- 2) Ensure all kit rigged and prepared for operations;
 - a. Water pump and hoses connected to manifold;
 - b. ROV flying lead connected to manifold;
 - c. ROV jetting lance connected to ROV flying lead;
- 3) Make the system live;
- 4) Commence pumping per programme;
- 5) Complete the above for operations with different nozzles;
- 6) Complete wash up discussion.

Figure 6-10 ODE Manifold



Various size nozzles with were used to help create the ideal jet for the ODE scope. The WROV flying lead arrangement comprised of a 20m hose and a 'T' bar handle lance.

6.3.2 Positives

- Safety

During this SIT we were dealing with high pressures, which could cause fatal injury. A site briefing and tour was given to all parties before any operations commenced and during the ODE SIT itself an area was cordoned off to allow safe viewing.

6.3.3 Issues

- ROV Lance

The ROV lance that was supplied by Proserv and used at the ODE SIT was identified as being unsuitable because it comprised two outlets – one nozzle and one retrojet diffuser similar to that used on a diver waterjet to prevent the operator being pushed backwards. It was suggested that the diffuser and tee section should be removed for the offshore exercise as the WROV visibility would be greatly diminished by the diffuser and also the thrust of the WROV would easily overcome the power of the jet, Figure 6-11 below.

Figure 6-11 ROV Jetting and diffuser unit in action



As seen below in Figure 6-12, the nozzle supplied by Proserv created a very powerful long jet of water but it was thought that this may be unnecessary and hard to control subsea. It was thought that a nozzle with a larger bore would be more useful.

Figure 6-12 ODE SIT Water Jet



6.3.4 Conclusion

The SIT at Qserv was organised very well. All equipment was tried and tested before the SIT commenced which is a credit to all involved. The points to be noted from it were that a retrojet diffuser on a WROV is not needed and a larger nozzle that will provide more flow and less back pressure should be used.

6.4 Dye Detection Test

Roemex RX9034A dye was selected as this is a GOLD standard fluid.

The fluorescent Roemex dye requires an excitation device (LED light), to improve detectability by ROV. An onshore trial was organised by Oceaneering and conducted at Bowtech in Aberdeen. A Roemex dye mix was placed in a closed container within a small test tank and various LED light sources were used to determine the optimum light source. A Green light performed best and Oceaneering sourced a number of lights that would later be fitted to the vessel WROV.

7.0 OFFSHORE PHASE

7.1 Offshore Demonstration Location

The Emergency Equipment Response Demonstration (EERD) Exercise took place West of Shetland in the Edradour area (Block 206/4) in a water depth of approximately 305m. A map of this location can be seen in Figure 7-1. Operations were coordinated from the Well Enhancer LWI Vessel shown in Figure 7-2.

Figure 7-1 Demonstration Location - Edradour area (Block 206/4)

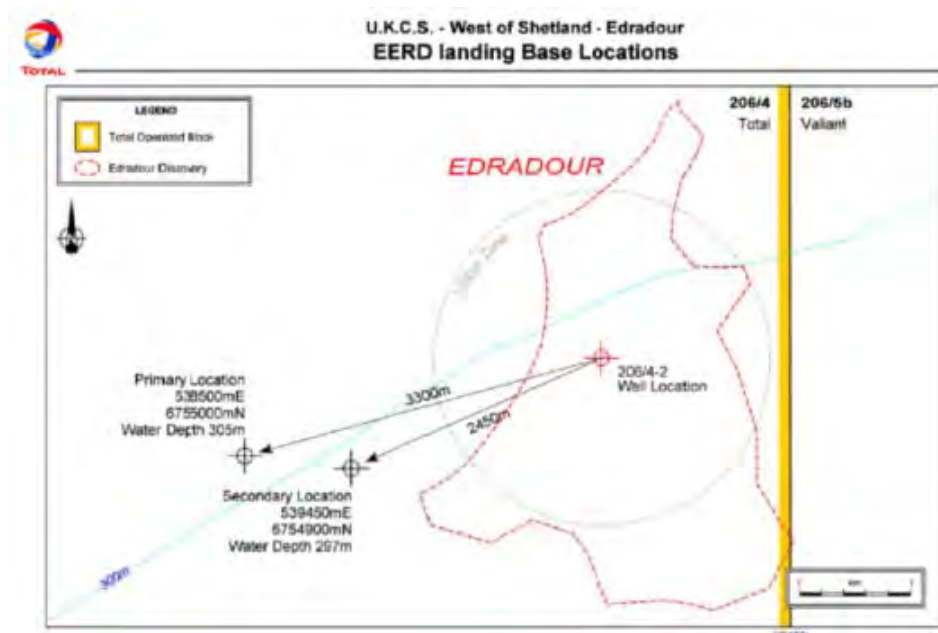


Figure 7-2 Well Enhancer LWI Vessel



7.2 Weather Conditions

West of Shetland weather makes vessel station keeping and stability imperative. Average conditions for mid water transfers and crane operations during exercise were between 15-25 knots of wind and within 1.8 to 2.5m significant wave height. The maximum wind speed reported was 31 knots. The maximum significant wave was forecast to exceed 5m during a period of time when the vessel completed an interim mobilisation.

7.3 Logistics

7.3.1 Mobilisation – Aberdeen

- WROV Mobilisation - Issues

On the day of mobilisation, the ROV crew were expecting the BOP skid, TDU, LED lights and camera. They also found out on the day that a Blueview Sonar and the Doppler current meter would be arriving which added considerable confusion to the situation. The outcome from several discussions between the TEPUK client representatives and ROV crew was that the amount of equipment required to be added to the ROV and the required interfaces did not appear to have been adequately planned with sufficient inclusion of the offshore team. This was attributed to poor communication between Well Ops and Canyon offshore personnel in the final weeks prior to mobilisation.

The final setup of the ROV was a compromise without the Blueview Sonar and Doppler current meter mounted.

- Loading and Sea Fastening - Issues

Noble Denton was contracted by TEPUK Marine Ops Superintendent to provide marine assurance for all sea fastenings. Delays were experienced getting sea fastening calculations from WOUK engineering company (Longitude), to Noble Denton who subsequently had a large amount of comments. These issues should have been closed out prior to mobilisation.

Due to operational issues WOUK reported to TEPUK that MPI could not be conducted on the welds at the time of completion. A decision was taken by TEPUK management to proceed with the departure from port, without the MWS issuing a certificate. The MWS did however stay on board on the vessel until all sea fastening was complete to provide advice on the sea fastening where possible.

- Onshore Support

In both Aberdeen and Lerwick problems were experienced with shore support i.e. welders, forklifts and cranes. In future 24hr cover should be planned when the vessel is alongside.

Ideally this activity could be controlled by a dedicated vessel mobilisation co-ordinator. This person would be shore based, present in person at the mobilisations and responsible for all activities from logistics to shore support.

- Wet testing of ROV's mid transit - Positives

A test dive of both ROVs took place during the transit to the field; this was requested by the ROV crew due to the amount work that had been completed on the ROV's particularly the WROV. This was successfully carried with no operational issues.

7.4 ODE Offshore Trials

7.4.1 Summary of activities

The ODE demonstration took place following the placement of the cap landing base at the desired demonstration location. The demonstration involved over boarding a 2" black eagle down line c/w Hot Stab to a subsea manifold adjacent to the landing base. A 20m flying lead c/w ROV mounted lance, (Figures 7-3 & 7-4) was used to pump dyed fluid from a Qserv pump on the back of the vessel which was fed directly from a filtered sea water supply.

The following steps provide an overview of the operations that took place during the ODE demonstration:

- Prepare equipment on deck;
- Function test equipment on deck;
- Overboard subsea manifold;
- Position adjacent to the landing base structure;
- Deploy the down line (2" Black Eagle hose) and engage the ROV Hot Stab to manifold;
- ROV picks up lance from the manifold and locates to the landing base;
- Pump fresh sea water until the down line has been flushed;
- Dyed fluid pumped from surface and seen to exit the lance above the landing structure;
- Pump fluid for 5 minutes;
- Stop pumping;
- ROV positions lance back onto manifold;
- Disconnect ROV Hot stab on the manifold and recover down line to vessel;
- Recover subsea manifold;
- Secure equipment on vessel.

7.4.2 Dye mix and Flowrates Used

A total of 1m³ of seawater was mixed with 4 sticks of Roemex RX-9034A dye to give a dosage of 200ppm. The mixture was pumped at 25 gallons per minute at approximately 1,750psi as measured on the topsides pressure gauge.

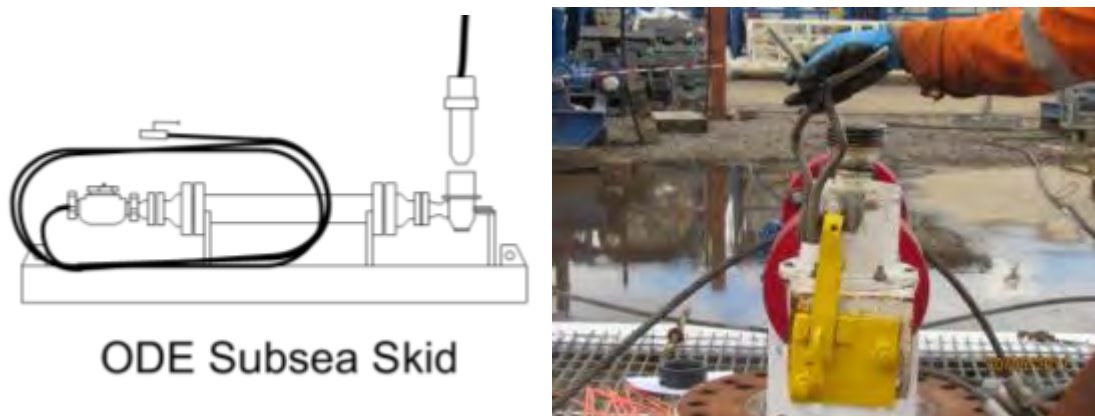
7.4.3 Positives

- Chemical Dispersal
Figure 7-3 depicts the result of this operation. Dyed water can clearly be seen jetting and dispersing from the WROV lance to the area around the wellhead over a distance of about 2 metres. Both the LED light installed on the WROV and the LED colour camera installed on the Observation ROV worked flawlessly.

Figure 7-3 ODE Exercise witnessed from WROV Colour & Obs ROV SIT camera



Figure 7-4 ODE Manifold & Moffat Balance Stab Interface



7.4.4 Issues

- ROV T Bar Lance

The ROV held lance's which arrived with the equipment were not changed following the ODE SIT and thought not to be ideal for the job, the ROV crew decided to use their own lance from the subsea jetting unit for this operation. The crew felt more comfortable using their own equipment as it had a proven track record. Also if it was dropped it could be picked up from any side, unlike a T bar, Figure 7-5.

The nozzles that were supplied were also thought to have a very small bore and may cause significant back pressure in the system. During the SIT the bespoke nozzle was used by partially flattening a ½" bore JIC fitting to produce a 'fan' effect, which proved to be very effective for the demonstration. This was again utilised offshore for the operation.

Figure 7-5 ROV crew jetting lance and bespoke nozzle



- **Lights & Camera**

The purpose of the LED light which was installed on the WROV was to enhance the clarity of the dye in the seawater suitable for capture by a camera mounted on the Observation ROV; both items can be seen in Figure 7-6. This allowed the light to stay focused on the dye while the Observation ROV could fly around the work site and pick up clear pictures of the dye enhanced waters around the well head.

Figure 7-6 L3C-550C Camera and LED - 1600 Light



Conclusion

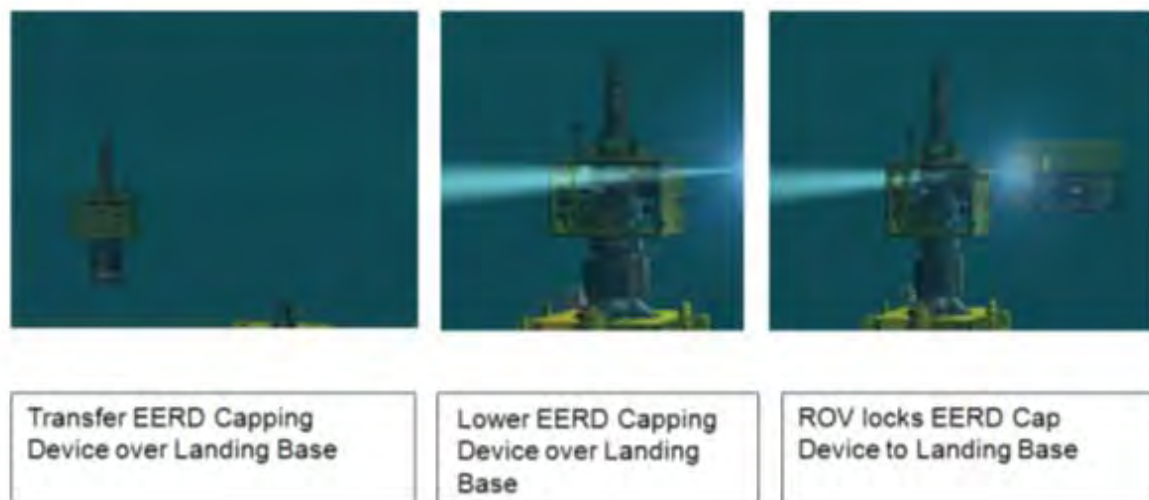
This equipment worked very well throughout the operation to illuminate the dye during the ODE exercise. It was relatively easy to interface with both ROV's and allowed the capture of some very impressive footage.

7.5 EERD Cap Offshore Trials

7.5.1 Summary of activities

The EERD Cap was locked to the landing base 18-3/4" H4 connector and several valves were operated by ROV to simulate the OSPRAG Cap installation and operation. Figure 7-7 shows the operational sequence.

Figure 7-7 EERD cap landing and locking on a typical connector



The following steps provide an overview of the operations required during the EERD Cap demonstration:

- Prepare equipment on deck;
- Function test on deck;
- Transport EERD Cap to moon pool;
- Attach lift wire and deploy subsea offset horizontally from landing base until approximately 5m above and offset from the base;
- Translate Cap over base centre;
- Lower Cap onto base mandrel;
- Lock Cap to base using ROV hot stab;
- Verify Cap is locked by viewing position indicator;
- Operate PWV & PMV via hot stab vent and panel valve, confirm closed;
- Re position ROV to opposite face and dock using TDU;
- Close manual valve using TDU mounted torque tool;
- Verify valve closed by viewing position indicator;
- Open manual valve using TDU mounted torque tool;
- Verify valve open by viewing position indicator;
- Attach lift wire to top of Cap if required;
- Re-position ROV to opposite face and engage hot stab to unlock connector;
- Verify connector unlocked by viewing position indicator;
- Pick up Cap clear of structure by direct pull;
- Recover Cap to Vessel;
- Overboard Cap with Vessel main crane to 30m below MSL^[1];

- Recover cap on main crane;
- Secure equipment on Vessel.

[1] Oil & Gas UK has made a specific request that a demonstration of deploying the cap on wire using a single crane be completed in addition to deploying on the tower through the moon pool. This is to prove that the cap is capable of being deployed on wire from a vessel crane in addition to moon pool deployment.

7.5.2 Positives

- Bull Horns
Bull horns were added to the both sides of the EERD Landing Base to allow the WROV to hook the landing base rigging. This would assist the ROV to connect / disconnect moonpool tower rigging from it much more efficiently, Figure 7-8.
- Guide Wireless Cap
The ROV pilots were happy about not dealing with guide wires during the EERD Cap deployment operation. It gave them a larger area to work in and less chance of entanglement and damaging tethers.

Figure 7-8 Guide Wireless EERD Cap and Bull horns on Landing Base



7.5.3 Issues

- Connectors
Over the campaign the Cap was landed onto different H4 mandrel stumps. There was some uncertainty offshore as to whether the Cap was landed fully on the 2nd shipping skid. Confirmation of locking position on this skid would have been very useful.

7.5.4 Conclusion

There were no major difficulties with the cap itself throughout the deployment, functioning and recovery operations. By using the moonpool tower and main crane on the vessel it was proven that a vessel of opportunity can be used to deploy a capping device to the seabed and land it into position.

7.6 SHPU / Shear Cutting Offshore Trials

7.6.1 Summary of Activities

A set of subsea shears was deployed from the vessel and used to cut a section of marine riser in the vertical position on the cutting support structure. Prior to this the ROV c/w super grinder and TCT blade cut a section of pipe from both the choke and kill lines which demonstrated ROV cutting ability.

The following steps provide an overview of the operations that took place during the EERD Shear Cutting demonstration:

- Prepare equipment on deck;
- Deploy Cutting Pipe Base;
- Perform Choke / Kill line cuts with ROV Super Grinder;
- Wet store cut sections in work basket;
- Deploy SHPU;
- Deploy Shears on Vessel crane/tower;
- Mate SHPU to Shear;
- Shear section of marine riser;
- Disconnect SHPU from Shear;
- Recover Shears on tower/Vessel crane;
- Recover SHPU;
- Recover Cutting Pipe Base;
- Recover cut section of marine riser;
- Perform as left survey;
- Secure equipment on Vessel.

7.6.2 Positives

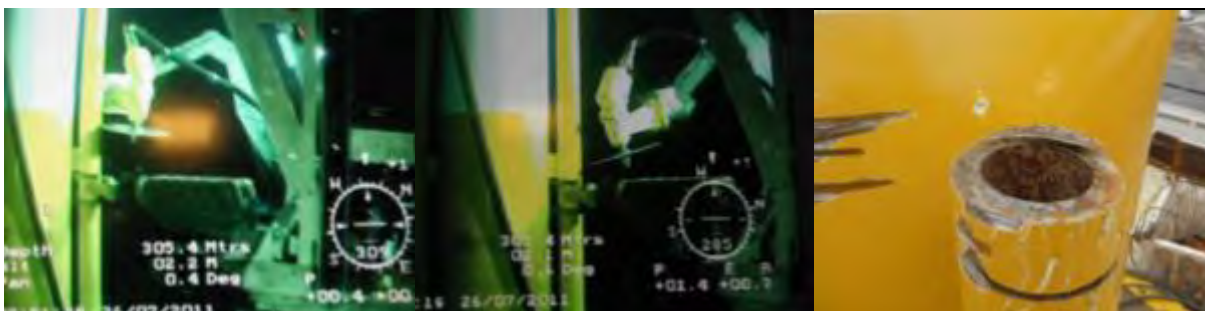
- Oceaneering Super Grinder

All the vessel ROV crew thought the 14" carbide tip blade that was supplied was an excellent blade to use. During the operation due to WROV movements it saw a lot of impacts, bending, warping and didn't break or chip, Reference Figure 7-9.

A recommendation from that crew was that if a larger diameter blade was available it would be useful and may have given the ROV extra room to work with when cutting the choke and kill line section from the marine riser.

Oceaneering have responded informing us that it is possible to get blades up to 16" / 18" in diameter but may require to be ordered in advance.

Figure 7-9 Super Grinder in operation and a typical result of the cut



- Oceaneering SHPU

The functionality of the Oceaneering SHPU shown in Figure 7-10 is a very simple and uncomplicated and the operation was performed without any major issues. All functions and pressures reading could be controlled and monitored from a laptop within the control cabin.

Figure 7-10 Oceaneering SHPU



- GSI Shear

The shear which was supplied by GSI was only needed for cutting the marine riser. A trial function of the shear was completed in mid water before the ROV crew committed to the cutting operation. Once in position it took 6 minutes to complete the cut, Figure 7-11 shows images of the cutting operation and the results of the cut.

Figure 7-11 Subsea Shearing Operation and final results



7.6.3 Issues

- Shear Grab handle
The shear structure was lacking a ROV grab handle to the left of the stab plate. The WROV found it very difficult to hold onto the shear/rigging with just a pad eye to use when it was in a mid water position.
- Congestion in the Moonpool Area
Although the SHPU and Shear operation went very well, the deployment of the equipment did highlight some concerns due to the amount of down lines and lift wires running to the seabed in very close proximity which could have caused issues.

The moonpool lines required were as follows:

- 1) SHPU electrical downline;
- 2) MPT winch Wire to Shears lift wire;
- 3) Main Crane (during cross haul only);
- 4) 2 x Guide wires to DMA on seabed;
- 5) Vessel Podline to SHPU.

Links from SHPU to Shear:

- 1) 25m Shear/SHPU hydraulic jumper;
- 2) 20m strong link between Shear & SHPU.

The bridge, deck and ROV crew performed extremely well to coordinate vessel moves, lift line functions and mid water transfers during this operation but it would have been more suitable if the situation could have been avoided, an example of the subsea congestion can be seen in Figure 7-12.

Figure 7-12 SHPU and lift lines congestion subsea



- Damage to SHPU Kit
During recovery of the SHPU several pieces of equipment were damaged, this may have been a result of the congestion in the moonpool area as the deck crew had a lot of equipment to deal with, Figure 7-13.
 - 1) The Oceaneering electrical down line required re-termination;
 - 2) The ROV hot stab hydraulic lines were bent and needed replacing;
 - 3) The hydraulic supply line around the outside of the structure was damaged and will need replacing.

Figure 7-13 Damage to SHPU sustained during recovery



7.6.4 Conclusion

This operation was by far the most intensive of them all. This crew work incredibly well together during every operation, but this particular task required extra focus and patience from all departments involved due to the amount of infrastructure that had been deployed subsea and vessel moves required to safely coordinate all items to the required depths and positions.

Following the shearing operation GSI personnel assured the Total reps that an ROV grab handle would be installed for any future operations.

It also may be an idea to deploy the SHPU to seabed, thus removing the Podline, guide wires and DMA.

8.0 EQUIPMENT SUITABILITY

8.1 Vessel

The Well Enhancer coped admirably with the work scope following the decision to utilise a single vessel for the deployment but the following must be considered for future operations:

- 1) Ensure sufficient and crane accessible deck space is optimised;
- 2) The use of two work class ROV's where possible;
- 3) Use of a Knuckle boom heave compensated crane;
- 4) Deep water capability and where possible prior experience;
- 5) Where an overboard crane is utilised for deployment, ideally the fully depth and weight capacity should be made available;
- 6) Should have proven evidence of operability in up to 5m Hs.

8.1.1 Mid Water Transfers

Due to the limitations with the Kenz crane on the Well Enhancer, a solution was devised to conduct a "mid Water transfer" where the landing base, pipe cutting base and shears were deployed from the vessel crane and transferred at 220m to the vessel "tower".

During an initial trial transfer with just the rigging specified in the lift plans the WROV had difficulties completing a transfer. This was due to the large amount of equipment that had been installed on the WROV and magnitude of the 150t ROV hooks being used in the operation.

Following discussions a WOUK Site Instruction was created which detailed the use of the moonpool podline deployed through a snatch block anchored to the MPT headache ball. Utilising this arrangement the pod line could be attached to the main crane wire and used to draw it closer to the MPT wire for easier WROV manipulation.

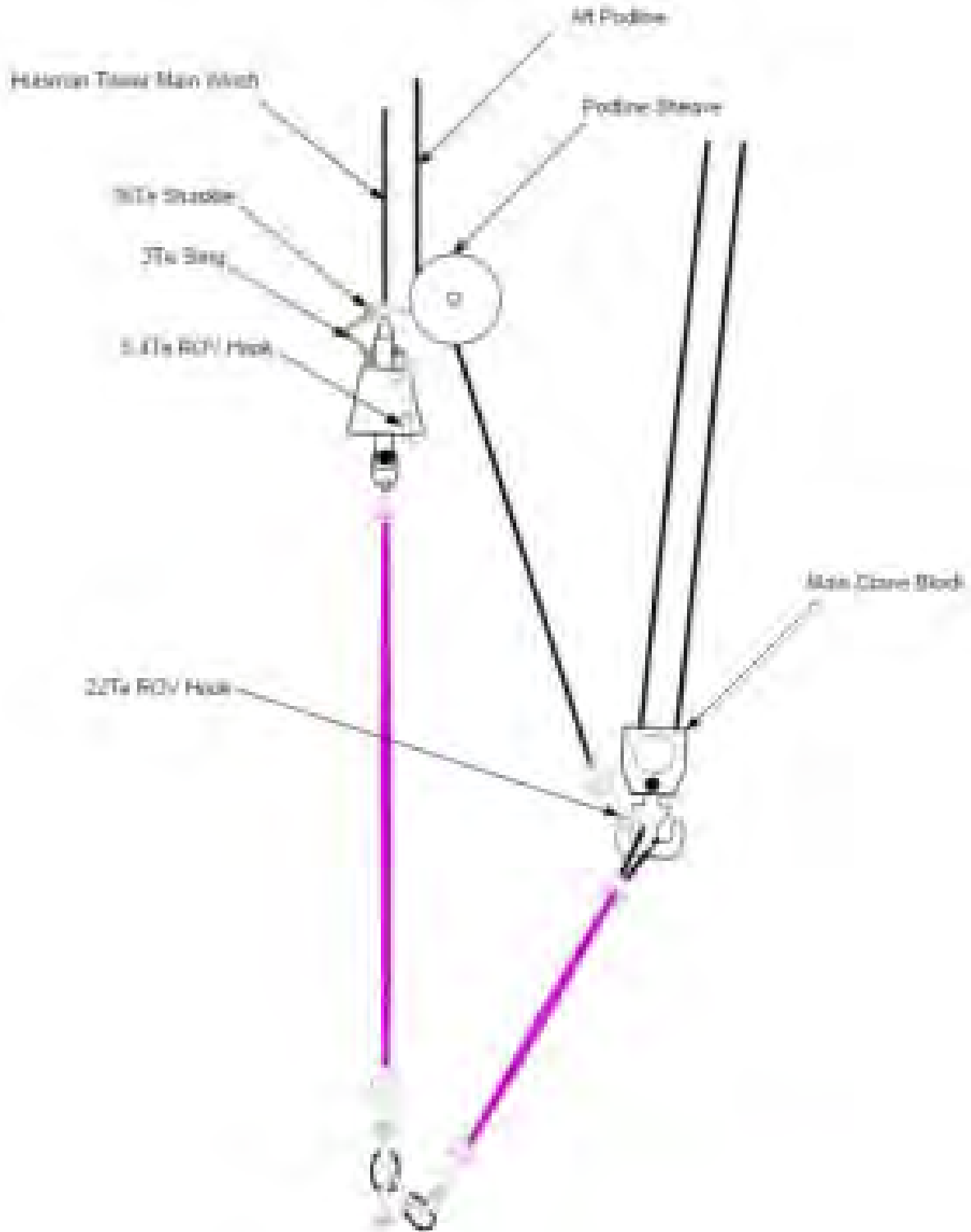
See Figure 8-1 and Appendix 4 - Mid Water Transfer for further Information about the Site Instructions raised.

Conclusion

Mid-Water transfer was identified as a risk at the HAZOP and concerns were raised with regards to the size of the rigging and an onshore trial was proposed. Due to the lead time of the equipment in question and the delivery of the items just prior to mobilisation, the onshore integration test was not possible. In addition to this, the connection of the individual rigging subsea by the ROV was stated to be within the capability of the ROV.

A decision was taken offshore to conduct a trial prior to commencing any overboard lifts. Performing the subsea trial offshore was a very worthwhile operation and it was evident that a solution had to be found. Following round the table discussions the new plan proved to be a simple operation that the crew carried out with ease every time.

Figure 8-1 Mid-Water Transfer Rigging Arrangement



8.1.2 Bumper Bars

Figures 8-2 and 8-3 show the bumper bar arrangement that was installed onto the vessel decks and structural members.

These were installed for the following reasons;

- 1) Protection of the vessel infrastructure;
- 2) Protection of vessel crew against swinging loads;
- 3) Dampen the force of impacts;
- 4) Assist with sea fastening operations.

Figure 8-2 Mezz deck bumper barriers



Figure 8-3 Main Aft Deck bumper barriers



Conclusion

The bumper bars that were used were most certainly needed and well utilised during the exercise. Due to the urgent nature of the operation and availability of deck crew personnel for a design review, there are improvements that should be considered, the following observations were made:

- 1) Taller bumper bars on the main aft deck;
- 2) Similar bumper bars on the port side of the main aft deck;

- 3) More bumper bars on the port side mezzanine deck;
- 4) Possibly remove/hinge the port side mezzanine deck guard rail.

8.2 ROV Equipment

8.2.1 TDU - Issues

- 1) The Oceaneering provided laptop was unable to interface and control the TDU through the ROV;
- 2) The weight and size of the TDU was an issue for the ROV crew during the mid water transfer operations. Adding additional weight to the aft of the WROV meant that balance weights had to be added to be forward to correct the ROV position. Also as the TDU is mounted over the aft thrusters it is estimated that around 30% of the power may have been lost;
- 3) This unit has been on the vehicle before, and there is some history of communication problems with it. Given the time constraints it was decided to use it as previous, i.e. using direct hydraulic feeds from the auxiliary valve pack to control the tool, and fitted extra tooling cameras.

Conclusion

The TDU successfully operated the valve as required for the EERD exercise, but for future operations if the TDU is third party supplied then more consultation is required with the ROV contractors personnel.

8.2.2 BOP Fluid Skid - Issues

The skid itself was too short for the vessels Canyon Triton XLS WROV as it was originally designed for an Oceaneering vehicle. This was known prior to mobilisation and the crew onboard were aware of the issue.

The skid was trial fitted to an XLS4 in Canyon's Aberdeen workshop. This test identified the following modification:

- 1) New longer sets of positioning pins had to be manufactured to suit the XLS so it could be installed;
- 2) The skid was modified to move the refill valve further forward and within reach of the ROV manipulator;
- 3) The sea water suction valve remained hidden out of reach, this could only be functioned by an operator if the vehicle was recovered to deck;
- 4) For the same reason, the flow meter was out of sight of our cameras, this was not corrected prior to mobilisation.

Conclusion

The vessels Triton XLS WROV is fitted with a protection frame mounted below the ROV and when the BOP Skid was fitted, the manipulator operated valves were out of reach. With onsite modifications the skid worked as required with no major issues.

8.2.3 Blueview BV 5000 Mechanical Scanning Sonar

This equipment proposed by Oceaneering was intended to acquire a 3D picture of possible rig / riser debris on seabed during a possible incident in low-visibility and zero visibility conditions. This particular model requires the ROV to remain stable (on seabed) while data is gathered for the image and this can take up to 18mins.

Issues

- 1) The unit needed to be mounted out front of WROV (between manipulators) - this left it exposed to damage while the ROV was engaged in rigging and hot stab operations;
- 2) During the mobilisation the crew experienced problems mounting and interfacing the Blueview equipment to the WROV this resulted in them not being able to gain control of pan and tilt functions;
- 3) To integrate this equipment, the crew had to provide it with 2 data channels plus one fibre, and three power supplies. The WROV system has 2 fibre passes through the TMS, both of which are normally used for the vehicle (one is a redundant spare).

Conclusions

Due to the interface issues and the fact that this was not the ideal piece of equipment it was decided to demobilise the equipment and technician prior to sailing.

A recommendation from the ROV crew would be to use proven equipment which can provide invaluable information in poor visibility and cluttered seabed situations. It would be useful to perform further research into a suitable device. e.g. 2D Forward-Looking Imaging Sonar P900-90.

8.2.4 ADCP Current Meter

The purpose of this device was to provide real-time current information to support the vessel operations while several tools were deployed simultaneously on lines from the vessel. This would give the operators an idea of the most suitable way to position the vessel and avoid down line entanglement.

- Issues – Phase 1
 - 1) Brackets had to be made up to mount the unit, which was extra unnecessary work;
 - 2) The unit required heading and depth data from the ROV, and the Fugro technician was unable to extract this from the data string that was provided;
 - 3) The ADCP current meter was a bulky item, circa 30kg, because of this it was not suitable for the Observation class ROV (Super Mohawk II - Sub Atlantic) and as there was insufficient space on the WROV (Triton XLS-14) once the TDU package was installed. It was left off until Phase 2 of the exercise;
 - 4) There was also an issue with the software on the supplied laptop, the technician departed vessel prior to phase one with a plan to make changes to the software and email it to the vessel.

- Issues - Phase 2
 - 1) A second laptop with software changes was mobilised to the vessel during the interim port call however after multiple unsuccessful efforts to try make it function correctly with the WROV a decision was made not to use the ADCP.

Conclusion

Following the first mobilisation in Aberdeen a decision was made to reduce the weight of the WROV and only use the ADCP in phase 2, where it would be needed most.

Following receiving the software update at the interim mobilisation, the result from all the above software issues was that confidence was lost in the ADCP. Any further efforts to make it work were stopped and reported to the Company Representative.

8.3 AVC Media

AVC Media camera crew were onboard for the entire offshore campaign, their knowledge of offshore operations and safety was ideal for this operation, they were always on the deck to record footage and never got in the way of any operations.

8.4 Lessons Learned

Lessons were recorded for the entire EERD onshore and offshore campaign, see Appendix 3 for the Lessons Learned Matrix.

Appendix 1
MARINE APPLICATION and AUTHORISATION

Marine and Coastal Access (MCA) Act 2009

Marine Licence Application Form

Activities that may require a marine licence, because they cannot be controlled under the Petroleum Act 1998 (as amended) or Energy Act 2008, or are not exempted under the Marine Licensing (Exempted Activities) Order 2011, will include (but may not be limited to):

- Disturbance of the sea bed, e.g. to access platform legs or to relocate cuttings piles, or to undertake trenching operations that are not covered by a Pipelines Works Authorisation (PWA) issued under the Petroleum Act.
- Temporary deposits, e.g. during abandonment operations or in advance of activities authorised under the Petroleum Act or Energy Act.
- Deposit or removal of certain cables, e.g. telecommunications, power or control cables not covered by a PWA.
- Deposits or removal of substances or objects, e.g. to undertake rock dumping, mattress emplacement or burial operations that are not covered by a PWA, or to remove platforms or other infrastructure from the sea bed.
- Deposit and use of explosives, e.g. to remove seabed obstructions, to sever wellheads or during the course of other decommissioning activities (N.B. seismic use of explosives would be covered by the DECC geological survey consenting regime).

Guidance in relation to the DECC MCA Act licensing regime can be found on the DECC Oil and Gas website at www.og.decc.co.uk/XXXX , or by contacting the DECC Environmental Management Team (emt@decc.gsi.gov.uk or 01224 254045 / 254050

Applications for a marine licence will require the payment of a fixed sum application fee. You will be invoiced for the fee following submission of the application. In the case of applications supported by an Environmental Statement (ES), there will be a separate fee to cover the costs associated with the ES review process, which will be calculated based on the time spent dealing with individual submissions. You will therefore be invoiced separately for this fee, following completion of the review process. Further information in relation to the DECC MCA Act marine licence charging scheme, and the Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) charging scheme, can be found on the DECC Oil and Gas website at www.og.decc.co.uk/XXXX .

Marine Licence Application Form

Department of Energy and Climate Change, Atholl House, 86-88 Guild Street, Aberdeen AB11 6AR

All tables and text boxes in this application form can be expanded as necessary.

1. TYPE OF APPLICATION

- a) Is this an application for a new marine licence? **YES**
- b) Is this an application to amend an existing marine licence? **NO**
- c) Is this an application to extend an existing marine licence? **NO**
- d) Is this an application to renew an existing marine licence? **NO**

The period of validity of marine licences can be extended up to a maximum of one year (12 months), but licences must be renewed if activities will extend into a second year. If you are applying to amend, extend or renew an existing licence, any changes in the application form must be clearly highlighted.

2. APPLICANT DETAILS

To be completed for all applications.

Name of Company	Total E & P UK
Address	Crawpeel Road Altens Aberdeen AB12 3FG
Name of Contact	Dougie MacPherson
Position within Company	Subsea Projects Team Leader
Telephone Number	01224 297229
Fax Number	01224 296812
E-mail	Dougie.macpherson:total.com

NOTE: The applicant will normally be the licensed operator.

3. LICENSED OPERATOR DETAILS

To be completed for all applications.

If the **Licensed Operator** is the **Applicant**, please tick this box and move to Section 4.

Name of Company	
Address	
Name of Contact	
Position within Company	
Telephone Number	
Fax Number	
E-mail	

4. ACTIVITY DETAILS

To be completed for all applications.

Location of Proposed Works:	West Of Shetland
Latitude / Longitude Coordinates:	6755000mNorth 538500mEast
Quad/Block:	206/4
Field Name:	
Earliest Start Date:	01 st July 2011
End Date:	31 th August 2011

Description of Proposed Activity

Please provide details of the proposed activity in the following text box, or enter the name of any relevant document or file submitted in support of the application.

DRAFT

1.0 INTRODUCTION

This application by JP Kenny Caledonia Ltd is on behalf of Oil and Gas UK for the temporary deployment of structures and cutting shears to facilitate an Emergency Equipment Response Demonstration.

This is following the BP Macondo blow out and subsequent Deepwater Horizon loss, the UK oil and gas industry's new Oil Spill Prevention and Response Advisory Group (OSPRAG) was established by Oil & Gas UK in May 2010. OSPRAG intends to review UKCS practice and regulation concerning the arrangements for pollution prevention and response.

2.0 OVERVIEW OF THE DEMONSTRATION

2.1 General

The demonstration shall be conducted from two off Company contracted support vessels. The exercise shall be conducted West of Shetland in a water depth of around 300m. The demonstration will comprise the following;

- Landing of Cap support structure and pipe cutting support structure on the seabed;
- Simulation of subsea oil dispersant supply above the landing structure;
- Cutting of a section of pipe on the pipe cutting support structure;
- Deployment of the EERD Cap onto the Cap landing structure;
- Recovery of all equipment from the seabed.

We may perform some localised perimeter dredging by ROV to assist in the recovery of the structures if they prove problematic to recover using direct pull alone. This is a contingency operation to locally excavate around the base mudmat perimeter to expose the mudmat - typically 8" depth or so.

2.2 Overview of the Structures Installation

The Cap landing structure will be deployed onto the seabed at a pre-determined location from the installation vessel. If the structure is not sufficiently level following land out on the seabed then the structure shall be picked up and landed at an adjacent location.

A pipe cutting support base will be landed at a location close to, but sufficiently far away from, the Cap landing structure such that safe operation of the shears and recovery of the pipe can be accomplished without impacting on the landing structure or subsequent deployment of the Cap.

2.3 Overview of the Oil Dispersal Equipment Demonstration

The oil dispersal equipment demonstration shall be conducted following the placement of a seabed mounted Cap landing base at the desired location.

The oil dispersal equipment demonstration shall involve overboarding a fluid supply hose adjacent to the landing base. This shall be followed by the pumping of dyed fluid from the support vessel via an ROV mounted lance used to direct the fluid at a location just above the landing base.

2.4 Overview of the Cutting of Pipe

A set of subsea shears will be deployed from the vessel and will be used to take a horizontal cut on the pipe section forming part of the pipe cutting support structure. The cut section of pipe will be recovered to the vessel.

2.5 Overview of the EERD Cap Installation

The EERD Cap will be deployed onto the landing base. If required by the programme the Cap will then be locked to the base and several valves operated to simulate EERD Cap installation and operation.

2.6 Overview of the Equipment Recovery

All equipment will be recovered from the seabed at the end of the demonstration.

3.0 VESSEL ACTIVITY

The first part of the demonstration to be conducted from the Subsea 7 vessel, Seven Oceans, and comprise the following:

- Landing of Cap landing base structure on seabed and landing of pipe support structure on the seabed;
- Landing of overburden weight onto Cap landing base;
- Deployment of ROV shears and the cutting of a section of pipe on the pipe support structure;
- Recovery of subsea shears and pipe support structure;
- Recovery of the overburden weights.

The second part of the demonstration to be conducted from the Well Ops vessel, Well Enhancer, and comprise the following:

- Simulation of subsea oil dispersant supply above the landing base structure;
- Deployment of the EERD Cap onto the landing base;
- Operate Cap functions by ROV;
- Recovery of EERD Cap;
- Recovery of the Landing Base structure from the seabed.

4.0 CHEMICALS TO BE USED AND DISCHARGED

The Seven Oceans DSV will deploy the pipe cutting shears to take a horizontal cut on the pipe section forming part of the pipe cutting support structure. There are no planned discharges during this operation and all hydraulic fluid (Gulf Coast DEBLU AWS 32 oil) will be returned to the fluid reservoir within the HPU.

The Well Enhancer DSV will deploy a fluid supply hose adjacent to the landing base. This shall be followed by the pumping of dyed fluid from the support vessel via an ROV mounted lance used to direct the fluid at a location just above the landing base, during this activity there will be a discharge of Romex RX-9034A dye approximately 10bbbls at 1000ppm to sea.



NOTE: For applications relating to a number of licensable activities, please clearly identify the separate activities.

5. ENVIRONMENTAL IMPACT ASSESSMENT

Is the application supported by an Environmental Statement? **NO**

If "Yes", a copy should be submitted to accompany the application form.

If "No", please provide an environmental impact assessment in the following text box, or enter the name of any relevant document or file submitted in support of the application.

5.1 Seabed Impacts

The placement of the cap and pipe cutting support structures onto the seabed could result in the direct physical injury or death of organisms that are present within that direct footprint. Direct physical impact will be more of a problem for sessile epifaunal organisms as mobile species or infauna may be able to move through the sediment away from the affected area (e.g. Bluhm, 2001). This direct impact is limited to the 39 m² that will be temporarily covered by the cap support structure and 15.21 m² for the pipe cutting support structure (total of 54.21 m²) and the seabed and faunal assemblage that may be impacted is considered to be typical of the wider area.

The placement of the two structures onto the seabed will also exclude the seabed habitat directly beneath from use by species found in the region. However, the two small structures will be in place for a very short time (a matter of days) and habitat exclusion will therefore be an extremely temporary impact.

Placement of the structure on the seabed could lead to increased levels of suspended solids in the water column which could smother epifaunal benthic species. Larger particles will settle out of the water column more quickly than smaller particles (e.g. Farrell, 2005); therefore, sediment resuspension is likely to persist for a longer period in areas with a high percentage of fine sediments compared to areas with a coarser sediment composition (e.g. Hitchcock et al., 1996, in Gubbay, 2003). Seabed sediments in the area are comprised of silty medium to fine sand (Fugro, 2009), although sediments in the area are thought to be mobile and dependant on local seabed currents (Fugro, 2009), suggesting that species in the area will be exposed to (and presumably tolerant of) sediment resuspension.

The volume of sediment resuspension is expected to be minimal and the area of sediment resuspension, if any, is expected to be restricted to metres around the two devices. Where sedimentation does impact negatively on species, consequences are likely to be short-lived since most of the smaller sedentary species (such as polychaete worms which dominate the area; Fugro, 2009) have short lifecycles and recruitment of new individuals from outside any narrow area of disturbance will be rapid.

No Annex I habitats were identified within the area (Fugro, 2009) and from available survey information it does not appear that habitats or species on other lists of conservation importance are present (e.g. OSPAR, 2008, List of Threatened and/or Declining Species and Habitats or the UK Biodiversity Action Plan Priority Habitats and Species; UKBAP, 2011).

Considering the very small area of direct impact, the temporally short-lived nature of the impacts, the noted recovery potential and the absence of protected or sensitive species/habitats in the area of potential impact, it is considered that the temporary installation of the capping device will not have a significant negative residual impact on the seabed in the region.

5.2 Chemical Impacts

The chemicals which will be used to demonstrate the EERD cap have been selected for their low environmental impact, including low toxicity, low bioaccumulation potential and readily biodegradable properties. The chemicals proposed for use during the testing of the cap are a hydraulic fluid (Gulf Coast DEBLU AWS 32 Oil) which will not be discharged and Roemex Ltd RX-9034a dye.

A chemical risk assessment has been undertaken for the discharge of RX-9034a during the proposed operations. The Osborne-Adams risk assessment methodology

for pipeline discharges as described by MS/CEFAS has been used, using the following formulae:

$$\frac{\text{Total quantity of chemical to be discharged (mg)}}{\text{Total expected discharge time in seconds}} = \text{Quantity of chemical released per second (QS)}$$

$$\frac{\text{Quantity in a litre to reach PNEC(mg) x volume water column (litres)}}{\text{QS x 3600}} = \text{Time taken to reach PNEC in hours (T1)}$$

$$\frac{\text{Residual current speed x 3600}}{2 \times 500} = \text{Refreshment rate (hour}^{-1}\text{) I}$$

$$\text{Refreshment rate I-1} = \text{Time taken to refresh column (hours) (T2)}$$

An acceptable discharge is one where the time taken to discharge sufficient chemical to exceed PEC/PNEC = 1 in the 500 m column water is greater than the time taken to completely refresh that column of water (i.e. if T1>T2), unless there are other local environmental sensitivities.

The risk assessment results are summarised in Table 2.1 below and show that the discharge of RX-9034a is not expected to have a significant impact on the marine environment.

Table 4.1 Summary of Risk Assessment Results

Chemical Name	Label	HQ/OCNS	Total quantity used (kg)	Total quantity discharged (kg)	Discharge Rate (m3hr-1)	PNEC	QS	T1 (hrs)	T2 (hrs)	T2>T1	Further Justification
RX-9034a	None	Gold	1.59	1.59	3.18	6.2	883.33	451498.43	27.78	False	x

6. SUMMARY ENVIRONMENTAL INFORMATION

a) Are there any protected sites (e.g. SPA / SAC / RAMSAR / SSSI), **YES/NO** or candidate protected sites within 40 km of the activity?

If “Yes”, please list them below.

Site	Designating feature(s)	Distance from activity (km)

b) Is the activity within a fish or shellfish spawning or nursery area? **YES/NO**

If “Yes”, please provide details of relevant species and relevant times of the year?

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Norway pout			SN	SN	SN							
Mackerel	N	N	N	N	N	N	N	N	N	N	N	N
Blue whiting	N	N	N	N	N	N	N	N	N	N	N	N

S = Spawning, N = Nursery, J = Juveniles, NS = No documented sensitivity, Blank = No data (more than one code can be entered)

c) Are there times of the year when seabirds in the vicinity of the activity are more vulnerable than at other times of the year? **YES/NO**

Please provide details of seabird vulnerability.

Quadrant/ Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
214/28		2	2	4	2	3	2	3	4	3	4	3
214/29		2	2	4	2	3	2	4	4	3	4	3
214/30	3	2	2	2	2	2	2	3	3	3	4	3
206/3	4	2	2	3	2	3	2	3	4	3	4	3
206/4	4	2	2	4	2	3	2	4	4	3	4	3
206/5	3	2	2	2	1	2	1	3	3	3	3	3
206/8	4	1	2	3	2	3	1	4	4	3	3	4
206/9	4	1	2	3	2	3	1	4	4	3	3	4
206/10	3	1	2	2	1	2	1	3	3	3	3	4

1 = Very High, 2 = High, 3 = Moderate, 4 = Low, Blank = No data

d) Are there times of the year when sea mammals (e.g. dolphins porpoises, whales, seals etc) in the vicinity of the activity are more abundant than at other times of the year? **YES/NO**

Please provide details of sea mammal abundance.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Blue whale	3	3	3	3	3	2	2	2	2	2	3	3
Fin whale	3	3	3	3	3	2	2	1	1	3	3	3
Sei whale	N	N	N	N	3	1	2	1	2	3	3	3
Humpback whale	3	3	3	N	3	1	1	2	1	N	3	3
Sperm whale	3	3	3	3	3	3	1	1	2	2	3	3
Bottlenose whale	3	3	3	2	3	3	3	2	2	3	3	3

Killer whale	3	3	3	2	1	2	2	1	1	2	3	3
Pilot whale	N	3	N	N	N	2	1	1	2	2	N	N
Minke whale	3	3	2	3	2	1	1	1	2	2	3	3
White beaked dolphin	3	3	2	3	2	1	1	1	2	2	3	3
Atlantic white sided dolphin	3	N	2	2	2	2	2	1	1	2	2	3
Rissos dolphin	N	N	3	3	3	2	2	1	1	2	2	3
Bottlenose dolphin	3	3	1	3	3	3	2	2	1	1	3	3
Harbour porpoise	3	3	2	2	2	2	2	2	1	2	2	3

1 = High Density, 2 = Moderate Density, 3 = Low Density, Blank = No data

e) Are there any other outstanding or unusual environmental features in the vicinity of the activity (e.g. seasonal algal blooms, sessile benthic species and geological or archaeological features)?

YES/NO

If “Yes”, please provide details in the following text box, or enter the name of any relevant document or file submitted in support of the application.

f) Please provide details of the sources on the summary environmental information.

Protected sites	
Fish / shellfish	Fisheries Sensitivities Maps in British Waters, Coull, Johnstone and Rodgers, UKOOA (1998)
Seabirds	Seabird Vulnerability in UK Waters. Block Specific Vulnerability, JNCC (1999)
Marine mammals	Distribution and Relative Abundance of harbour porpoises, white beaked dolphins and minke whales around the British Isles, Northridge, Tasker, Webb and Williams, ICES J. mar. Sci. 52: 55-56 (1995) Marine Mammal Observation During Seismic Surveys in 1996, Stone, JNCC Report 228 (1997) Marine Mammal Observation During Seismic Surveys in 1997, Stone, JNCC Report 278 (1998) Marine Mammal Observation During Seismic Surveys in 1998, Stone, JNCC Report 301 (2000) Marine Mammal Observation During Seismic Surveys in 1999, Stone, JNCC Report 316 (2001)
Other environmental features	N/a

7. CONSULTATION

Marine Licence Application Form

Department of Energy and Climate Change, Atholl House, 86-88 Guild Street, Aberdeen AB11 6AR

Has there been prior consultation with any relevant stakeholders, e.g. the MMO, Devolved Authorities, Statutory Nature Conservation Agencies, MCA, Statutory Light Authorities or MOD?

YES/NO

If “Yes”, please confirm which bodies have been consulted, whether there were any objections, and whether copies of any relevant correspondence have been provided to accompany the application.

Name of Body	Did they object to the activities? (YES/NO)	Is relevant correspondence provided? (YES/NO)

8. MARINE LICENCE VARIATIONS

If you are applying to amend, extend or renew an existing marine licence, please provide a chronological summary of all requested variations.

9. COMPLETED APPLICATIONS

Completed applications should be forwarded to the DECC Environmental Management Team, preferably by e-mail to emt@decc.gsi.gov.uk or by post to:

Department of Energy and Climate Change (DECC)
 Energy Development Unit (EDU)
 Offshore Environment and Decommissioning Branch (OED)
 Environmental Management Team
 Atholl House
 86-88 Guild Street
 Aberdeen AB11 6AR

All routine applications should be submitted at least 28 days in advance of the proposed commencement of the licensable activities, and applications supported by an Environmental Statement should be submitted at least three months in advance of the proposed commencement of the activities. If any information is not available at the time of submission, this should be indicated in the appropriate section of the application form, and the information should be provided separately as soon as possible. Any delay in forwarding information or responding to DECC enquiries is likely to result in a delay in determining the application.

Department of Energy and
Climate Change

Energy Resources and
Development Unit

4th Floor
Atholl House
86-88 Guild Street
Aberdeen AB11 6AR

Tel +44 (0)1224 254007
Fax +44 (0)1224 254019

www.decc.gov.uk
EMT@decc.gsi.gov.uk

Dougie MacPherson
Crawpeel Road
Altens
Aberdeen
AB12 3FG

04 July 2011

Dear Dougie

RE: EMERGENCY EQUIPMENT RESPONSE DEMONSTRATION

I refer to your application dated 21 June 2011 reference MCAA/0017/2011 in relation to the emergency equipment response demonstration for Block 206/4.

After due consideration of the activities to be undertaken, DECC can confirm that the emergency equipment response demonstration covering the following components will not require a Marine Licence:

- Landing of Cap support structure and pipe cutting support structure on the seabed;
- Cutting of a subsea section of pipe on the pipe cutting support structure;
- Deployment of the EERD Cap onto the Cap landing structure;
- Recovery of all equipment from the seabed;
- Localised perimeter dredging by ROV to assist in the recovery of structures.

We therefore consider that the above activities are Exempted under Regulation 16(1) the S.I. Marine Licensing (Exempted Activities) Order 2010.

Although you do not require a licence to proceed with the above activities a Marine Licence for the chemical use and discharge of Romex-RX9034A has been issued below. It would be appreciated if you could inform DECC of any changes to the proposed operation as detailed in your correspondence in order that we may determine that this advice remains appropriate.

If you have any queries in relation to this notification, please do not hesitate to contact Dr Julie Cook on 01224 254007 or e-mail the Environmental Management Team at emt@decc.gsi.gov.uk.

Yours sincerely,



Derek Seward
Head, Environmental Management Team

MARINE AND COASTAL ACCESS ACT 2009

EMERGENCY EQUIPMENT RESPONSE DEMONSTRATION – CHEMICAL USE AND DISCHARGE OF ROMEX-RX9034A

I am directed by the Secretary of State to issue this letter as a licence, solely for the purposes of Marine and Coastal Access Act 2009 to Total E & P UK as described in your application dated 21 June 2011.

This licence is given subject to the conditions set out below.

1. **Commencement and Completion of Operations**

The licence holder must notify the Department of Energy and Climate Change (hereinafter called the Department) of the date of commencement and the date of completion of all operations authorised under the licence. Separate notifications are required at the times of commencement and completion.

2. **Location**

Latitude: 60° 55' 41" N Longitude: 02° 17' 23" W

3. **Inspections**

The licence holder shall ensure that copies (electronic or paper) of the licence and all other relevant documents are available for inspection by any authorised Inspector at:

- (a) the premises of the licensee;
- (b) the premises of any agent acting on behalf of the licence holder;
- (c) on board any vessel(s) employed to undertake or support the Works; and
- (d) the facilities undertaking the operations covered by the licence.

4. **Authorised Deposits**

The Licence holder is authorised to discharge 1.59m³ at 1000ppm of Romex RX 9034A dye. The Licence holder shall make record of chemical use during the course of the operations covered by the licence. Copies of the record must be made available to the Department on request, and retained for a period of one calendar year following submission of the relevant permit returns.

The licence holder shall within 28 days of completion of the operations covered by the licence or within 28 days of the date of expiry of the licence, whichever is the sooner, submit a return confirming the quantities of all chemicals used or discharged during the course of the other operations covered by the licence. The return should be sent to the Environmental Management Team at emt@decc.gsi.gov.uk.

5. **Licence Variation**

In the event of the licence holder becoming aware that any of the information on which the issue of the licence was based may change, or has changed, they must notify the Department immediately. In the event that the licence holder wishes any of the particulars detailed in the licence to be altered, the licence holder must notify the Department immediately and request a variation.

MCAA/0017 /2011

The licence for the works is valid from **01 Jul 2011 until 31 Aug 2011**. You are asked to make any application to vary this licence in writing at least two weeks before it is required.

If operations continue past the expiry date of the permit you should apply to the Department for a new licence allowing a minimum of 28 days.

The Department requires you to take note of the following comments:

Section 1

1. A collision risk management plan should be developed for the operation to record the pre planning measures taken to minimize the risk of ship collision and to define any guarding role of the ERRV whilst on location.
2. The crew of the ERRV attending the operation should be experienced in traffic monitoring duties and be briefed on the main routes of concern in the area.
3. The main operators of ships on routes within 2nm should be provided with advanced notice of the operation.
4. Please note that a charge will be levied on the applicant, by The Maritime and Coastguard Agency for the transmission of maritime safety information, via Navtex or Coastguard VHF radio network, in respect of the proposal. Agreement by the applicant to pay any such charges is a condition of the consent.
5. Unless an agreement has been made with the Fisherman's Federations, details of the deployment should be passed, by email, to kingfisher@seafish.co.uk, for inclusion in the Kingfisher Information Services fortnightly bulletin, at least two weeks before the start date.

Section 2

1. You are deemed to have satisfied yourself that there are no barriers, legal or otherwise, to the carrying out of the operations covered by the Licence. The issue of a Licence does not absolve the Licence Holder from obtaining such authorisations, consents etc that may be required under any other legislation.
2. All communications relating to the Licence should be addressed to:

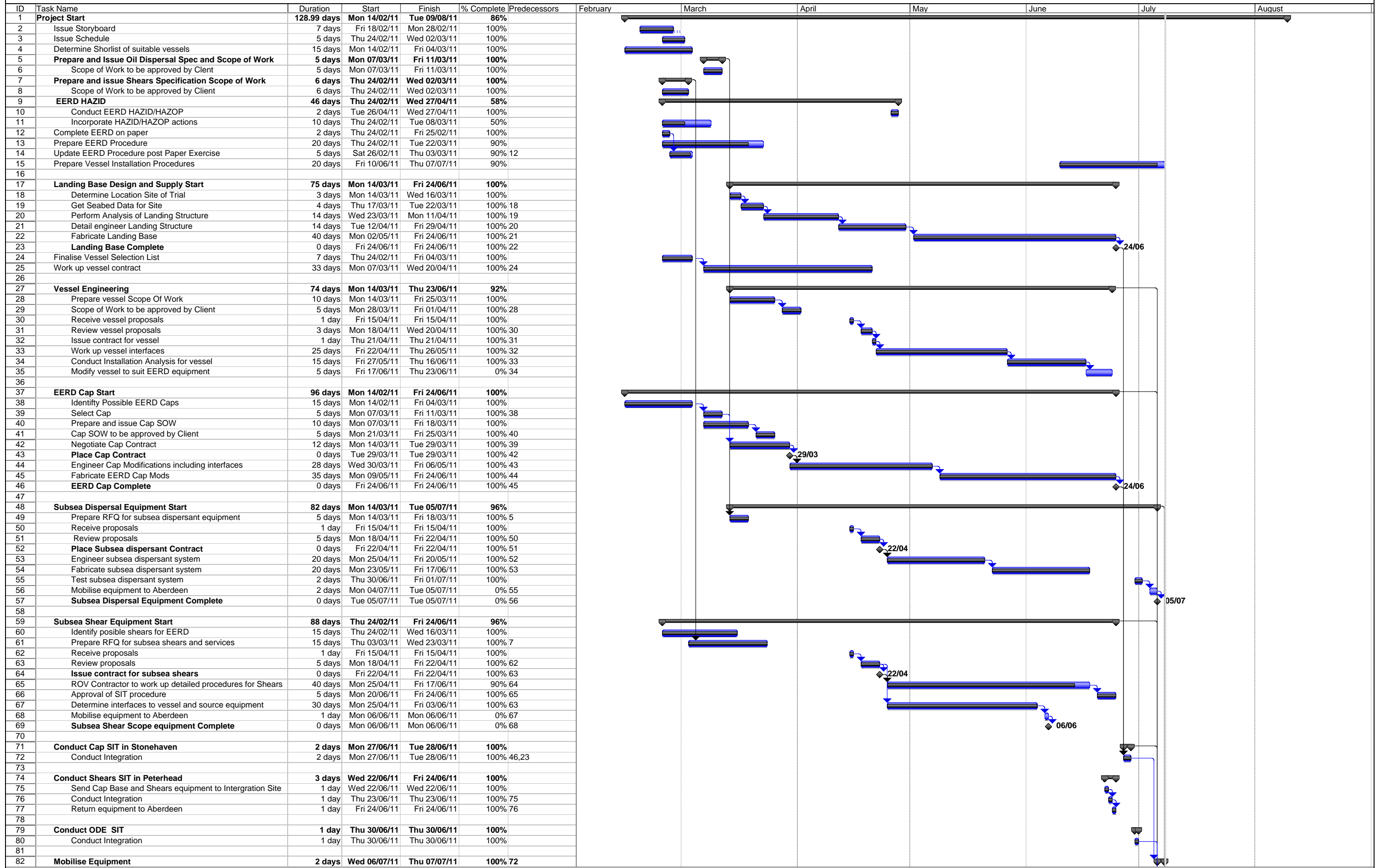
EMT@decc.gsi.gov.uk

The Department of Energy & Climate Change
Environmental Management Team
Energy Development Unit (EDU)
4th Floor, Atholl House
86-88 Guild Street
ABERDEEN AB11 6AR

Tel number: (01224 254050

Fax number: (01224) 254019

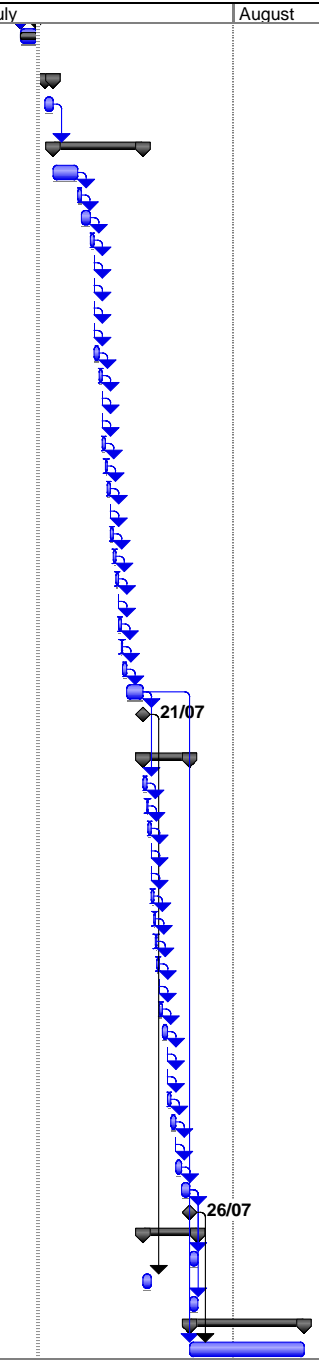
Appendix 2
PROJECT SCHEDULE



Project: EERD Schedule 08 July 2011
Date: Fri 08/07/11

Task Progress Summary External Tasks Deadline Split Milestone Project Summary External Milestone

ID	Task Name	Duration	Start	Finish	% Complete	Predecessors	February	March	April	May	June	July	August
83	Transport Equipment to Aberdeen Holding Site	2 days	Wed 06/07/11	Thu 07/07/11	100%	27,37,48,59,71,80							
84													
85	Equipment Mobilisation	1 day	Sat 09/07/11	Sat 09/07/11	0%								
86	Transport Equipment to Aberdeen Quayside	1 day	Sat 09/07/11	Sat 09/07/11	0%								
87													
88	Vessel Scope - Aberdeen Mobilisation	8 days	Sun 10/07/11	Thu 21/07/11	0% 86								
89	Mobilise Equipment onto Vessel	3 edays	Sun 10/07/11	Wed 13/07/11	0%								
90	Wait on Tide	0.13 edays	Wed 13/07/11	Wed 13/07/11	0% 89								
91	Vessel transit	1.1 edays	Wed 13/07/11	Thu 14/07/11	0% 90								
92	Conduct DP Trials	0.17 edays	Thu 14/07/11	Thu 14/07/11	0% 91								
93	Conduct seabed survey	0.08 edays	Thu 14/07/11	Thu 14/07/11	0% 92								
94	Conduct localised dredging if required	0.17 edays	Thu 14/07/11	Thu 14/07/11	0% 93								
95	Preapre landing base for deployment	0.05 edays	Thu 14/07/11	Fri 15/07/11	0% 94								
96	Deploy Cap landing base on seabed	0.25 edays	Fri 15/07/11	Fri 15/07/11	0% 95								
97	Contingency in event of levelling works - resiting required	0.33 edays	Fri 15/07/11	Fri 15/07/11	0% 96								
98	Deploy 40t weights onto base	0.15 edays	Fri 15/07/11	Fri 15/07/11	0% 97								
99	Deploy Subsea Dispersant Equipment and pressure test	0.21 edays	Fri 15/07/11	Fri 15/07/11	0% 98								
100	Conduct Subsea Dispersant Demo	0.25 edays	Fri 15/07/11	Sat 16/07/11	0% 99								
101	Recover Subsea Dispersant Equipment	0.17 edays	Sat 16/07/11	Sat 16/07/11	0% 100								
102	Recover 40t weights	0.21 edays	Sat 16/07/11	Sat 16/07/11	0% 101								
103	Cap pre-deployment checks etc	0.19 edays	Sat 16/07/11	Sat 16/07/11	0% 102								
104	Deploy EERD Cap lock and function test	0.33 edays	Sat 16/07/11	Sun 17/07/11	0% 103								
105	Recover EERD Cap	0.23 edays	Sun 17/07/11	Sun 17/07/11	0% 104								
106	Recover cap Landing Base	0.33 edays	Sun 17/07/11	Sun 17/07/11	0% 105								
107	Recover Clump weights / Transponder	0.17 edays	Sun 17/07/11	Sun 17/07/11	0% 106								
108	Complete site survey	0.08 edays	Sun 17/07/11	Sun 17/07/11	0% 107								
109	Sail to Lerwick	0.42 edays	Sun 17/07/11	Mon 18/07/11	0% 108								
110	Wait on tide	0.13 edays	Mon 18/07/11	Mon 18/07/11	0% 109								
111	Backload vessel equipment	0.75 edays	Mon 18/07/11	Tue 19/07/11	0% 110								
112	Waiting on Weather Allowance (from Total)	2 edays	Tue 19/07/11	Thu 21/07/11	0% 111								
113	Vessel Part 1 Scope Complete	0 days	Thu 21/07/11	Thu 21/07/11	0% 112								
114													
115	Well Enhancer Part 2 Scope - Lerwick Mobilisation	3.99 days	Thu 21/07/11	Tue 26/07/11	0%								
116	Mobilise vessel in Lerwick including interface testing	0.25 edays	Thu 21/07/11	Thu 21/07/11	0% 112								
117	Wait on Tide	0.13 edays	Thu 21/07/11	Thu 21/07/11	0% 116								
118	Transit to Location WoS	0.42 edays	Thu 21/07/11	Fri 22/07/11	0% 117								
119	Conduct DP trials	0.17 edays	Fri 22/07/11	Fri 22/07/11	0% 118								
120	Perform ROV Survey	0.08 edays	Fri 22/07/11	Fri 22/07/11	0% 119								
121	Ready base for deployment	0.05 edays	Fri 22/07/11	Fri 22/07/11	0% 120								
122	Rig up and overboard cutting support base	0.17 edays	Fri 22/07/11	Fri 22/07/11	0% 121								
123	Deploy and land cutting base on seabed	0.19 edays	Fri 22/07/11	Fri 22/07/11	0% 122								
124	Carry out choke and kill line cutting	0.17 edays	Fri 22/07/11	Fri 22/07/11	0% 123								
125	Rig up and deploy shearing equipment	0.46 edays	Fri 22/07/11	Sat 23/07/11	0% 124								
126	Cut pipe	0.04 edays	Sat 23/07/11	Sat 23/07/11	0% 125								
127	Recover shears and cut pipe and HPU	0.5 edays	Sat 23/07/11	Sat 23/07/11	0% 126								
128	Deploy crane wire and connect to base slings	0.25 edays	Sat 23/07/11	Sun 24/07/11	0% 127								
129	Recover cutting base	0.21 edays	Sun 24/07/11	Sun 24/07/11	0% 128								
130	Complete site survey	0.08 edays	Sun 24/07/11	Sun 24/07/11	0% 129								
131	Transit to lerwick	0.42 edays	Sun 24/07/11	Sun 24/07/11	0% 130								
132	Wait on Tide	0.13 edays	Sun 24/07/11	Sun 24/07/11	0% 131								
133	Demob Vessel	0.75 edays	Sun 24/07/11	Mon 25/07/11	0% 132								
134	Waiting on Weather Allowance (from Total)	1 eday	Mon 25/07/11	Tue 26/07/11	0% 133								
135	Vessel Scope Complete	0 days	Tue 26/07/11	Tue 26/07/11	0% 134								
136	Transit equipment back to Destination	4.99 days	Thu 21/07/11	Wed 27/07/11	0%								
137	Transit Shearing equipment to oceaneering	1 day	Tue 26/07/11	Wed 27/07/11	0% 134								
138	Transit Cap back to Total	1 day	Thu 21/07/11	Thu 21/07/11	0% 113								
139	Transit pipie structure back to Neptune	1 day	Tue 26/07/11	Wed 27/07/11	0% 134								
140	Lessons Learned and Close-out report	10 days	Tue 26/07/11	Tue 09/08/11	0%								
141	Complie and issues lessons learned	10 days	Tue 26/07/11	Tue 09/08/11	0% 112,135								



Appendix 3
LESSONS LEARNED MATRIX

EERD LESSONS LEARNED SPREADSHEET

#	Lesson for	Category	Result	Topic	Description	Lesson	Photos	Amendments	Recommendations	Status
1	Neptune Deeptech Ltd	Testing	Could have been better	SIT	Connector Status Markings	Land out and Connector lock and unlock markings were not present on the Landing Structure prior to SIT. They should have been. Project requested that Neptune land out the Cap on the structure prior to SIT and confirm correct operation. This was not done resulting in a significant SIT delay. At one point there was uncertainty as to whether the Cap had actually landed out correctly.	<u>Yes</u>	Following the SIT Neptune Deeptech marked relevant location on the cap to if it had been landed out and locked down correctly.	1) It is an absolute MUST that markings be present on mating structures to prevent any possible repeat and these MUST be present prior to any SIT activity being conducted. 2) Over the campaign the Cap was landed onto different stumps, 1) Landing Base, 1 & 3) Shipping skids. There was some uncertainty offshore as to whether the Cap was landed fully on the 2nd shipping skid. Confirmation of locking position on this skid would have been very useful.	Closed
2	Neptune Deeptech Ltd	HSEQ	Could have been better	SIT	Connector not fully landed	As above	<u>Yes</u>	As above	Nil	Closed
3	Neptune Deeptech Ltd	Testing	Could have been better	SIT	Debris on mandrel	Mandrel on Landing structure was dirty and had not been lubricated. This may have contributed to problem with unlocking of Cap from Base. Following clean up and rust debris the Cap subsequently unlocked more readily.	<u>Yes</u>	A Neptune Deeptech technician preformed cleaning and greasing activities to the connector on request.	Ensure procedures capture need to visually inspect H4 mandrel.	Closed
4	Oceaneering / GSI	Testing	Went Very Well	SIT	Shears	SIT of Shears at Dry Dock was superbly managed and conducted by Oceaneering	<u>Yes</u>	Nil	Nil	Closed
5	Well Ops UK	Operations Planning	Went Well	MOC	Dual to Single Vessel	Considering the relatively short notice period the operation generally went well and Well Ops were able to take on the additional scope at short notice.	-	Nil	Nil	Closed
6	Total E&P UK	Operations Planning	Could have been better	HAZID	Timing	Final system HAZID and the Operational Review was conducted very late and should have been conducted earlier. Late change from a 2 vessel operation to a single vessel option contributed to this as significant changes to programme planning required.	-	Nil	Plan to conduct such operations as far in advance as practicably possible	Closed
7	Oceaneering	Equipment	Went Very Well	SIT	LED -1600 light and L3C-550C Camera	Excellent work done in trialling LED lights onshore by Oceaneering with dye detection dye	<u>Yes</u>	Nil	Nil	Closed
8	Oceaneering	Equipment	Went Very Well	SIT	Cutting Trials	When requested Oceaneering did well to organise further setting up and conducting multiple shearing trials at various locations.	-	Nil	Nil	Closed
9	Proserv	Equipment	Could have been better	SIT	ODE ROV Lance	The ROV lance used at the ODE SIT was identified as being unsuitable. For some reason the suggested modifications were not undertaken by the supplier and the original diver style 'T' piece with retro jet and diffuser was mobilised offshore.	<u>Yes</u>	For simplicity the ROV crew used their own lance from the subsea jetter for the operation.	1) Ensure that ROV crew are aware of all equipment being mobilised for an offshore scope. 2) Ensure that suppliers attend the SIT to ensure all actions are recorded.	Closed
10	Qserv	Equipment	Could have been better	SIT	ODE ROV Lance	As above	<u>Yes</u>	As above	1) Ensure that ROV crew are aware of all equipment being mobilised for an offshore scope. 2) Company is responsible for following up outstanding actions from SIT's.	Closed
11	Neptune Deeptech Ltd	Fabrication and Manufacturing	Went Well	Rigging	Landing Base Bull horns	Bull horns were added to the both sides of the EERD Landing Base to allow the WROV to hook the landing base rigging in a mid water location which would assist the ROV to connect / disconnect MPT rigging from it much faster.	<u>Yes</u>	Bull horns were added as to two upper sides of the landing base as per the attached photo.	Nil	Closed
12	Total E&P UK / J P Kenny Ltd	Team Organisation	Went Very Well	Project Briefing	Pre - mob	Engagement and briefings of Client Rep needs to be addressed between Total and JPK earlier in the campaign to define roles and responsibilities before the project mobilises.	-	A pre-mob meeting was held in Total offices. This was a worthwhile activity and should have been held earlier as it ironed out many concerns and helped create a positive working relationship between all attendees.	Briefing with Total E&P UK project management about project documents, roles and responsibilities should be conducted on first day of reps employment.	Closed
13	Well Ops UK	Mobilisation	Could have been better	WROV	Hot Stab ROV Skid	This unit was test fitted to an XLS4 at the WOUK Aberdeen workshop and revealed a few shortcomings; 1) The WROV on the vessel had been retro fitted with a bumper skid underneath its chassis for extra protection, because of this the pins which interface to the ROV framework were too short. 2) The skid has clearly been designed for a smaller vehicle than XLS, and when fitted the manipulator operated valves and flow meter on the forward end of the skid were now under the WROV and out of reach.	-	1) New longer sets of pins were manufactured to suit the XLS and allowed it to be installed; 2) The skid was modified to move the recover refill valve further forward and within reach of the ROV manipulator. 3) The sea water suction valve remained hidden out of reach, this could only be functioned by an operator if the vehicle was recovered to deck; 4) For the same reason, the flow meter was out of sight of our cameras, also this was not corrected.	The skid worked as required, but the return hot stab leaked at a JIC fitting. HOLD TBC - As an improvement suggestion, the return hot stab could be simplified by moving one non return valve to the fixed end of the return hose, thereby reducing the number of joints at the stab end.	Closed
14	Well Ops UK	Pre-mobilisation	Could have been better	WROV	ROV Equipment Interfaces	The amount of equipment required to be added to the ROV and the required technical interface does not appear to have been adequately planned with sufficient inclusion of the offshore team. The final setup of the ROV was a compromise without everything mounted and yet the weight was still 10.7 ton. The SWL of the WROV A frame is 12Te. The ROV crew on the Well Enhancer should have been consulted earlier so they could assist with the technical interface of 3rd party contractors equipment to the ROV's.	-	1) The Blueview kit was de-mobbed prior to sailing; 2) The Fugro Current Meter was never used due to interfacing issues;	1) During SIT a mock up ROV was prepared and used by Oceaneering, WOUK ROV personnel should have attended SIT. 2) Considered over all weight of equipment being added when planning a project when planning a project.	Closed
15	Oceaneering	Operations	Could have been better	WROV	TDU	At the EERD cap SIT a Total rep asked Oceaneering tooling technicians if there was a chance of any interface issues with other companies ROV's and the feedback was that the TDU units were universal. Interface of the TDU was subsequently an issue during the mob. 1) The Oceaneering provided laptop was unable to interface and control the TDU through the ROV; 2) The ROV crew confirmed that the unit has been on the vehicle before, and they had some history of communication problems with it; The TDU successfully operated the valve as required.	-	Given the time constraints they decided to use it like last time it was installed on this exact WORV - By using direct hydraulic feeds from the WROV auxiliary valve pack to control the tool, and they also fitted their own tooling cameras.	1) What can be done to make sure that this interface issue doesn't not happen again? Is this something that WOUK and Oceaneering need to investigate further? 2) There was a clear requirement to use a TDU on the OSPRAG Cap as BP always use them WoS due to high currents. The EERD Cap is meant to replicate OSPRAG Cap and as close as practicably possible to its controls hence reason for fitting TDU for this programme. 3) As a result it would be a better arrangement to mobilise for a vessel for real scenario with two WROV's.	Open

EERD LESSONS LEARNED SPREADSHEET

16	Well Ops UK	Mobilisation	Could have been better	Communications	Team Organisation	The Co-ordination of project / marine mobilisation activities not adequately organised. Deck crew and Client were not fully aware of extent of vessel modifications / maintenance planned to be undertaken alongside the EERD exercise mob.	-	Nil	All departments on the vessel should be made aware of the major activities that are being planned during a mobilisation. More consideration should be given to the project team that is joining the vessel to ensure that they are not effected by these activities.	Closed
17	Bowtech Products Limited	Mobilisation	Went Very Well	ROV's	LED -1600 light and L3C-550C Camera	The LED light was fitted to WROV and the camera to Obs ROV. It was thought that with this configuration Obs ROV could get different views and angles to give a better description of the operations. The system worked very well to illuminate the dye during the ODE exercise.	Yes	Nil	Nil	Closed
18	Well Ops UK	Mobilisation	Could have been better	Mobilisation	Mobilisation Efficiency	In both Aberdeen and Lerwick problems were experienced with shore support i.e. welders, fork lifts and cranes. Due to operational and weather circumstances we were lucky and this did not delay the project.	-	Nil	In future 24hr cover should be planned when the vessel is alongside. This activity could be controlled by a dedicated mobilisation co-ordinator. This person would be shore based, is present in person at the mobilisations and responsible for all activities from logistics to shore support.	Closed
19	Well Ops UK	Testing	Went Well	ROV's	Wet Testing of new equipment installed on ROV's	A wet testing both ROVs took place during the transit to field, this was requested by the ROV crew due to the amount of changes that had taken place on the ROV's, especially the WROV. WROV 1) Blue View (removed prior to sailing) 2) TDU 3) LED Light 4) BOP Skid 5) Current Meter (removed prior to sailing) Obs ROV 1) Bowtech Camera	-	Nil	This was a worth while operation. The ROV crew did not find any issues but if they had, they would had several hours of transit time remaining to spend amending issues.	Closed
20	Well Ops UK	Team Organisation	Could have been better	Engineering Support	Project Engineers	Only one WOUK Project Engineer was assigned to the project. This role was covered during the night by the Offshore Project Superintendent (OPS). The Project Engineer work load is high and having one per shift would enable them to keep ahead of the job with procedures and task plans etc, in return allowing them to spend more time on deck and the control rooms assisting with operations.	-	Nil	It would be ideal to mobilise a second project engineer so 24hr support can be provided on the vessel.	Closed
21	Total E&P UK	Load-Out / Engineering	Went badly	Assurance Documents	Sea Fastening Assurance	Noble Denton required that the vessel perform 100% MPI on all sea fastening welds prior to sailing. WOUK recommended that it was unwise to carry out this operation because of the weather conditions. Application of sea fastening assurance was over complicated by Noble Denton and captured a lot of the Project Engineers time during the mobilisation to deal with issues. Contingency for bad weather at completion of sea fastening during inspection should be considered to allow MPI or alternative inspection method to be completed.	-	Nil	A back up inspection should have been made available to ensure that the sea fastening assurance could have been granted to the vessel prior to sailing. This could be any of the following: - Load test - Ultrasonic Test	Closed
22	Neptune Deeptech Ltd	Engineering	Could have been better	SIT	Interface clash between EERD cap and shipping skid.	Removal of guide posts from shipping skids for EERD cap transport.	Yes	Guide posts were removed during the SIT. Interface test was repeated and confirmed to be suitable.	Guideposts should have been removed prior to engagement as they were not required for the application	Closed
23	Oceaneering	Equipment	Went Very Well	WROV	Interface clash between the ROV super grinder and choke/kill lines.	All ROV crew thought the 14" blade that was supplied was an excellent blade to use. During the operation due to ROV movements the blade did see a lot of impacts, bending, warping and didn't break or chip.	Yes		Although the 14" blade worked and completed each cut very effectively, a larger blade may have given the ROV extra room to work with. Oceaneering have responded informing us that it is possible to get blades up to 16" / 18" in diameter but may require to be ordered in advance.	Closed
24	GSI	Equipment	Could have been better	WROV	Grab Handle	The shear structure was lacking a ROV grab handle left of the ROV stab plate. The WROV found it very difficult to hold onto the shear with just a pad eye to use when it was in a mid water.	Yes	Nil	Following the shearing operation GSI personnel assured the Total reps that an ROV grab handle would be installed for future operations.	Closed
25	Well Ops UK	Equipment	Could have been better	2" Black Eagle Downline	Manual Handling	To reel in / out this down line, an operator is required to isolate and disconnect it from the main sea water supply hose before commencing the reeling operation.	-	Nil	In the future a reel that does not require this disconnection would make operations faster and safer.	Closed
26	Well Ops UK	Engineering	Could have been better	Bumper bars	Bumper Bars	The bumper bars that were used were most certainly needed and well utilised during the exercise but the deck crew thought they were not sufficiently well designed in some locations.	Yes	1) Extra protection was added with webbing ratchet straps being installed between two vertical mezzanine deck bumper bars. 2) Extra protection was also added with webbing ratchet straps from the aft starboard side main deck bumper bars and top of the SIL down line reel which was installed on the starboard side mezzanine deck. 3) As a further precaution to avoid possible damage, all vessel electrical infrastructure was isolated and removed from the mezzanine deck hand railings.	1) Build contingency into the mobilisation plan for extra welding of structures; 2) Contact should be make with vessel crew early in the project to discuss requirements; 3) See WOUK Site instruction 003 - 005 and Mid Water Transfer Rigging Arrangement. 4) Remove or hinge any vessel railings in the area of heavy lifts; 5) Add bumper bars to the port side of the aft main deck.	Closed
27	Future Client	HSEQ	Could have been better	Fluid Discharge	Fluid Discharge	During the WROV valve functioning operations a fitting came loose on the returns hot stab, this resulted in a small discharge of water based hydraulic fluid.	-	Nil	1) It could be a good idea to perform a pressure test on the assembled fittings prior to deployment with a dummy receptacle. 2) Always check tightness of the fitting prior to deployment, torque if required; 3) Always check for dirt and damage on fitting.	Closed

EERD LESSONS LEARNED SPREADSHEET

28	Well Ops UK	Contingency	Could have been better	Deck Operations	Rigging	If a vessel is going offshore utilising a tower and crane each should have two sets of dedicated specialist rigging for major lifts as it would reduce manual handling and efficiency issues moving rigging from cane to moonpool.	-	Riggers were told to utilise the main crane when transporting rigging where possible.	The rigging itself was not a major issue but if a second set of deployment rigging was available for the main crane and MPT operations could continue while riggers would have more time to shift heavy rigging around the vessel and not incur any down time. It was estimated by a Deck Forman that 30mins was last each time rigging was transferred from sites.	Closed
29	Well Ops UK	Operations	Could have been better	WROV	Mid Water Transfers	During a trial mid water transfer the ROV crew realised that the WROV did not have enough thrust to overcome the 13m transit distance with heavy rigging e.g. between MPT to the main crane hook. It was thought that having the TDU mounted on the rear of the WROV reduced its thrust by 30% as it covered the aft thrusters.	Yes	See the following documents for the mid water transfer solution, Site Instruction 003 - 005 and Mid Water Transfer Rigging Arrangement diagram.	1) Eliminate mid water transfers by utilising a heave compensated knuckle boom crane would be far more deal. 2) See WOUK Site instruction 003 - 005 and Mid Water Transfer Rigging Arrangement;	Closed
30	Well Ops UK	Operations	Went Badly	WROV	ROV Weight	1) Ensure that ROV 's are not over loaded with additional equipment. WROV 1) Blue View (removed prior to sailing due to interface & weight issues); 2) TDU; 3) LED Light; 4) Hot Stab ROV Skid; 5) Current Meter (removed prior to sailing due to interface & weight issues). 2) The ROV crew thought the equipment list at the outset of the exercise was very ambitious for one WROV. With the skid & TDU fitted the system weight was approximately 10800kg according to TMS load cell. The WROV A frame SWL is 11Te.	-	Following discussion with the ROV crew it was decided to remove the Blue View Image equipment and Fugro current meter. It was an option to install the Current Meter for Phase 2.	1) A vessel with two work class ROV's may be a better choice so equipment weight could be distributed evenly. 2) See WOUK Site instruction 003 - 005 and Mid Water Transfer Rigging Arrangement;	Closed
31	Future Client	Operations	Could have been better	Vessel spec	Mid Water Transfers	1) Ensure that the vessel being used has the capability to perform any deployment and recovery operation with one lift system, thus eliminating the need for mod water transfers. 2) If a mid water transfer is required refer to WOUK Site instruction 003 - 005 and the attached Mid Water Rigging arrangement (these should be used as an example) for rigging configurations. 3) Ensure the vessel has a history of mid water transfer if its required. In this instance it was assumed that transfer would not be a problem as it had been done before on the vessel, but we later learned that this was with max weight of circa 10Te structures. - This was raised as a possible issue at the HAZID and it was agreed that Well Ops would liaise with Canyon such that Canyon ROV Super could go see the hook arrangement to determine if this was going to be an issue with handling. Combination of the following made the transfer not possible without a change of approach: a) Long bridle legs on structure sling sets meant soft strops had to be kept short to ensure loads could be over boarded from mezz deck; b) Use of main block not whip line; c) Presence of TDU package on ROV reducing thrust; b) Sheer size of ROV hooks and rigging.	Yes	1) Following a TBT it was agreed to use the vessel podline run through a snatch block rigged to the MPT block, the podline was then rigged to the main crane rigging. When pulled up it would draw both down lines together (see attached referenced documents) 2) It was discussed to remove the TDU from the WROV to return thrust to the vehicle, this never happened.	1) Use a capable HC knuckle boom crane with enough wire to deploy structures to seabed; 2) If possibly, use lighter rigging; 3) View vessel history for similar operations; 4) See WOUK Site instruction 003 - 005 and Mid Water Transfer Rigging Arrangement; 5) Remove excess weight from the ROV to give maximum thrust; 6) Use shorter structure bridles.	Closed
32	All	Operations	Went Well	Weather Criteria	Vessel Specification	West of Shetland weather makes vessel station keeping and stability imperative. Average conditions for mid water transfers and crane operations during exercise on Well Enhancer were 15-25 knots of wind with 1.8 to 2.5m sig wave height. This operation was carried out in the summer season. Historical weather trends for area researched and referenced when producing minimum vessel specification.	-	Nil	1) See WOUK Site instruction 003 - 005 and Mid Water Transfer Rigging Arrangement; 2) Can historical weather information for WoS be added here? HOLD	Open
33	Well Ops UK	Technical Support	Could have been better	Vessel Specification	Client Office Navigation Screen	On arrival to the vessel it was noticed that no Navigation screen was installed in the in clients office.	-	On request, the Well Enhancer electrician installing a dedicated Winfrog laptop in the client office	Install a dedicated Navigation screen to the client office. All Reps would appreciate and use this service.	Closed
34	SeaTronics	Mobilisation	Could have been better	WROV	Blueview BV 5000 Mechanical Scanning Sonar	Onshore engineering and suppliers should have more discussions with the WROV crew to make them more aware of what is required of WROV for upcoming projects. 1) The ROV crew were unable interface the unit to gain control of pan and tilt functions; 2) Unit needed to be mounted out front of WROV (between manipulators) - this left it exposed to damage while the ROV was engaged in rigging and hot stab operations. 3) To integrate this equipment, the crew had to provide it with 2 data channels plus one fibre, and three power supplies. The WROV system has 2 fibre passes through the TMS, both of which are normally used for the vehicle (one is a redundant spare).	Yes	Prior to the vessel departing Aberdeen, the Blueview equipment and technician was de-mobbed, this decision was taken because of interface and equipment weight issues with the WROV	MBES (Multi beam Echo Sonar) kit have proven to be invaluable in poor visibility and cluttered situations on seabeds. It would be useful to perform further research into a suitable device.. E.g. 2D Forward-Looking Imaging Sonar P900-90.	Closed

EERD LESSONS LEARNED SPREADSHEET

35	Fugro Subsea Services	Mobilisation	Could have been better	WROV	ADCP Current Meter	<p>The ADCP current meter was a bulky item, circa 30kg, because of this it was not suitable for the Obs class ROV (Super Mohawk II - Sub Atlantic) and as of insufficient space on WROV (Triton XLS-14) when TDU package was installed on vehicle we were left with little choice but to leave it off until Phase 2 of the exercise.</p> <p>Requirements 1) Required one data channel & one power supply; 2) Integrating the unit was straightforward, we quickly got communications; 3) Brackets had to be made up to mount the unit; 4) The unit requires heading and depth data from the ROV, and the technician was unable to extract this from the data string provided.</p> <p>The technician left with a plan to make changes to the software and email it to the vessel.</p>	Yes	Fugro mobilised a second laptop with a software update for Phase 2 but after several attempts to make it work it was decided to focus on the actual operations in hand and turn the Fugro equipment off.	<p>Further research should be performed into using a current meter with a typical ROV.</p> <p>Normally this issue may not arise but the exercise did prove what can happen and could easily happen during a fast response.</p>	Open
36	Well Ops UK	Operations	Went Very Well	WROV	Mid Water Transfers	Once the WROV had completed the mid water transfer trial and any issues were solved the operation became seamless each time. This isn't an activity that the vessel normally performs with large structures but with proper planning we proved it could be done.	-	Nil	See WOUK Site instruction 003 - 005 and Mid Water Transfer Rigging Arrangement.	Closed
37	Well Ops UK	Operations	Went Very Well	WROV	Guide Wires	The ROV pilots were happy about not having guide wires to deal with during the EERD cap deployment operations. It gave them a smaller area to work in and less chance of entanglement and damaging tethers	-	Nil	Nil	Closed
38	Well Ops UK	Operations	Could have been better	EERD Cap Deployment	LARS Cap Funnels	<p>If guide funnels are to be used for deployment through the moonpool of a vessel ensure they are large enough to accept the LARS system on the vessel.</p> <p>During interface trials and the actual deployment of the EERD cap on the LARS, the operators felt that the interface was 'sticky' time was spent to ensure he got the LARS pins to fit correctly in the cap funnels before final deployment.</p>	Yes	Nil	<p>1) Ensure any future caps with guide funnels are within the correct tolerance of a typical vessel LARS system.</p> <p>2) It was discussed that this issue could have been a simple issue caused by excess paint being applied to the inner area of the funnel or lack of grease in the matting surfaces.</p>	closed
39	All	Operations	Could have been better	Lift Planning	Rigging and lifting	Procedures / deck plan / lift plans should have more input from offshore personnel prior to issue for use. These people work the vessel regularly and know its limits and capability.	-	<p>Example; The Overburden weight was situated too far aft on the mezzanine deck meaning crane was close to limits at that boom radius for lifting, warning alarm sounding during initial stage of lift.</p> <p>To solve this, one of the sea fastening webs forward of the weight was removed so it could slide out to a more suitable radius prior to being lifted.</p>	Have initial discussions with offshore personnel earlier in the project planning a stages, this may be difficult but would be extremely worth while.	Closed
40	Well Ops UK	Operations	Could have been better	WROV	Mid Water Transfers	The excessive SWL of the ROV rigging, hooks and masterlinks meant that ROV was unable to handle the rigging subsea and alternative solutions had to be found.	Yes	See Site instruction 003 - 005 and mid water transfer rigging arrangement.	Attempts should be made to keep the SWL and thus size and weight of the rigging to a specification more suited to the actual lift.	Closed
41	Oceaneering	Operations	Went Well	WROV	SHPU	The functionality of the SHPU itself was very simple and uncomplicated and the operation was performed without any major issues.	Yes	Nil	See Comment below	Closed
42	Oceaneering	Operations	Could have been better	WROV	SHPU	<p>Although the SHPU and Shear operation went well, however the deployment of the device did highlight some concerns as we had several lines running to the seabed in very close proximity which could have caused issues.</p> <p>1) MPT winch Wire 2) Main Crane (during cross haul) 3) SHPU electrical downline 4) 2 x Guide wires & DMA 5) Podline 6) 25m SHEAR/SHPU jumper 7) 20m Strong point between Shear 7 SHPU</p>	-	Nil	<p>Could some of these lines be eliminated by using a ROV BOP (dirty workpack) skid to function the Shear?</p> <p>... Some changes may have to be made e.g. Choice of hydraulic oils and pumping capacity</p>	Closed
43	Future Client	Operations	Went Well	Vessel Specification	Vessel Specification	A list of suitable vessels that meet specifications should be created in the event of a well blow out. This list should detail the minimum vessel specification that would be needed to complete the job successfully.	-	Nil	<p>Produce North Sea construction vessels criteria document for emergency call out specification used for choosing a vessel in the event of a well capping operation.</p> <p>1) Knuckle boom crane for safer moving of loads; 2) Working depths to OSPRAG requirements; 3) Capable of remaining on station in a conditions up to 5m Hs; 4) Large free deck space; 5) 2 x WROV to spread equipment over both 6) Review of vessel operating history; 7) Minimum DP2.</p>	Open
44	Well Ops UK	Operations	Could have been better	Safety	Crew Change	On the final day of the the EERD exercise the day shift Deck Foreman and Operators crew changed. This team had been on the vessel since the mobilisation date and had fine tuned themselves with the operations over the past two weeks.	-	Nil	It was less than 24hrs until the EERD exercise de-mobilisation, it could have been wise to keep that rigging team on board the vessel to complete the operations in the manner that they had learned.	Closed
45	Well Ops UK	Operations	Went Very Well	All Crew	All operations	The ROV, SIL, Deck and Marine crew on the Well Enhancer enjoyed and performed every task to the best ability. Everything was orchestrated very professionally during this operation.	-	Nil	Nil	Closed
46	AVC	Operations	Went Very Well	All Crew	All operations	Richard and Neil were greatly underestimated, their knowledge of offshore operations and safety was ideal, they were always on the deck to record footage and never got in the way of any operations. All deck crew were more than happy to help them both at any point of the trip.	-	Nil	Nil	Closed

Appendix 4
MID-WATER TRANSFER OPERATIONS

Status to Date:

This Site Instruction covers every mid-water transfer with the LOAD being recovered from the seabed to the short mark on the MPT and then transferring to the Kenz crane.

NOTE: ALL Crane Wires must have beacons attached, with light sticks to aid the ROV's where necessary.

(✓) Complete

RIGGING FOR PODLINE SHEAVE ON MAIN WINCH SWIVEL

1.	Install a 35Te shackle on the main winch above the ferrule	
2.	Attach a 5.4Te ROV hook between the swivel and the 35Te shackle in order to prevent travel	
3.	Attach a 22te ROV hook to the podline	
4.	Feed the aft podline through the sheave and attach the sheave to the 35te shackle on the main winch	
5.	Deploy podline c/w 22te ROV hook down the main MPT winch wire to the swivel which is at the short mark at 220m. ROV to confirm visual.	
6.	Deploy main crane to the short mark with ROV confirming visual, ROV will ask either of loads to adjust until they are plumbed up.	
7.	wROV to connect the 22te ROV hook on the aft podline to the 55Te masterlink on the main crane rams horns.	
8.	ROV Supv to request that the podline is raised slowly , bringing the main crane block toward the Huisman Tower swivel NOTE: Ensure the main winch does not run the podline spelter socket into the podline sheave	
9.	ROV Supv to call all stop on the podline when a connection can be made with the hook on the Kenz rigging to either of the 85Te masterlinks which are attached to the 157Te masterlink	
10.	ROV Supv to connect 100te ROV hook on the Kenz crane rigging to the 85Te masterlink on the Load rigging which is connected to the Kenz crane	
11.	Once connected, ROV Supv to instruct the Kenz to pick up and take the weight of the load NOTE: ROV is to monitor rigging closely throughout the transfer	
12.	ROV Supv to disconnect the 125Te ROV hook from the 157Te masterlink to release the MPT winch wire from the load.	
13.	ROV to request that the podline is lowered until the Kenz hook is sitting where it wants to sit and allow the wROV to disconnect the 22Te ROV hook from the 55Te masterlink on the main crane rams horns	
14.	With the podline released from the Kenz, ROV to instruct the WOS to come up on the podline to take up the slack.	
15.	ROV to request the WOS continue up on the podline until the socket gathers the snatch block and the shackle and continue to raise.	
16.	ROV to release the holdback rigging from the snatch block to the MPT main winch swivel.	
17.	wROV to make sure none of the rigging hangs up and request that aft podline is recovered to surface and remove the shackle and snatch block and store the podwire.	
18.	Recover the MPT main swivel to deck NOTE: The LARS and upper trolley will be put down to the bottom of the hull to collect the swivel.	
19.	With the MPT Main hook back on surface and the MPH closed, recover the Kenz load just below the splash, continue to bring inboard and land as per relevant site instruction for that load.	

Any questions, consult the Project Engineer

- **Procedural / Equipment / Safety suggestion are wanted. Please hand to the Project Clerk**
- **Ensure your crews read this**

WOUK OPE	 	Date : 19/07/2011
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Status to Date:

This Site Instruction covers every mid-water transfer with the LOAD leaving surface on the KENZ crane and being transferred to the MPT Main Wire.

NOTE: ALL Crane Wires must have beacons attached, with light sticks to aid the ROV's where necessary.

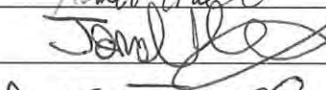
(✓) Complete

RIGGING FOR PODLINE SHEAVE ON MAIN WINCH SWIVEL

1.	Install a 35Te shackle on the main winch above the ferrule	
2.	Attach a 5.4Te ROV hook between the swivel and the 35Te shackle in order to prevent travel	
3.	Attach a 22te ROV hook to the podline	
4.	Feed the aft podline through the sheave and attach the sheave to the 35te shackle on the main winch	
5.	Deploy podline c/w 22te ROV hook to the short mark at 220m. ROV to confirm visual.	
	Deploy main winch to the short mark, ROV spotting as site instruction 001 step 4.1.9	
6.	NOTE: Ensure the main winch does not run into the podline spelter socket into the podline sheave	
7.	Deploy the main crane with the load to the short mark at 220m. ROV to confirm visual. As per site instruction 001, steps 4.1.1 to 4.1.8	
	NOTE: Once at depth all stop and ROV will plumb loads up before continuing.	
8.	wROV to connect the 22te ROV hook on the aft podline to the 55Te masterlink on the main crane rams horns.	
9.	Deploy the Huisman Tower winch c/w 35Te shackle and sheave to the 220m short mark with ROV confirming visual and monitoring during deployment	
10.	ROV Supv to request that the podline is raised slowly , bringing the main crane block toward the Huisman Tower swivel	
	NOTE: Ensure the main winch does not run into the podline spelter socket into the podline sheave	
11.	ROV Supv to call all stop on the podline when a connection can be made between the Huisman Tower and main crane rigging	
12.	ROV Supv to connect 125te ROV hook on the MPT rigging to the 157Te masterlink on the Landing Base rigging which is connected to the Kenz crane	
13.	ROV Supv to instruct the MPT to pick up and take the weight of the load	
	NOTE: ROV is to monitor rigging closely throughout the transfer	
14.	ROV Supv to disconnect the 100Te ROV hook from the 85Te masterlink to release the Kenz from the load.	
15.	ROV to request that the podline is lowered until the Kenz hook is sitting where it wants to sit and allow the wROV to disconnect the 22Te ROV hook from the 55Te masterlink on the main crane rams horns	
16.	With the podline released from the Kenz, recover Kenz hook to surface but keep block in water.	
17.	ROV to instruct the WOS to come up on the podline to take up the slack.	
18.	ROV to request the WOS continue up on the podline until the socket gathers the snatch block and the shackle and continue to raise.	
19.	ROV to release the holdback rigging from the snatch block to the MPT main winch swivel.	
20.	wROV to make sure none of the rigging hangs up and request that aft podline is recovered to surface	
21.	Continue with deployment while the Kenz block is recovered	

Any questions, consult the Project Engineer

- **Procedural / Equipment / Safety suggestion are wanted. Please hand to the Project Clerk**
- **Ensure your crews read this**

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Well Ops
TOTAL E&P
EDRADOUR

Site Instruction 003

Date: 18/07/2011

Rev : 0

Status to Date:

During a trial mid water transfer, it was found that the wROV was struggling to make the connection between the main crane and the MPT. A snatch block assembly will be used to assist the transfer.

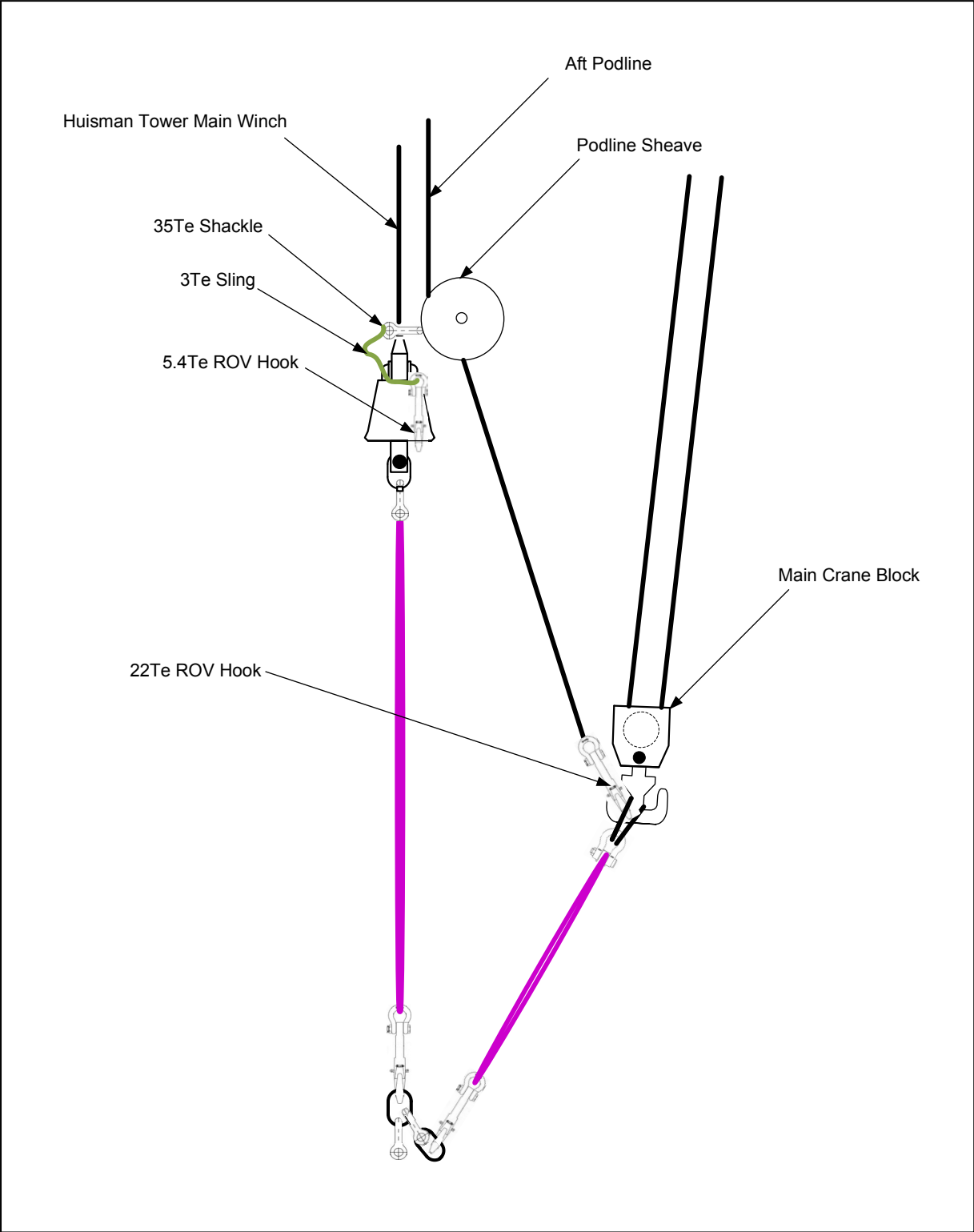
NOTE: ALL Crane Wires must have beacons attached, with light sticks to aid the ROV's where necessary.		(✓) Complete
1.	Install a 35Te shackle on the main winch above the ferrule	
2.	Attach a 5.4Te ROV hook between the swivel and the 35Te shackle in order to prevent travel	
3.	Attach a 22te ROV hook to the aft podline	
4.	Feed the aft podline through the sheave and attach the sheave to the 35te shackle on the main winch	
5.	Deploy aft podline c/w 22te ROV hook to the short mark at 220m. ROV to confirm visual.	
6.	Deploy the main crane to the short mark at 220m. ROV to confirm visual.	
7.	wROV to connect the 22te ROV hook on the FWD podline to the 55Te masterlink on the main crane rams horns.	
8.	Deploy the Huisman Tower winch c/w 35Te shackle and sheave to the 220m short mark with ROV confirming visual and monitoring during deployment	
9.	ROV Supv to request that the podline is raised slowly , bringing the main crane block toward the Huisman Tower swivel	
10.	ROV Supv to call all stop on the podline when a connection can be made between the Huisman Tower and main crane rigging	
11.	ROV Supv to connect 100te ROV hook to the 85Te masterlink on the Huisman Tower winch rigging	
12.	ROV Supv to instruct the main crane to pick up and take the weight of the load NOTE: ROV to monitor rigging closely throughout the transfer	
13.	ROV Supv to disconnect the 125Te ROV hook from the 157Te masterlink	
14.	ROV to request that Huisman Tower winch c/w 35te shackle and sheave is recovered to surface	
15.	wROV to disconnect 22Te ROV hook from the 55Te masterlink on the main crane rams horns	
16.	wROV to request that aft podline is recovered to surface	
17.	Recover the main crane c/w rigging to surface	

Any questions, consult the Project Engineer

- Procedural / Equipment / Safety suggestion are wanted. Please hand to the Project Clerk
- Ensure your crews read this

WOUK OPE		Date : 18/07/2011
WOPT E OPM / OPS		
CLIENT		

Mid Water Transfer Rigging Arrangement



Appendix 5
EQUIPMENT DATASHEETS

VALVE ACTUATORS

Remotely Operated Vehicle (ROV) operated Valve Actuators are available in several sizes and configurations. The design of the actuator eliminates damage to the valve itself by isolating the forces of the ROV from the valve. All valves are pressure tested and certified before being individually packaged for shipment. As with all DTS products, these actuators are designed, assembled, and tested to the highest industry standards.

Paddle and Bucket Style Valve Actuators

Pressure	up to 20,000 psi
Valve sizes	From 3/16 in to 4 in diameter bore valves
Valve Types	2 way 2 position, 3 way 3 position and 4 way 3 position are available
Connection Types	NPT, JIC, SAE, HP and MP

Custom Designs Available



HOT STABS & MANIFOLD



All Standard API 17D and API 17H Hot Stabs and Receptacles are manufactured and tested to the highest industry standards. These products are individually packaged to protect critical sealing surfaces. All products are supplied with test certificate and COC.

Also Available as a rental tool.

Technical Data / Specifications

Specifications

Pressures	Up to 15,000 psi (HP 17H)
Flow	Up to 200 gpm (2 in Stab)
Connection Types	Various sizes in JIC, NPT, MP and HP

Materials

Nitronic 50 and 60, 316 SS, 17-4 SS

ROV Interface

Compliant and rigid handles available

Custom designs available



**KEY FEATURES**

- Variable blade sizes available
- ROV friendly
- Field proven design

The Super Grinder was designed for the quick and efficient cutting of pipe. It's uses have broadened over time as it can cut through almost anything as long as the thickness is reasonable (up to 1 ½"). There are different size blades that can be used with the grinder depending on what is being cut. The most efficient and most commonly used blade is a 14" x 70 tooth carbide tipped blade with a 1" arbor.

Specifications

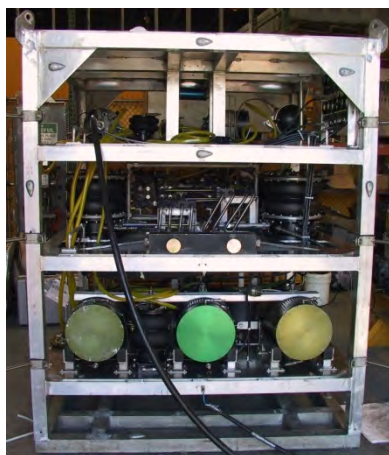
Size (L x W x H):	500 x 120 x 300mm
Weight Air / Water:	27 / 14Kg
Blade	
Operational Speed :	1800 rpm
Blade Type :	14 inch x 72 teeth carbide tip (for steel)
Cut depth:	3 inches
Nominal parameters	
Nominal Hydraulic pressure :	2700-3000psi
Nominal flow :	6 gpm

Transport Information

Transport case (L x W x H):	610 x 650x 500 mm
Weight:	45 - 68kg

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The Subsea HPU is a complete stand-alone package, powered via dedicated ROV umbilical. Unit contains a complete control system that proportionally adjusts the flow and pressure for each hydraulic output. The suite is perfectly suited to augment ROV systems performing large projects with high horsepower requirements. System is based on proven and existing ROV technology. System is capable of electrical controls expansion for additional survey equipment. System comes configured with a Launch and recovery A Frame, Umbilical Winch, 20 ft work van.



ToolPool@Oceaneering.com

Vessel Electrical Requirements

- 480 VAC – 3Phase
- 250 A Supply

System Horsepower

- 225 HP

Nominal Operating Pressure

- 3,000 psi

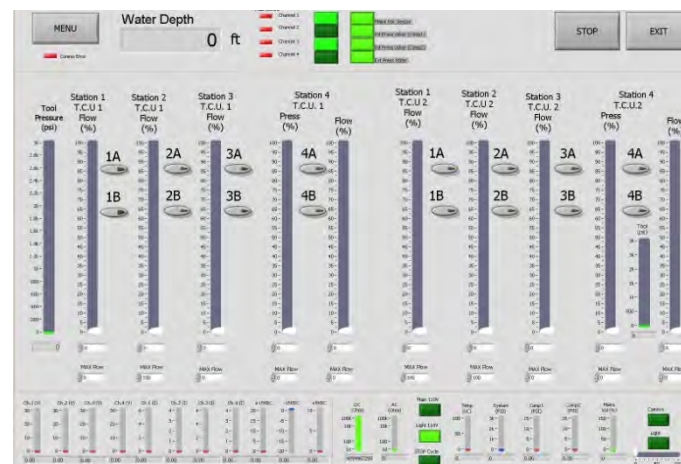
Hydraulic Capability (GPM – Gallons per Minute)

- 8X Flow controlled 0 to 25 GPM (bi-directional)
- 2X Pressure and flow control 0 to 25 GPM (bi-directional)
- 6X 3 GPM (bi-directional)

Depth Limitation

- 10,000 fsw (3,000 meter)

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<http://oceaneering.com/Deepwater.asp>

Oceaneering DTS Subsea Hydraulic Power Unit

The Subsea HPU is a complete stand-alone package, powered via dedicated ROV umbilical. Unit contains a complete control system that proportionally adjusts the flow and pressure for each hydraulic output. The suite is perfectly suited to augment ROV systems performing large projects with high horsepower requirements. System is based on proven and existing ROV technology. System is capable of electrical controls expansion for additional survey equipment.

System comes configured with a Launch and Recovery A-Frame, Umbilical Winch, 20 ft work van.

Vessel Electrical Requirements

480 V AC – 3-Phase

250 A Supply

System Horsepower

225 hp

Nominal Operating Pressure

3,000 psi

Hydraulic Capability

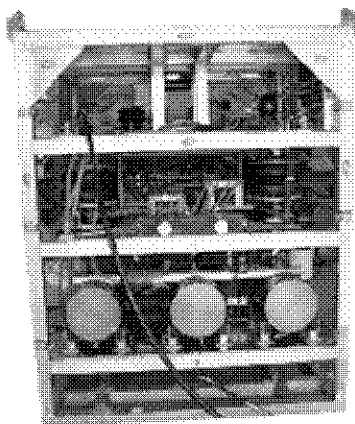
8X Flow Controlled 0 to 25 gpm (Bi-Directional)

2X Pressure & Flow Control 0 to 25 gpm (Bi-Directional)

6X 3 gpm (Bi-Directional)

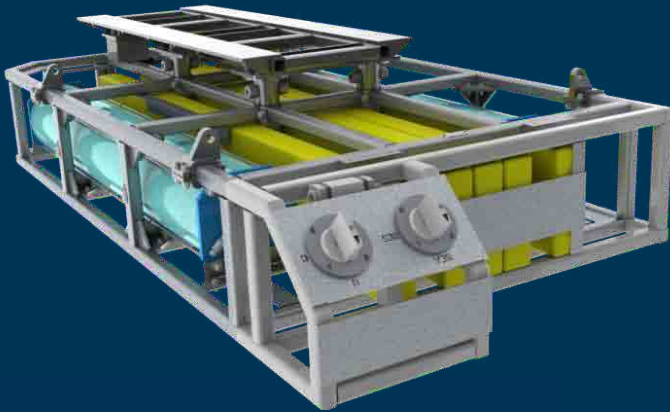
Depth Limitation

10,000 fsw (3,000 m)



KEY FEATURES

- Up to 135 gallon storage
- Interfaces with any work class ROV system
- Exceeds minimum output requirements



The Blowout Preventer (BOP) intervention skid allows any work class Remotely Operated Vehicle (ROV) to perform function testing as well as emergency override of BOP functions. The skid output exceeds the minimum requirements specified by the International Association of Diving Contractors (IADC) for BOP Intervention. Internal valves provide for continuous pumping of saltwater in emergency situations.

Using field proven components, Oceaneering's skid features ease of service and built-in reliability. All components are corrosion resistant with seals designed for long term well control fluid exposure. The skid is a modular design allowing components to be easily replaced or serviced. The skid is designed to support full ROV and Tether Management System (TMS), weight since it must be fit for any ROV of opportunity.

Specifications**Performance**

Input flow:	15 gpm
Input pressure:	2500 psi
Output flow:	10 gpm @ 3000 psi
Output pressure:	5000psi
Stored volume:	64 gallons (std) 135 gallons (opt)

Weight & Dimensions

Weight in air (empty):	720kg
Weight in air (full):	970kg
Weight in air c/w interface frame & full	1075kg
Weight in water:	22kg buoyant
Length:	2745cm, 3050cm with control panel
Width:	1525cm
Height:	460cm
Depth rating:	3000m

Gulfstream Services, Inc

103 Dickson Rd.
Houma, LA 70363
(985) 868-0303

GSI

107 Row 2
Lafayette, LA 70508
(337) 704-0091

Shear Support Equipment

Tool House and Sling Positioning Basket



Dimensions:
8' Tall x 8' Wide x 8'6" Long
Weight: 12,000 lbs.

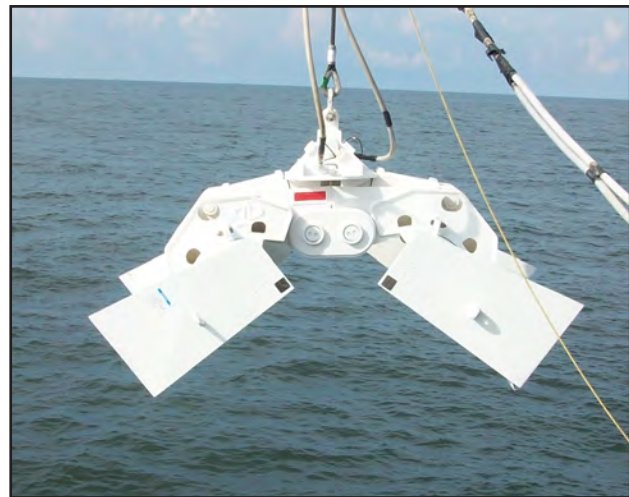
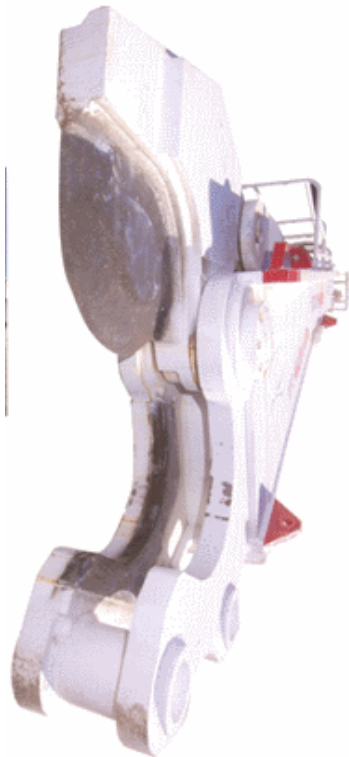


Dimensions:
3' Tall x 3' Wide x 10' Long
Weight: 8,800 lbs.

Contains the slings used for positioning shear for assorted cuts



HYDRAULIC TOOLS/OFFSHORE SERVICES



*A typical package includes; 1 subsurface tool, 1 hydraulic power unit, 1 hose reel, 1 sling basket, 1 tool house, and 1 hose chute. The grapple package may contain additional item depending on specific customer requirements.

Hydraulic Shear Assembly

OSS 20 Description & Specs.

OSS 20 is a 20-ton universal shear that is utilized for both surface and subsurface decommissioning of platforms, conductors, rigs, pipelines, docks, and bridges.

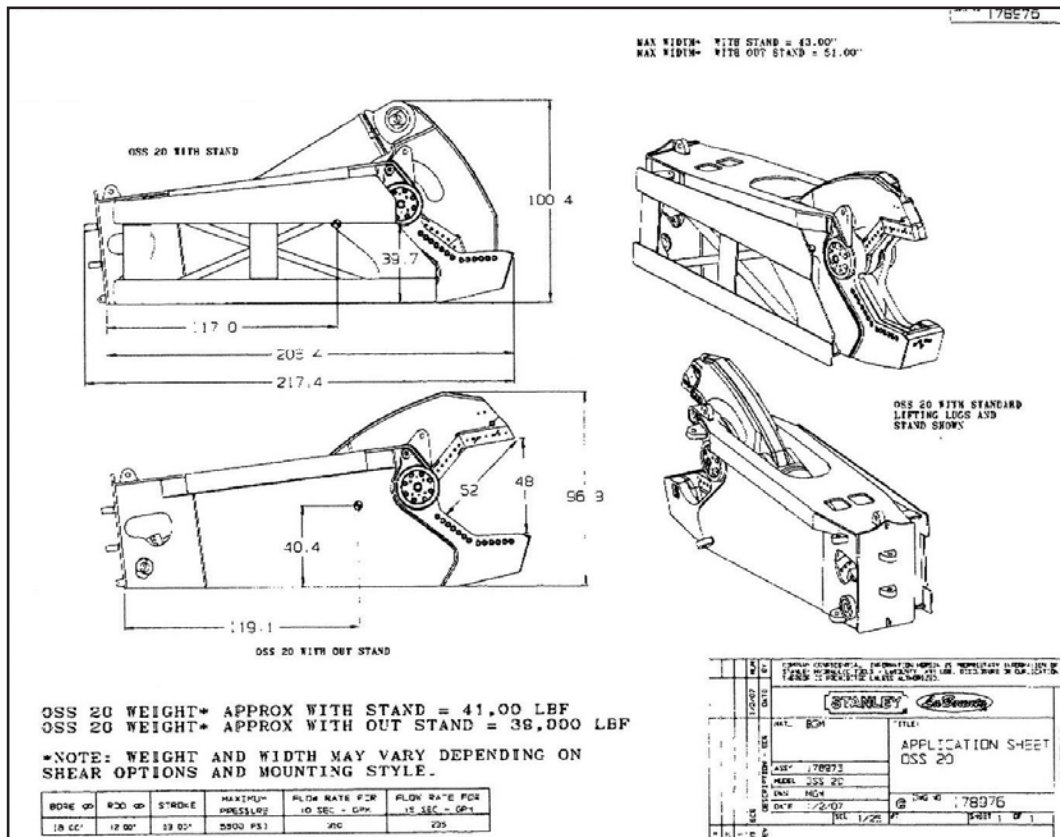
The cut ranges for the OSS 20 are as follows:

- 2 3/8" Tubing to 26" O.D.
- 1/2" thick walled multi-string grouted casing
- 44" I-beam
- 30" H-beam
- 2" plate
- 38" concrete
- 3 1/4" anchor chain

Dimensions Weight

H 4'4"
W 7'9" 40,000 LBS
L 17'6"

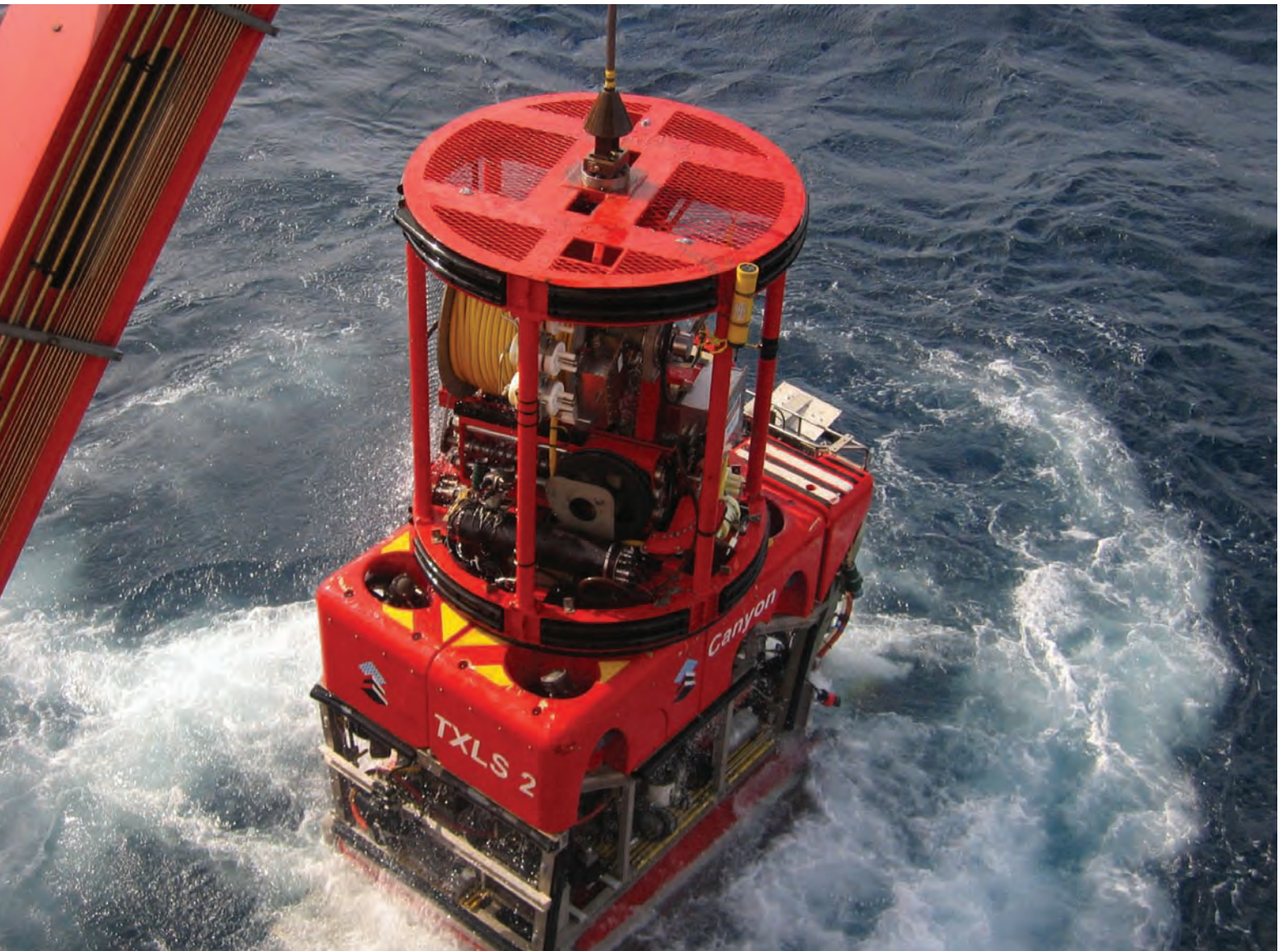
OSS 20 Specifications



All of Gulfstream Services' shears come with five positioning slings that reduce top-side rig down time and allows subsurface angles to be manipulated more closely – regardless of a horizontal or vertical cut. Each shear comes with a Gulfstream Services maintenance program and 24/7 on-site technical support.

Triton[®] XLS

Specialty Marine Contracting ROV System



The Triton XLS, a 100-hp work-class ROV system, with up to 150 hp available, represents the latest design in Perry Slingsby Systems' highly successful Triton XL series. The enhancements to the previous system include improved performance and upgraded controls, increased depth capabilities, and a significantly longer 380-meter tether cable deployed from the proven Triton top hat tether management system.

The Triton XLS system's 3,000 kg of through-frame lift provides a platform for a wide variety of tooling modules and custom intervention work skids.

Depth-rated to 3,300 meters, the Triton XLS is designed specifically for deep and ultra-deepwater operations. The Triton-class ROV systems, including this latest XLS design, have performed more deepwater construction, intervention, salvage and project support activities worldwide than any other ROV design.

APPLICATIONS

The Triton XLS is a highly dependable work-class vehicle designed for extreme water depths and demanding subsea construction tasks. The system effectively supports offshore projects and construction tasks, including:

- Deepwater and ultra-deepwater installation and construction support
- Subsea cable burial and maintenance
- Deepwater salvage and recovery
- Remote tool deployment
- Subsea pipeline construction, completion and survey activities
- Platform inspection, repair and maintenance
- Suction pile installation
- Drill support and completion activities

Vehicle

- 100 hp to 150 hp
- 2,500 m (8,200 ft) to 3,300 m (10,824 ft) rated
- 200 kg (441 lb) payload

Minimum Dimensions

- Length: 3 m (9 ft, 10 in.)
- Width: 1.85 m (6 ft, 1 in.)
- Height: 2 m (6 ft, 8 in.)
- Weight in air: 4,309 kg (9,500 lb)
- 4 x horizontal and 4 x vertical thrusters



- Altimeter
- 1 x SIT or low-light-level CCD camera
- 1 x color zoom camera
- 2 x B/W cameras
- Rigmaster TA-60 5-function manipulator
- Schilling S/C 7-function manipulator
- Simrad Mesotech MS 1000/1081 digital sonar system
- Circuits with 6 x 250-watt lights standard
- Solid-state Gyro
- Pitch/roll sensor
- Digiquartz® depth gauge
- Auto functions (heading/depth/altitude)
- Strobe and locating beacon

Tether Management System (TMS)

- 380-m (1,246-ft) to 650-m (2,132-ft) tether
- TMS camera

Dimensions

- Diameter: 1.98 m (6.5 ft)
- Height: 2.44 m (8 ft)
- Weight in air: 3,266 kg (7,200 lb)
- Weight in water: 2,390 kg (5,270 lb)

Umbilical Winch/Launch and Recovery System (LARS)

- Winch: Dynacon Model 521/521XL
- LARS: Dynacon 7021/6022 A-Frame
- 150-hp winch
- Umbilical length: 2,500 m (8,200 ft) to 3,300 m (10,824 ft)
- 10-metric ton safe working load
- 15-metric ton capacity fully deployed
- Positive latch and rotation
- Self-erecting A-frame

A-Frame Dimensions

- Reach: 3.1 m (10 ft, 3 in.)
- Width: 3.1 m (10 ft, 3 in.)
- Length: 8.5 m (28 ft)
- Height collapsed: 3.05 m (10 ft)
- Weight (total): 28,576 kg (28.5 metric tons)

Control Cabin and Consoles

Dimensions

- Length: 6.1 m (20 ft)
- Width: 2.4 m (8 ft)
- Height: 2.6 m (8 ft, 6 in.)
- Weight: 10,900 kg (24,000 lb)

Workshop and Spares Cabin

Dimensions

- Length: 6.1 m (20 ft)
- Width: 2.4 m (8 ft)
- Height: 2.6 m (8 ft, 6 in.)
- Weight: 10,900 kg (24,000 lb)

Specifications subject to change.

Changing the way you succeed.

Canyon Offshore
5212 Brittmoore
Houston, Texas 77041
Houston 713.856.6010
Singapore 65.6.545.3885
Aberdeen, UK 44.1224.351800

www.helixesg.com

The Industry Standard for Seven-Function Dexterous Manipulators

Hundreds of TITAN 4 manipulator systems are in use worldwide every day. TITAN manipulators are the highest quality system on the market for the dexterity and strength needed to withstand the industry's harsh and repetitive needs day after day.

- Acute Precision Control
- Durable Through the Harshest Conditions
- Reliability Through the Harshest Conditions
- Large Operating Envelope
- High Lift-to-Weight Ratio
- Depth Rating from 4,000 msw to 7,000 msw
- Titanium Construction

The TITAN 4 is widely regarded as the world's premier servo-hydraulic remote manipulator system. Since 1987, TITAN systems have been the industry standard for dexterous manipulator systems used in subsea applications, and are extensively used on ultra-heavy work class ROVs.

The TITAN 4 has the dexterity and accuracy necessary to perform the fine movements needed for complex tasks. When this ability is combined with the manipulator's reach (1,922 mm or 75.7 inches), payload capacity (122 kg or 270 lb at full extension), depth rating (available up to 7,000 msw), and large operating envelope, the TITAN 4 offers unequalled performance in a wide range of subsea applications.





Slave arm electronics are located in the forearm, increasing system reliability and minimizing electrical connections.

ACUTE PRECISION CONTROL

The TITAN 4 manipulator's accuracy is limited only by the pilot's eye. The Master Controller includes a six-degree-of-freedom replica master arm that ensures comfortable, intuitive manipulator operation. It's movements are just as sharp when it's moving a 5 lb object as when it is moving a 250 lb object.

The controller also contains function keys for selecting menu options and a display for viewing diagnostic and status information. The controller's advanced operational features are individual joint freeze, position scaling (altering the ratio of master arm movement to manipulator arm movement), password security, programmable stow/deploy routines, individual joint movement limits, incremental gripper movement, individual joint diagnostics, and automatic error checking.



The replica master arm ensures comfortable, intuitive operation.

TITAN 4 SPECIFICATIONS

General Description

Mode of operation..... Closed-loop position control
 Input device Replica master arm
 Number of functions Six plus grip
 Materials of construction Primarily titanium

Manipulator Arm Specifications

All specifications are based on the standard system configuration using Shell Tellus® Oil 32 hydraulic fluid, input pressure of 207 bar (3,000 psi), and available flow of 19 lpm (5 gpm).

Depth rating:

Standard 4,000 msw (13,124 fsw)
 Extended 7,000 msw (22,967 fsw)
 Maximum reach 1,922 mm (75.7 in.)
 (From azimuth pivot to standard gripper T-bar slot)

Weight in air 100 kg (221 lb)
 Weight in seawater 78 kg (174 lb)
 Lift at full extension, nominal 122 kg (270 lb)
 Maximum lift, nominal 454 kg (1,000 lb)
 Maximum gripper opening (standard gripper), nominal 99 mm (3.9 in.)
 Grip force, nominal 4,092 N (920 lb)
 Wrist torque, nominal 170 Nm (125 ft-lb)
 Wrist rotate, continuous 360 degrees, 6-35 rpm

Manipulator Arm Functions

Actuator Function	Type	Nominal Mechanical Range
Azimuth	Rotary	240 degrees
Shoulder pitch	Linear	120 degrees
Elbow pitch	Rotary	270 degrees
Wrist pitch	Rotary	180 degrees
Wrist yaw	Rotary	180 degrees
Wrist rotate	Gerotor	360 degrees continuous
Gripper (standard)	Linear	99 mm (3.9 in.)

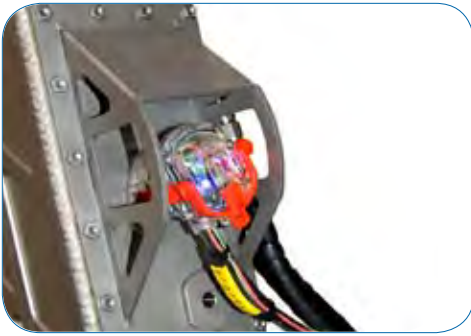
Master Controller Specifications

Length 470 mm (18.5 in.)
 Width 177 mm (7.0 in.)
 Height 67 mm (2.6 in.)
 Weight 3.7 kg (8.2 lb)

Approved Hydraulic Fluids

Hydraulic oil All common mineral, Glycol, and environmentally friendly fluids

(Continued on next page)



Colored diagnostic lights in the connector head indicate the status of electrical power delivery to the slave arm, master controller transmission to the slave arm, and slave arm responsiveness.

DURABILITY

Construction

The TITAN 4 is constructed primarily of titanium for structural strength, light weight, corrosion resistance, and extraordinary resistance to damage from collisions. TITAN manipulators have a proven track record of reliability in the world's most demanding subsea environments. The TITAN 4 features:

- Roller bearings on all pivot points to withstand heavy loading and eliminate wear
- Titanium external fasteners
- Long-lasting, third-generation rotary actuators to minimize leakage and friction, and to reduce service requirements
- 99-mm (3.9-inch) parallel-acting titanium gripper



The in-arm slave electronics module features diagnostic lights that indicate processor health.

(Specifications, continued from previous page)

Hydraulic Requirements

Viscosity	10-200 cSt
Available flow	5.7-19.0 lpm (1.5-5.0 gpm)
Pressure.....	103 bar (1,500 psi) minimum to 207 bar (3,000 psi) maximum
	Slave arm performance is reduced at less than 3,000 psi.
Hydraulic fluid temperature, maximum	54 degrees C (130 degrees F)
Return pressure, maximum.....	34.5 bar (500 psi)
Filtration, hydraulic supply.....	3 microns (10 microns absolute)
Customer-supplied mating fittings required:	
Supply hose fitting.....	-4 JIC female, 1/4-inch
Return hose fitting.....	-6 JIC female, 3/8-inch
Contact the factory about operation at other pressures and flow rates	

Electrical and Telemetry Requirements

System supply at junction box.....	90-260 VAC, 50-60 Hz, single phase
Input power:	
Master controller.....	90-260 VAC, 50-60 Hz, single phase
Slave arm.....	24 VDC
Power consumption:	
Master controller.....	6 W start, 3 W run
Slave in-arm controller plus solenoid.....	6 W start, 45 W run
Slave arm current draw.....	1.875 A at 24 VDC
Telemetry.....	User selectable, RS-232 or RS-422/485 half-duplex 2-wire

Environmental Specifications

Operating temperature	-2 to +54 degrees C (+28 to +130 degrees F)
Storage temperature	-15 to +71 degrees C (+5 to +160 degrees F)
Humidity.....	0% to 100% condensing



The titanium wrist camera can be ordered already installed on a new TITAN 4 manipulator system.

SYSTEM RELIABILITY

Robust Power/Signal Connection

A Schilling SeaNet cable connects the arm to electrical power and telemetry, providing a robust, reliable attachment. The small-diameter cable (8.9 mm, or 3/8 inch) is actively pressure balanced and oil filled. The connector head has spring-loaded contacts, and a positive locking feature eliminates accidental cable disconnection.

Reliable In-Arm Slave Electronics

All downside arm electronics are located inside the manipulator forearm. This configuration greatly reduces the number of electrical connections, simplifying service operations and increasing the system's ability to withstand shock.

Quick, Easy Diagnostics

The SeaNet cable connector head contains bright LED status indicator lights that allow first-level diagnostics to be performed solely by visual inspection. The lights show that electrical power is being delivered to the arm, that the controller is transmitting to the arm, and that the arm is responding. This information lets the operator quickly determine where to begin troubleshooting, without removing connectors, applying a voltmeter, or opening sealed enclosures. The system also detects missing or reduced arm position sensor signals, and diagnostic lights on the in-arm electronics module indicate processor health.

EXTENSIVE OPERATING ENVELOPE

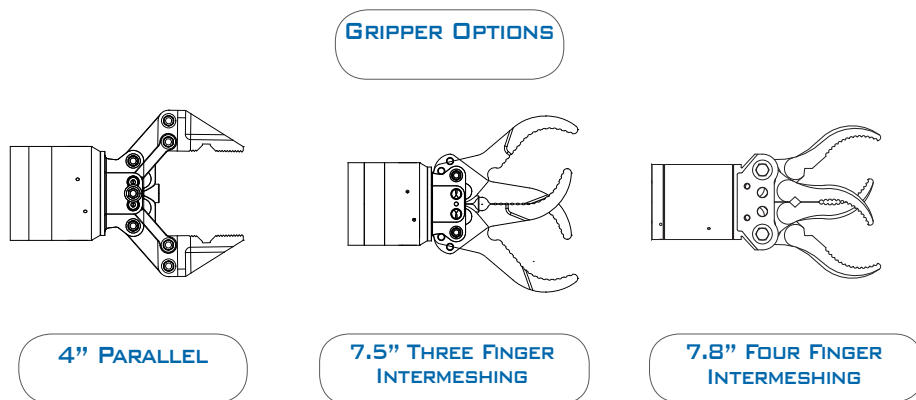
It is engineered to give its operators the largest range of motion in its class. This significant flexibility only enhances the TITAN's precision dexterity for exploration and recovery missions.

SCHILLING MANIPULATOR COMPATIBILITY

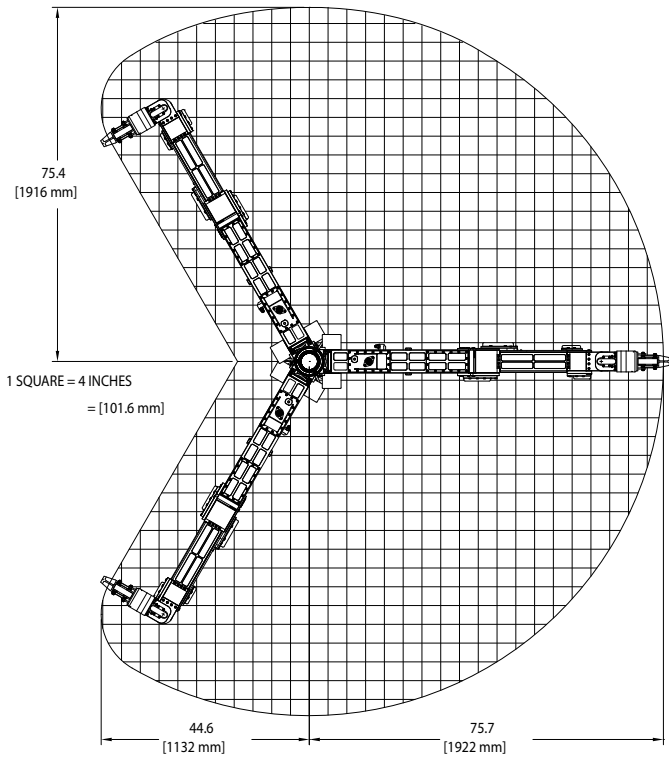
To create the best manipulators on the market, Schilling took the best field-proven manipulator technologies and used them repetitively throughout the system. The result is a simple, reliable system with high component commonality that minimizes spare part requirements. Many parts are interchangeable throughout the entire Schilling manipulator line: TITAN 4, ATLAS, RIGMASTER, CONAN, and ORION.

OPTIONS AND ACCESSORIES

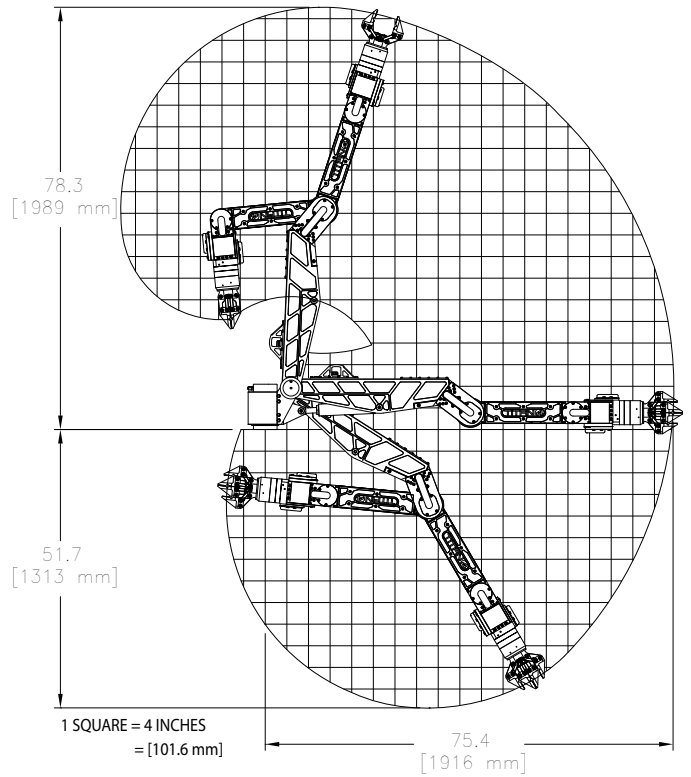
- Extended Depth Rating to 7,000 msw
- Spares Kit
- Seal Installation Tool Kit
- Technician's Tool Kit
- Dual-Manipulator Configuration (two manipulator arms and a single master controller with two replica master arms)
- Radiation Hardening (up to 1×10^7 rad gamma)
- Titanium Wrist-Mounted Camera



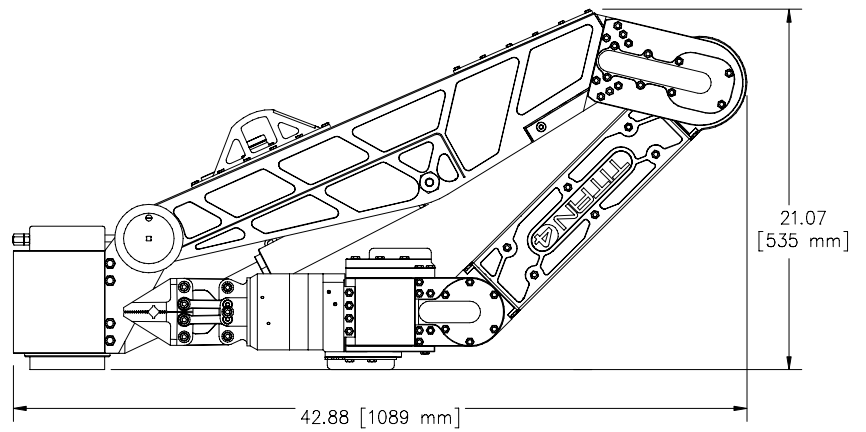
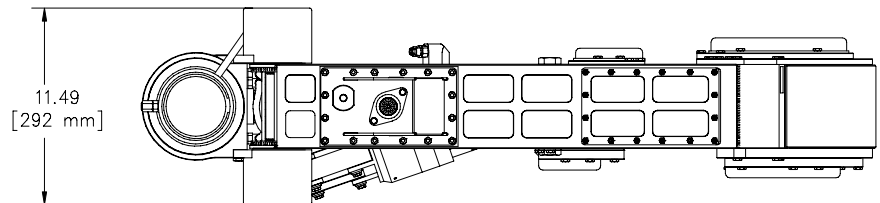
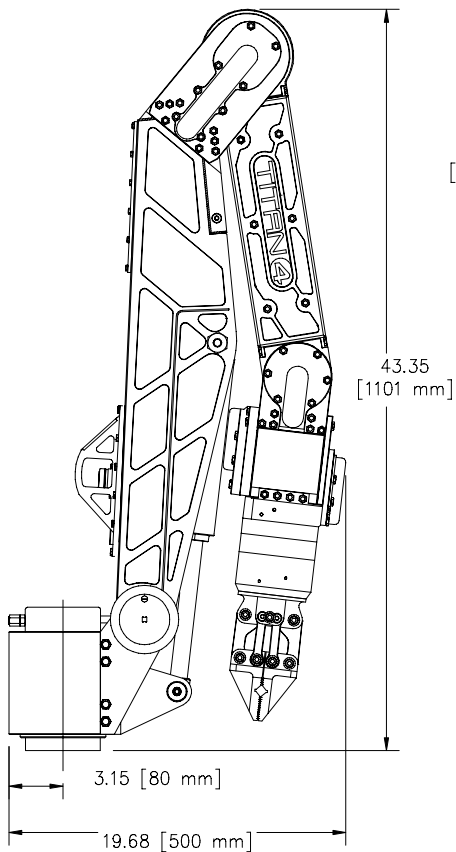
Dual TITAN manipulator configuration.



RANGE OF MOTION, TOP VIEW



RANGE OF MOTION, SIDE VIEW



STOW DIMENSIONS

MANIPULATOR COMPARISON

						
Model	TITAN 4	ATLAS 7R	RIGMASTER	CONAN 7P	ORION 7P/7R**	ORION 4R
Category	Heavy Work	Heavy Work	Heavy Work	Heavy Work	Medium Work	Medium Work
Power Source	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Rate/Position Control	Position	Rate	Rate	Position	Position or Rate	Rate
Number of Functions	7	7	5	7	7	4
Materials	Primarily Titanium	Anodized Aluminum & Stainless Steel	Anodized Aluminum, Stainless Steel & Titanium	Anodized Aluminum & Stainless Steel	Anodized Aluminum & Stainless Steel	Anodized Aluminum & Stainless Steel
Maximum Reach	1,922 mm/75.7 in.	1,664 mm/65.5 in.	1,067 mm/42.0 in. (retracted); 1,372 mm/54.0 in. (extended)	1,806 mm/71.1 in.	1,532 mm/60.3 in. (7P/R) 1,850 mm/72.8 in. (7PE/RE)	682 mm/26.9 in.
Input Device	Replica Master Arm	Rate Hand Controller	Rate Hand Controller	Replica Master Arm	Replica Master Arm or Rate Hand Controller	Rate Hand Controller
Depth Rating, Standard	4,000 msw/13,124 fsw	6,500 msw/21,000 fsw	6,500 msw/21,000 fsw	3,000 msw/9,800 fsw	6,500 msw/21,000 fsw	6,500 msw/21,000 fsw
Depth Rating, Optional	7,000 msw/23,000 fsw	N/A	N/A	N/A	N/A	N/A
Lift at Full Reach	122 kg/270 lb	250 kg/550 lb	270 kg/595 lb (retracted); 181 kg/400 lb (extended)	159 kg/350 lb	68 kg/150 lb	136 kg/300 lb
Weight in Air	100 kg/221 lb	73 kg/160 lb	64 kg/142 lb	107 kg/235 lb	54 kg/120 lb	30 kg/67 lb
Weight in Seawater	78 kg/174 lb	50 kg/109 lb	48 kg/105 lb	73 kg/161 lb	38 kg/83 lb	21 kg/46 lb

**Specifications shown are for the standard-reach ORION 7P.

CUSTOMER SUPPORT, TECHNICAL SUPPORT, AND TRAINING

- Worldwide Customer Support Network with Factory-Trained Technicians
- 24-Hour Telephone Access to Qualified Technical Staff
- On-Site and Offshore Installation/Mobilization Support
- Strategically Located Spares and Factory Service Facilities Worldwide
- Operation and Maintenance Training Courses Available at Our Factory, at Customer Facilities, or at Our Service Centers Worldwide

SO DEEP, NO ONE COMES REMOTELY CLOSE



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MOHAWK Inspection ROV System



Sub-Atlantic's fully electric MOHAWK remotely operated vehicle is a small compact, high performance professional ROV system which can be used for a variety of underwater tasks including observation, survey, NDT inspections and tooling.

- High Reliability, Easy Maintenance
- Sub-Atlantic AC Propulsion Thrusters
- Multiple Camera and Sensor Interfaces
- 1000 msw / 3280 fsw Depth Rated
- Auto-Heading and Depth (Optional Auto-Altitude)
- Plastic Open Frame Design
- Live Boat or TMS Operation
- 35 kg / 77 lb Payload
- Manipulator Options
- Tooling Skid Options

This small, professional inspection ROV delivers exceptionally high thrust in all directions from Sub-Atlantic's reliable AC power thruster system. Mohawk provides high quality video for inspection work but also has the capabilities for running underslung tool packages such as tree valve torque tools, high pressure water jetting pumps and small hydraulic or electric manipulators. Mohawk is rated at 1000 msw / 3280 fsw standard but can be easily upgraded to 2000 msw / 6560 fsw. Mohawk uses a small diameter main lift cable which reduces the Launch and Recovery System requirements and vessel deck space.

Live Boat or TMS Operation



The Mohawk can be free-flown in 'live boating' mode or with our cage type TMS systems (see TMS datasheet). We also offer a range of Launch and Recovery Systems (LARS)

Compact Control

Surface equipment consists three basic units:

- Surface Control Unit (SCU) in an 8U x 19" rack mount configuration.
- Transformer Power Unit (TPU) incorporating transformer in a floor mounted cabinet
- Hand Control Unit (HCU) which is lightweight and portable.

The components are generally installed in a ISO control cabin supplied by customer or Sub-Atlantic.



The HCU (top), SCU (left) and TPU (right) are compact for operation in small control spaces. The three units are linked by interconnecting cables with plugs and sockets

As an alternative, the HCU and SCU can be supplied mounted in a 19 in. rack mount flight case complete with two 9" colour monitors. An additional spare slot can accommodate a video recorder. The rear case panel fixes to the base during operation to locate the HCU.



Mohawk System Specification

ROV General Specification

Depth Rating.....	1000 msw (3280 fsw) standard (deeper options)
Payload:	35 kg (77 lb) lead ballast
Height.....	620 mm (24.4 in.)
Length.....	930 mm (36.6 in)
Width	770 mm (30.3 in)
Mass in Air.....	165 kg (364 lb)
Max. Thrust @ 0 Knots with zero voltage losses:	
Forward	80 kgf (110 lbf)
Reverse.....	68 kgf (88 lbf)
Lateral.....	60 kgf (61 lbf)
Vertical.....	30 kgf (61 lbf)
Max.Velocity/Operational Current (zero tether excursion):	
Forward.....	1.5 m/s (3.0 Kt)
Reverse.....	1.5 m/s (3.0 Kt)
Lateral.....	1.25 m/s (2.5 Kt)
Vertical.....	0.75 m/s (1.5 Kt)
Turning Rate.....	120 Degrees per Second (approx)
ROV Power Requirements	440 Vac 3 ph 50/60 Hz 8 kVA

Surface Equipment General Specification

SCU

Height.....	355 mm (14.0 in.)
Width	483 mm (19.0 In.)
Depth.....	450 mm (17.7 In.)
Mass.....	12 kg (27 lb)
SCU Power Requirements.....	220/240 Vac 50/60 Hz 2 kVA

TPU

Height.....	650 mm (25.6 in.)
Width	630 mm (24.8 In.)
Depth.....	505 mm (19.9 In.)
Mass.....	(approx.)50 kg (330 lb)

HCU

Height.....	160 mm (6.3 in.)
Width	480 mm (18.9 In.)
Depth.....	230 mm (9.1 In.)
Mass.....	1.5 kg (3 lb)

Flight Case Option with 2 x 9" monitors & 8U control module

Height (operation).....	980 mm (38.6 in.)
Height (transport).....	800 mm (31.5 in.)
Width	520 mm (20.5 In.)
Depth (operation).....	720 mm (28.3 In.)
Depth (transport).....	550 mm (21.7 In.)
Mass.....	66 kg (145 lb)
SCU Power Requirements.....	220/240 Vac 50/60 Hz 2 kVA

Tether and Main Lift Cable Dimensions

Tether (standard).....	19.5 mm / 0.77 in. diameter
Main Lift Umbilical (standard 3000 Volt system)	25.4 mm / 1.0 in. diameter

Reliable Thrusters

Mohawk is propelled by five Sub-Atlantic CTE01 thrusters incorporating AC electric motor arranged in the following configuration:-

- 4x single propeller thrusters in a vectored configuration producing high all round thrust & speed
- 1 x twin propeller vertical providing near to equal up & down thrust.
- Power to each thruster is through an integral lead and moulded plug for attachment to electronics enclosure.



Sub-Atlantic's CTE01 reliable brushless AC thruster develops 29 kgf (64 lbf) of static thrust. The design of the housing allows the stator to be easily replaced in the field.

Electronic Pod and Telemetry

- Fibre-Optic telemetry system providing 3 x video, 4 x RS232 & 2 x RS485. Capacity can be doubled using two FO telemetry cards.
- Vehicle Communication utilises 1 x RS485 channel. Uplink/Downlink includes 16 analogue channels and 32 digital switch channels all with 12 bit resolution.
- All electronics are located in an aluminium alloy housing rated to 1000 msw / 3280 fsw with some free space for additional devices.
- Housing centre section incorporates all the electrical connectors for the various ROV components and optional sensors.
- Vacuum and water ingress alarms.
- Options to 2000 msw / 6560 fsw.

Lighting

- 3 off 250-Watt halogen lamps, dimmer controlled on 2 circuits

Camera Facilities

- Tilt unit on upper deck..
- 3 simultaneous video channels.

Junction Box

- An oil filled junction box is used for termination of the copper and fibres in the tether.

Vehicle Power Outlet

- 440 / 220 Vac and various dc supply voltages are available to run tools and sensors. Additional power supplied can be added as required.

Frame

- High impact resistance & buoyant polypropylene.
- Central load frame in aluminium alloy.
- Optional bullet for live boating.



The Mohawk is more than an inspection ROV. Here, it is shown fitted with a 1600 Nm tree valve torque tool skid. This operation is normally carried out using a work-class ROV.

Buoyancy

- Single module with closed cell microspheres,
- Rated 2000 msw (6560 fsw).

Surface Equipment

SCU (Surface Control Unit)

- 2 off 15" Colour monitors
- Light dimmers
- Automatic depth & heading control (altitude optional)
- Tether/Umbilical turns counter
- Video overlay system
- Earth leakage protection system

HCU (Hand Control Unit)

- 2 x control joysticks
- Light dimmer controls
- Camera and Tilt controls
- Digital switches
- Auto-function control
- Joystick trims
- Thruster power trims and isolations
- TMS tether pay in/out

TPU (Transformer Power Unit)

- 3000 Volt transformer
- Line insulation current monitor
- Main lift cable entry gland

Tether

- The Mohawk uses an 19.5 mm / 0.77 in. diameter tether.

Main Lift Umbilical

- Sub-Atlantic ROVs use a common 25.5 mm / 1.0 in. diameter umbilical suitable for all our open frame vehicles, simplifying spares and interchangeability between systems.

Sensors & Equipment

The Mohawk ROV system will support a range of sensors and equipment, typically:-

- Cameras, Sonar's, Oceanographic Sensors,
- Small hydraulic and electric hydraulic manipulators
- Tool skids, small HPU's and valve packs, torque tools, etc.

Tether Management System

Available in three sizes, Sub-Atlantic's cage type TMS is renowned in the industry for ruggedness, reliability and simplicity.

- Size 1 suitable for Mohawk
- 250 metres capacity of 19.5 mm / 0.77 diameter tether
- Stainless steel telescopic frame allowing underslung tool skids on ROV
- Fully electric, single drive motor

Refer to Cage Type TMS data sheet.

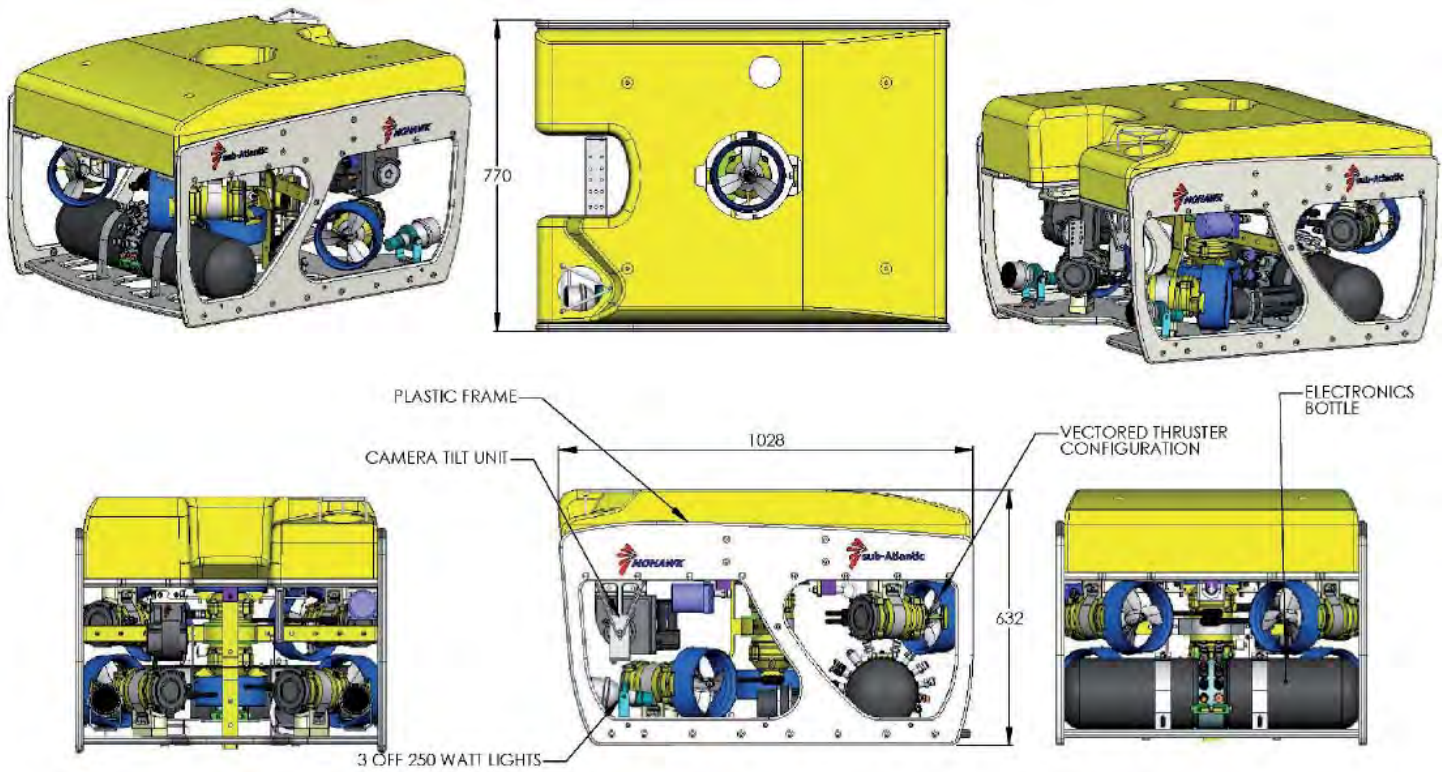


Launch & Recovery Systems

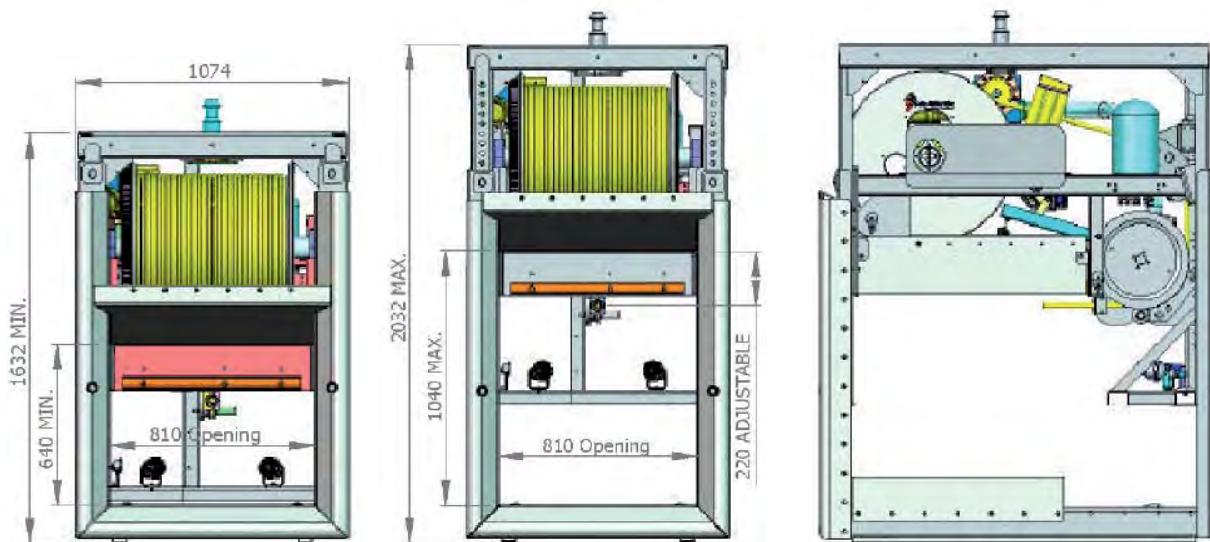
Launch and recovery systems can be supplied to different depth requirements and formats such as A-frame or jib crane.

Control Cabins

- Various sizes and configurations available
- A60 and Zoned specifications
- Workshop options



Mohawk ROV Dimensions



Size I TMS Dimensions

The specification details are illustrative for marketing purposes only. Actual equipment may be different as a result of product improvement or other reasons. Specific interface and performance information should be reconfirmed at time of order placement.



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The Industry Standard for Seven-Function Dexterous Manipulators

Hundreds of TITAN 4 manipulator systems are in use worldwide every day. TITAN manipulators are the highest quality system on the market for the dexterity and strength needed to withstand the industry's harsh and repetitive needs day after day.

- Acute Precision Control
- Durable Through the Harshest Conditions
- Reliability Through the Harshest Conditions
- Large Operating Envelope
- High Lift-to-Weight Ratio
- Depth Rating from 4,000 msw to 7,000 msw
- Titanium Construction

The TITAN 4 is widely regarded as the world's premier servo-hydraulic remote manipulator system. Since 1987, TITAN systems have been the industry standard for dexterous manipulator systems used in subsea applications, and are extensively used on ultra-heavy work class ROVs.

The TITAN 4 has the dexterity and accuracy necessary to perform the fine movements needed for complex tasks. When this ability is combined with the manipulator's reach (1,922 mm or 75.7 inches), payload capacity (122 kg or 270 lb at full extension), depth rating (available up to 7,000 msw), and large operating envelope, the TITAN 4 offers unequalled performance in a wide range of subsea applications.





Slave arm electronics are located in the forearm, increasing system reliability and minimizing electrical connections.

ACUTE PRECISION CONTROL

The TITAN 4 manipulator's accuracy is limited only by the pilot's eye. The Master Controller includes a six-degree-of-freedom replica master arm that ensures comfortable, intuitive manipulator operation. It's movements are just as sharp when it's moving a 5 lb object as when it is moving a 250 lb object.

The controller also contains function keys for selecting menu options and a display for viewing diagnostic and status information. The controller's advanced operational features are individual joint freeze, position scaling (altering the ratio of master arm movement to manipulator arm movement), password security, programmable stow/deploy routines, individual joint movement limits, incremental gripper movement, individual joint diagnostics, and automatic error checking.



The replica master arm ensures comfortable, intuitive operation.

TITAN 4 SPECIFICATIONS

General Description

Mode of operation..... Closed-loop position control
 Input device Replica master arm
 Number of functions Six plus grip
 Materials of construction Primarily titanium

Manipulator Arm Specifications

All specifications are based on the standard system configuration using Shell Tellus® Oil 32 hydraulic fluid, input pressure of 207 bar (3,000 psi), and available flow of 19 lpm (5 gpm).

Depth rating:

Standard 4,000 msw (13,124 fsw)
 Extended 7,000 msw (22,967 fsw)
 Maximum reach 1,922 mm (75.7 in.)
 (From azimuth pivot to standard gripper T-bar slot)

Weight in air 100 kg (221 lb)
 Weight in seawater 78 kg (174 lb)
 Lift at full extension, nominal 122 kg (270 lb)
 Maximum lift, nominal 454 kg (1,000 lb)
 Maximum gripper opening (standard gripper), nominal 99 mm (3.9 in.)
 Grip force, nominal 4,092 N (920 lb)
 Wrist torque, nominal 170 Nm (125 ft-lb)
 Wrist rotate, continuous 360 degrees, 6-35 rpm

Manipulator Arm Functions

Actuator Function	Type	Nominal Mechanical Range
Azimuth	Rotary	240 degrees
Shoulder pitch	Linear	120 degrees
Elbow pitch	Rotary	270 degrees
Wrist pitch	Rotary	180 degrees
Wrist yaw	Rotary	180 degrees
Wrist rotate	Gerotor	360 degrees continuous
Gripper (standard)	Linear	99 mm (3.9 in.)

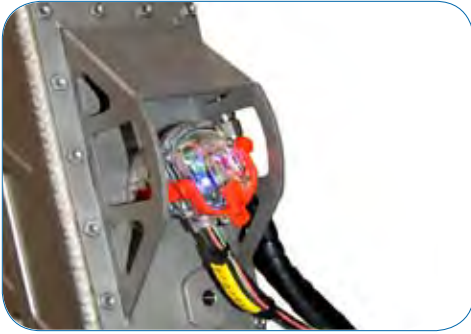
Master Controller Specifications

Length 470 mm (18.5 in.)
 Width 177 mm (7.0 in.)
 Height 67 mm (2.6 in.)
 Weight 3.7 kg (8.2 lb)

Approved Hydraulic Fluids

Hydraulic oil All common mineral, Glycol, and environmentally friendly fluids

(Continued on next page)



Colored diagnostic lights in the connector head indicate the status of electrical power delivery to the slave arm, master controller transmission to the slave arm, and slave arm responsiveness.

DURABILITY

Construction

The TITAN 4 is constructed primarily of titanium for structural strength, light weight, corrosion resistance, and extraordinary resistance to damage from collisions. TITAN manipulators have a proven track record of reliability in the world's most demanding subsea environments. The TITAN 4 features:

- Roller bearings on all pivot points to withstand heavy loading and eliminate wear
- Titanium external fasteners
- Long-lasting, third-generation rotary actuators to minimize leakage and friction, and to reduce service requirements
- 99-mm (3.9-inch) parallel-acting titanium gripper



The in-arm slave electronics module features diagnostic lights that indicate processor health.

(Specifications, continued from previous page)

Hydraulic Requirements

Viscosity	10-200 cSt
Available flow	5.7-19.0 lpm (1.5-5.0 gpm)
Pressure.....	103 bar (1,500 psi) minimum to 207 bar (3,000 psi) maximum
	Slave arm performance is reduced at less than 3,000 psi.
Hydraulic fluid temperature, maximum	54 degrees C (130 degrees F)
Return pressure, maximum.....	34.5 bar (500 psi)
Filtration, hydraulic supply.....	3 microns (10 microns absolute)
Customer-supplied mating fittings required:	
Supply hose fitting.....	-4 JIC female, 1/4-inch
Return hose fitting.....	-6 JIC female, 3/8-inch
Contact the factory about operation at other pressures and flow rates	

Electrical and Telemetry Requirements

System supply at junction box.....	90-260 VAC, 50-60 Hz, single phase
Input power:	
Master controller.....	90-260 VAC, 50-60 Hz, single phase
Slave arm.....	24 VDC
Power consumption:	
Master controller.....	6 W start, 3 W run
Slave in-arm controller plus solenoid.....	6 W start, 45 W run
Slave arm current draw.....	1.875 A at 24 VDC
Telemetry.....	User selectable, RS-232 or RS-422/485 half-duplex 2-wire

Environmental Specifications

Operating temperature	-2 to +54 degrees C (+28 to +130 degrees F)
Storage temperature	-15 to +71 degrees C (+5 to +160 degrees F)
Humidity.....	0% to 100% condensing



The titanium wrist camera can be ordered already installed on a new TITAN 4 manipulator system.

SYSTEM RELIABILITY

Robust Power/Signal Connection

A Schilling SeaNet cable connects the arm to electrical power and telemetry, providing a robust, reliable attachment. The small-diameter cable (8.9 mm, or 3/8 inch) is actively pressure balanced and oil filled. The connector head has spring-loaded contacts, and a positive locking feature eliminates accidental cable disconnection.

Reliable In-Arm Slave Electronics

All downside arm electronics are located inside the manipulator forearm. This configuration greatly reduces the number of electrical connections, simplifying service operations and increasing the system's ability to withstand shock.

Quick, Easy Diagnostics

The SeaNet cable connector head contains bright LED status indicator lights that allow first-level diagnostics to be performed solely by visual inspection. The lights show that electrical power is being delivered to the arm, that the controller is transmitting to the arm, and that the arm is responding. This information lets the operator quickly determine where to begin troubleshooting, without removing connectors, applying a voltmeter, or opening sealed enclosures. The system also detects missing or reduced arm position sensor signals, and diagnostic lights on the in-arm electronics module indicate processor health.

EXTENSIVE OPERATING ENVELOPE

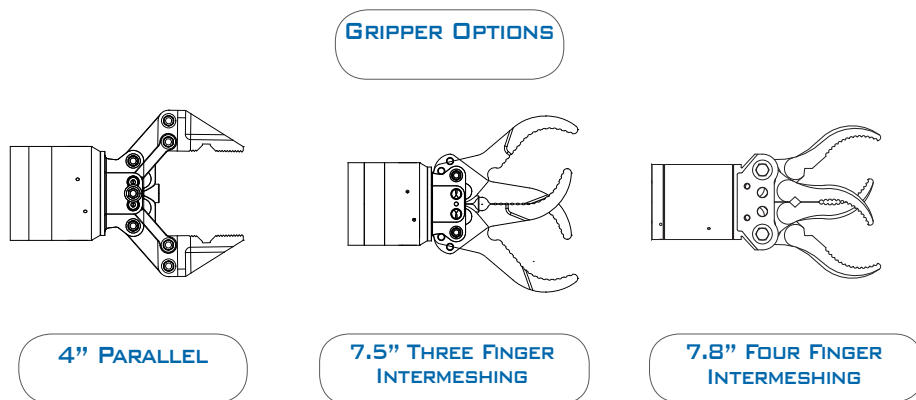
It is engineered to give its operators the largest range of motion in its class. This significant flexibility only enhances the TITAN's precision dexterity for exploration and recovery missions.

SCHILLING MANIPULATOR COMPATIBILITY

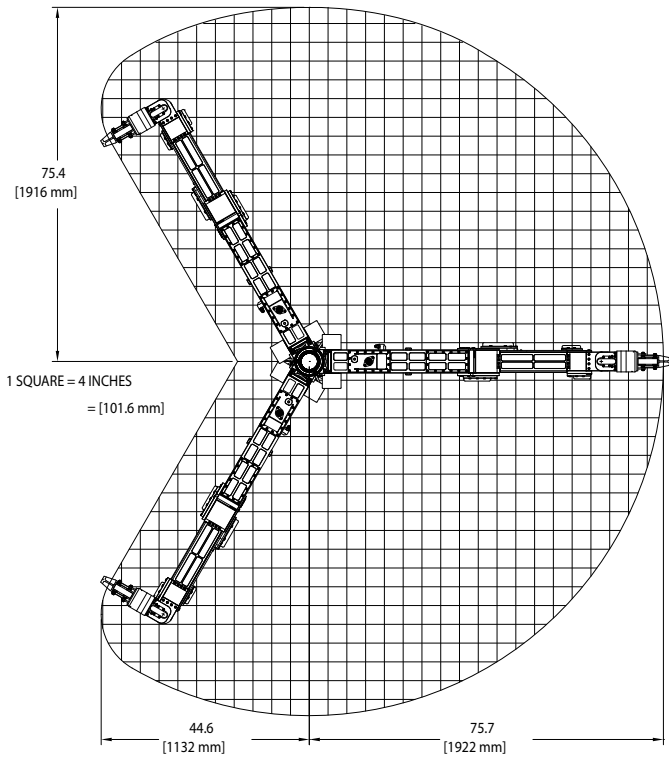
To create the best manipulators on the market, Schilling took the best field-proven manipulator technologies and used them repetitively throughout the system. The result is a simple, reliable system with high component commonality that minimizes spare part requirements. Many parts are interchangeable throughout the entire Schilling manipulator line: TITAN 4, ATLAS, RIGMASTER, CONAN, and ORION.

OPTIONS AND ACCESSORIES

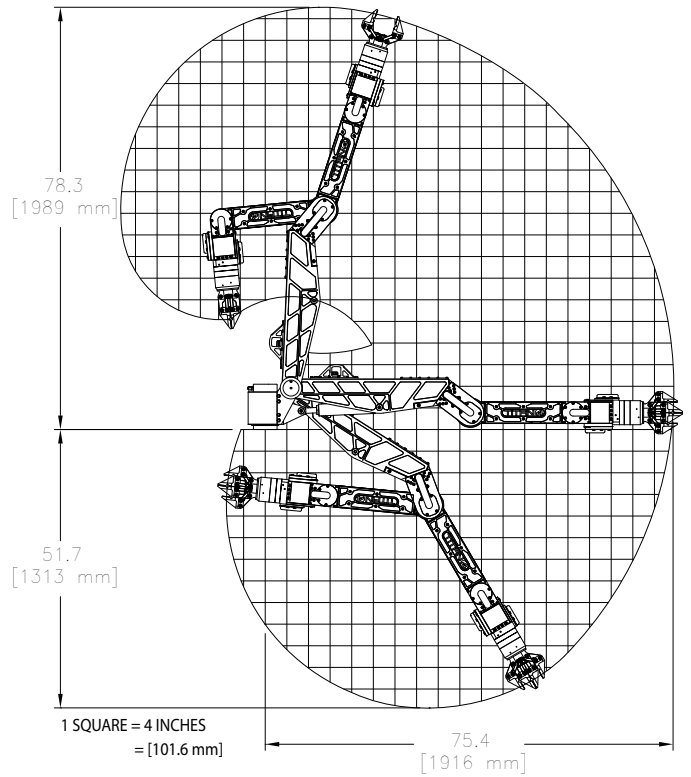
- Extended Depth Rating to 7,000 msw
- Spares Kit
- Seal Installation Tool Kit
- Technician's Tool Kit
- Dual-Manipulator Configuration (two manipulator arms and a single master controller with two replica master arms)
- Radiation Hardening (up to 1×10^7 rad gamma)
- Titanium Wrist-Mounted Camera



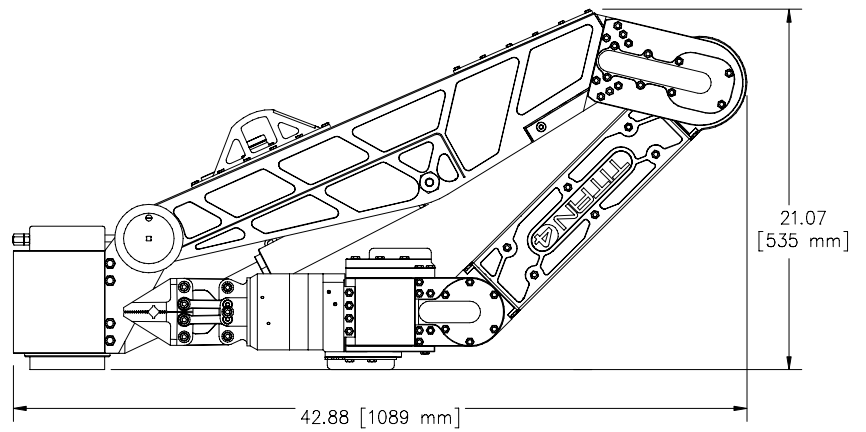
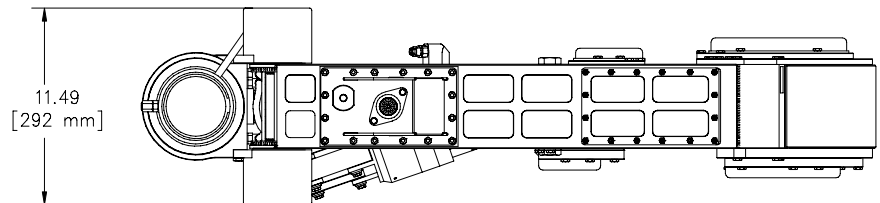
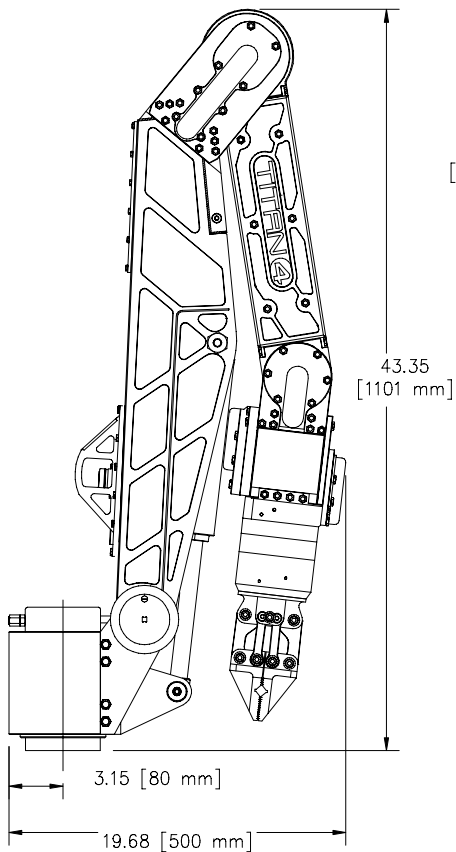
Dual TITAN manipulator configuration.



RANGE OF MOTION, TOP VIEW



RANGE OF MOTION, SIDE VIEW



STOW DIMENSIONS

MANIPULATOR COMPARISON

						
Model	TITAN 4	ATLAS 7R	RIGMASTER	CONAN 7P	ORION 7P/7R**	ORION 4R
Category	Heavy Work	Heavy Work	Heavy Work	Heavy Work	Medium Work	Medium Work
Power Source	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Rate/Position Control	Position	Rate	Rate	Position	Position or Rate	Rate
Number of Functions	7	7	5	7	7	4
Materials	Primarily Titanium	Anodized Aluminum & Stainless Steel	Anodized Aluminum, Stainless Steel & Titanium	Anodized Aluminum & Stainless Steel	Anodized Aluminum & Stainless Steel	Anodized Aluminum & Stainless Steel
Maximum Reach	1,922 mm/75.7 in.	1,664 mm/65.5 in.	1,067 mm/42.0 in. (retracted); 1,372 mm/54.0 in. (extended)	1,806 mm/71.1 in.	1,532 mm/60.3 in. (7P/R) 1,850 mm/72.8 in. (7PE/RE)	682 mm/26.9 in.
Input Device	Replica Master Arm	Rate Hand Controller	Rate Hand Controller	Replica Master Arm	Replica Master Arm or Rate Hand Controller	Rate Hand Controller
Depth Rating, Standard	4,000 msw/13,124 fsw	6,500 msw/21,000 fsw	6,500 msw/21,000 fsw	3,000 msw/9,800 fsw	6,500 msw/21,000 fsw	6,500 msw/21,000 fsw
Depth Rating, Optional	7,000 msw/23,000 fsw	N/A	N/A	N/A	N/A	N/A
Lift at Full Reach	122 kg/270 lb	250 kg/550 lb	270 kg/595 lb (retracted); 181 kg/400 lb (extended)	159 kg/350 lb	68 kg/150 lb	136 kg/300 lb
Weight in Air	100 kg/221 lb	73 kg/160 lb	64 kg/142 lb	107 kg/235 lb	54 kg/120 lb	30 kg/67 lb
Weight in Seawater	78 kg/174 lb	50 kg/109 lb	48 kg/105 lb	73 kg/161 lb	38 kg/83 lb	21 kg/46 lb

**Specifications shown are for the standard-reach ORION 7P.

CUSTOMER SUPPORT, TECHNICAL SUPPORT, AND TRAINING

- Worldwide Customer Support Network with Factory-Trained Technicians
- 24-Hour Telephone Access to Qualified Technical Staff
- On-Site and Offshore Installation/Mobilization Support
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RIGMASTER

The Industry Standard for Five-Function Grabber Arms

For nearly every TITAN 4 manipulator in the market, there is a RIGMASTER supporting the mission. The RIGMASTER's titanium construction makes it a durable and reliable in heavy-work class missions.

- Structural Strength and Long Service Life
- Large Operating Envelope
- Highest Lift-to-Weight Ratio in its Class
- Interchangeable Jaw Configurations
- Boom Function Extends Arm Length by 305 mm (12 inches)
- Standard Depth Rating of 6,500 msw

The RIGMASTER is a five-function, rate-controlled, heavy-lift grabber arm that can be mounted on a wide range of subsea ROVs. The RIGMASTER is engineered for the strength needed to withstand the industry's harsh and repetitive needs day after day. The grabber arm can be used to grasp and lift heavy objects or to anchor the ROV by clamping the gripper around a structural member at the work site.

The RIGMASTER's boom function extends or retracts

the gripper by 305 mm (12 inches) for a maximum extension of 1,372 mm (54.0 inches). The system's standard four-finger intermeshing gripper can handle bulky objects by opening to 284 mm (11.2 inches).





The RIGMASTER is paired with an ORION manipulator arm on the Schilling QUEST™ ROV.

DURABILITY

The RIGMASTER is constructed to be reliable in situations that require rugged operation. The arm's linear actuators have been life tested under full load for 250,000 cycles with minimal wear. The actuators use the latest cap seal technology to minimize leakage, ensuring long life and minimal maintenance. The RIGMASTER is constructed primarily of titanium for structural strength, light weight, corrosion resistance, and extraordinary resistance to damage from collisions. RIGMASTER manipulators have a proven track record of reliability in the world's most demanding subsea environments.

LIFT-TO-WEIGHT RATIO

The RIGMASTER has the highest lift-to-weight ratio of any manipulator in its class. Weighing only 48 kg (105 lb) in



RIGMASTER SPECIFICATIONS

General Description

Control method Rate control
 Control input device Optional rate hand controller
 Number of functions Four plus grip
 Materials of construction Titanium, anodized aluminum, 17-4 stainless steel,

Manipulator Arm Specifications

All specifications are based on the standard system configuration using Shell Tellus® Oil 32 hydraulic fluid, input pressure of 207 bar (3,000 psi), and available flow of 19 lpm (5 gpm).

Depth rating 6,500 msw (21,327 fsw)
 Reach (from shoulder pivot to tip of standard gripper):
 Retracted boom 1,067 mm (42.0 in.)
 Extended boom 1,372 mm (54.0 in.)
 Weight in air 64 kg (142 lb)
 Weight in seawater 48 kg (105 lb)
 Lift at full extension, nominal:
 Retracted boom 270 kg (595 lb)
 Extended boom 181 kg (400 lb)
 Maximum standard gripper opening, nominal 284 mm (11.2 in.)
 Grip force, nominal 4,448 N (1,000 lbf)
 Wrist torque, nominal 205 Nm (150 ft-lb)
 Wrist rotate, continuous 360 degrees, 6-35 rpm

Manipulator Arm Functions

Actuator Function	Type	Nominal Mechanical Range
Base yaw	Linear	105 degrees
Shoulder pitch	Linear	105 degrees
Boom extend/retract	Linear	305 mm (12 in.)
Wrist rotate	Gerotor	360 degrees
Gripper, standard	Linear	284 mm (11.2 in.)

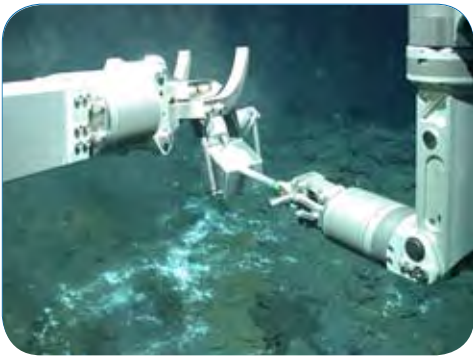
Approved Hydraulic Fluids

Hydraulic oil All common mineral, Glycol, and environmentally friendly fluids

Hydraulic Requirements

Viscosity 10-200 cSt
 Available flow 5.7-19.0 lpm (1.5-5.0 gpm)
 Pressure 103 bar (1500 psi) minimum to 207 bar (3,000 psi) maximum
 Slave arm performance is reduced at less than 3000 psi.
 Hydraulic fluid temperature, maximum 54 degrees C (130 degrees F)
 Rotary actuator return pressure, maximum 24 bar (350 psi)
 Filtration 10 microns (25 microns absolute)

(Continued on next page)



The RIGMASTER working together with an ORION manipulator collecting scientific samples from the ocean floor.

Photo Courtesy of Marum

seawater, RIGMASTER's titanium linear actuators allow the manipulator to lift 270 kg (595 lb) when the boom is retracted and 181 kg (400 lb) at full arm extension. The wrist, which provides continuous 360-degree rotation, is driven by a high-torque, low-speed gerotor hydraulic motor that produces 170 Nm (125 ft-lb) of torque.

SYSTEM CONFIGURATION

On an ROV, a RIGMASTER arm is typically paired with a dexterous manipulator arm such as a TITAN, CONAN, or ORION model. The standard arm is configured for left-hand installation, so that a dexterous arm can be mounted on the right. The RIGMASTER arm can be stowed vertically or horizontally to accommodate a range of ROV configurations. No electrical connections are required for the arm. Each joint or function is supplied by two hydraulic hoses that can be controlled with simple, customer-supplied valves and a switch box. An optional ergonomic rate hand controller is available for manipulator operation.

SCHILLING MANIPULATOR COMPATIBILITY

To create the best manipulators on the market, Schilling took the best field-proven manipulator technologies and used them repetitively throughout the system. The result is a simple, reliable system with high component commonality that

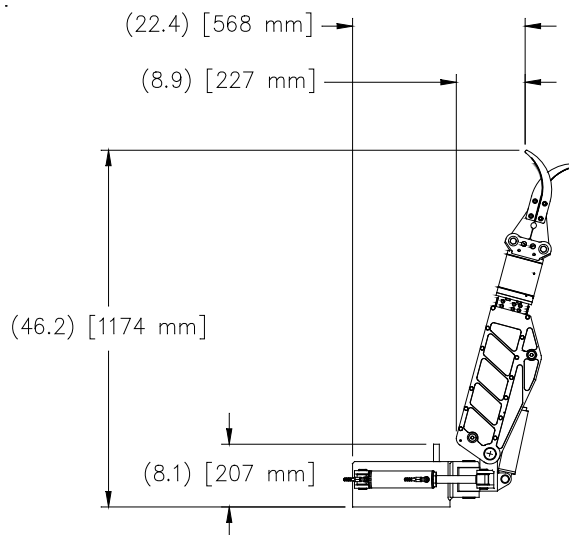
(Specifications, continued from previous page)

Hydraulic control hose length extending from base,	
nominal, all functions	55 inch (4.6 ft)
Control hoses:	
Working pressure	207 bar (3000 psi)
Proof pressure	310 bar (4500 psi)
Burst pressure	621 bar (9000 psi)
Customer-supplied mating fittings required,	
Control hose fittings	-4 JIC male, 1/4 inch
Contact the factory about operation with other pressures and flow rates.	

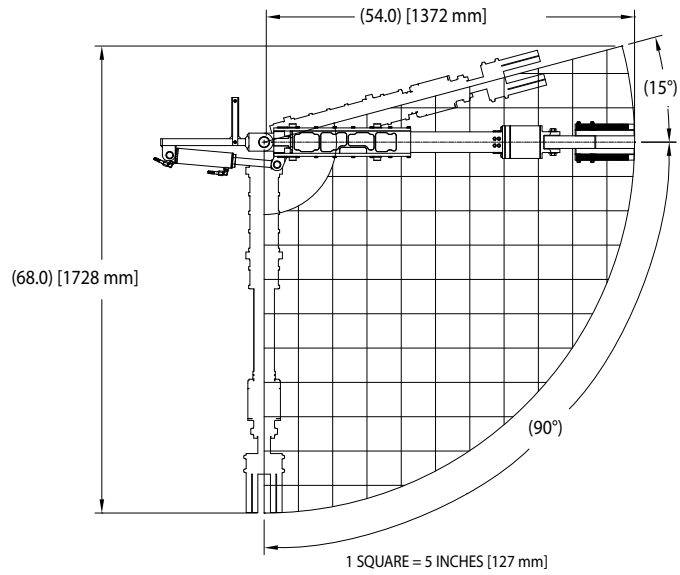
minimizes spare part requirements. Many parts are interchangeable throughout the entire Schilling manipulator line: TITAN 4, ATLAS, RIGMASTER, CONAN, and ORION.

OPTIONS AND ACCESSORIES

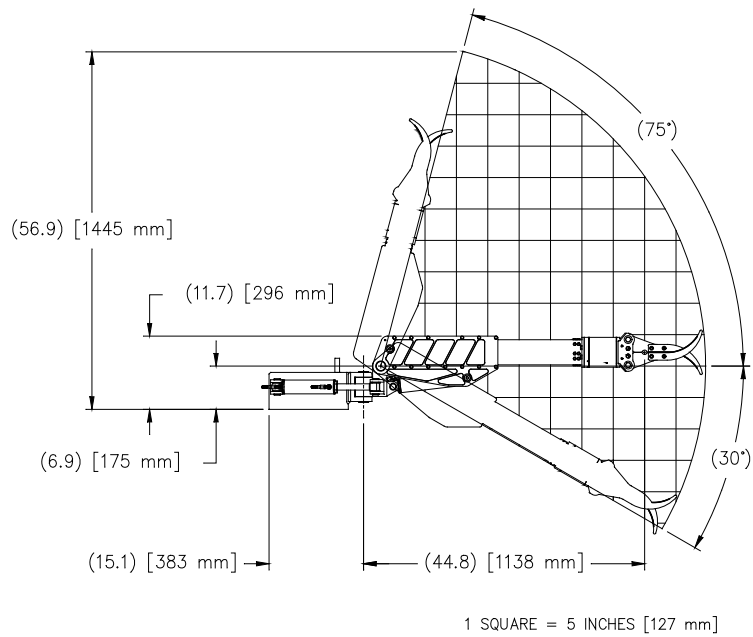
- Rate Hand Controller
- Relief Valve Kit
- Spares Kit
- Technician's Tool Kit



STOW DIMENSIONS



RANGE OF MOTION, TOP VIEW



RANGE OF MOTION, SIDE VIEW



MANIPULATOR COMPARISON

						
Model	TITAN 4	ATLAS 7R	RIGMASTER	CONAN 7P	ORION 7P/7R**	ORION 4R
Category	Heavy Work	Heavy Work	Heavy Work	Heavy Work	Medium Work	Medium Work
Power Source	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Rate/Position Control	Position	Rate	Rate	Position	Position or Rate	Rate
Number of Functions	7	7	5	7	7	4
Materials	Primarily Titanium	Anodized Aluminum & Stainless Steel	Anodized Aluminum, Stainless Steel & Titanium	Anodized Aluminum & Stainless Steel	Anodized Aluminum & Stainless Steel	Anodized Aluminum & Stainless Steel
Maximum Reach	1,922 mm/75.7 in.	1,664 mm/65.5 in.	1,067 mm/42.0 in. (retracted); 1,372 mm/54.0 in. (extended)	1,806 mm/71.1 in.	1,532 mm/60.3 in. (7P/R) 1,850 mm/72.8 in. (7PE/RE)	682 mm/26.9 in.
Input Device	Replica Master Arm	Rate Hand Controller	Rate Hand Controller	Replica Master Arm	Replica Master Arm or Rate Hand Controller	Rate Hand Controller
Depth Rating, Standard	4,000 msw/13,124 fsw	6,500 msw/21,000 fsw	6,500 msw/21,000 fsw	3,000 msw/9,800 fsw	6,500 msw/21,000 fsw	6,500 msw/21,000 fsw
Depth Rating, Optional	7,000 msw/23,000 fsw	N/A	N/A	N/A	N/A	N/A
Lift at Full Reach	122 kg/270 lb	250 kg/550 lb	270 kg/595 lb (retracted); 181 kg/400 lb (extended)	159 kg/350 lb	68 kg/150 lb	136 kg/300 lb
Weight in Air	100 kg/221 lb	73 kg/160 lb	64 kg/142 lb	107 kg/235 lb	54 kg/120 lb	30 kg/67 lb
Weight in Seawater	78 kg/174 lb	50 kg/109 lb	48 kg/105 lb	73 kg/161 lb	38 kg/83 lb	21 kg/46 lb

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 Fax: +44 (0) 1224 560 901

3D Mechanical Scanning Sonar

BlueView's BV5000-1350 and BV5000-2250 3D mechanical scanning sonar create high-resolution imagery of underwater areas, structures, and objects. With the touch of a button, these new 3D mechanical scanning sonar create 3D point clouds of an underwater scene with minimal training required. The compact, lightweight units are easily deployed on a tripod or an ROV. The scanning sonar head and integrated mechanical pan and tilt mechanism generate both sector scans and spherical scan data. For the first time, get 3D laser-like scanning capabilities underwater, even in low and zero visibility conditions and seamless integration with traditional laser scan imagery.



APPLICATIONS

- 3D site survey
- 3D structure inspection
- Rig decommissioning
- Bridge inspections
- Underwater metrology

BENEFITS

- Easy, one touch scan function
- 3D mosaic imaging without position info
- Easily combined with laser scan imagery
- Compact size fits into tight spaces
- Operates in low & zero visibility conditions

FEATURES

- 2 model options (1.35 & 2.25 MHz)
- Standard Ethernet/RS485 interface
- Easy Windows based software
- Leica Cyclone data compatible
- Sector & Spherical Scans

Inclusions

Included	BV5000-1350	BV5000-2250
Hardware	<ul style="list-style-type: none"> • MB1350-45 Sonar • Pan & Tilt w/ mounting hardware • Sonar, Pan & Tilt junction box • Shipping case • Accessory kit* 	<ul style="list-style-type: none"> • MB2250-45 Sonar • Pan & Tilt w/ mounting hardware • Sonar, Pan & Tilt junction box • Shipping case • Accessory kit*
Software	<ul style="list-style-type: none"> • RS485 to USB drivers • ProScan 1.3 (or current) • MeshLab (included w/ ProScan) 	<ul style="list-style-type: none"> • RS485 to USB drivers • ProScan 1.3 (or current) • MeshLab (included w/ ProScan)
Manuals	<ul style="list-style-type: none"> • BV5000 User Handbook • Quick Start Guide 	<ul style="list-style-type: none"> • BV5000 User Handbook • Quick Start Guide
Warranty	<ul style="list-style-type: none"> • 1 year 	<ul style="list-style-type: none"> • 1 year

*Accessory kit includes: Retract-A-Bit Hex Driver; 7 ft. Cat 5 Ethernet Cable; 15 ft. Sonar/Pan & Tilt Cable; 2 m USB Cable; 15A US Power Cord; RS485 to USB driver CD; ProScan 1.3 (or current) + MeshLab CD

BV5000

Options

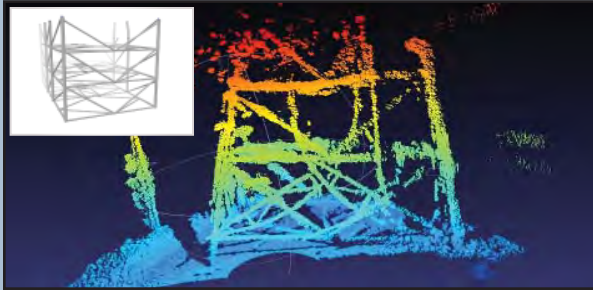
3D Mechanical Scanning Sonar

Optional	BV5000-1350 & BV5000-2250
Hardware	<ul style="list-style-type: none"> • 15 ft. Sonar, Pan & Tilt Cable (1 included w/ BV5000 Accessory Kit) • 200 ft. Sonar, Pan & Tilt Cable Assembly (needed for tripod and fixed mount systems) • 4 ft. Sonar, Pan & Tilt Cable Whip Kit w/ Wiring Diagram (needed for ROV mount systems) • EXC500 Ethernet Extender Kit (includes 500 ft. Cable Assembly)
Software	<ul style="list-style-type: none"> • Leica Cyclone Register • Leica Cyclone Model • Leica Cyclone Register Customer Care Package (CCP) • Leica Cyclone Model Customer Care Package (CCP)
Manuals	<ul style="list-style-type: none"> • Cyclone/BlueView (ships with Cyclone software)
Training	<ul style="list-style-type: none"> • On-Site "Getting Started" hardware/Software (per day) • Leica Cyclone "On-Site" Training (2-day)
Warranty	<ul style="list-style-type: none"> • BV5000-1350 Extended Warranty (per year) • BV5000-2250 Extended Warranty (per year)

Specifications

	BV5000-1350	BV5000-2250
Sonar & Software		
Sector/Spherical Scan Area (°)	45 - 360	45 - 360
Sonar Field of View (°)	45 x 1	45 x 1
Update Rate (Hz)	Up to 40	up to 40
Frequency (MHz)	1.35	2.25
Maximum Range	30 m (98 ft.)	10 m (32 ft.)
Optimum Range	1 - 20 m (3.2 - 65 ft.)	0.5 - 7 m (1.6 - 23 ft.)
Number of Beams	256	256
Beam Width (°)	1 x 1	1 x 1
Beam Spacing (°)	0.18	0.18
Time Resolution	0.031 m (1.23 in.)	0.019 m (0.74 in.)
Data Output Format	.son, .off and .xyz files	.son, .off and .xyz files
Mechanical		
Size (L x W x H in inches)	10.5 x 9.2 x 15.4	8.9 x 8.6 x 15.4
Weight in Air/Water(lbs.)	21.7/8.2	19.1/6.0
Depth Rating	300 m (1,000 ft.)	300 m (1,000 ft.)
Coms (Sonar/Pan & Tilt)	Ethernet/RS485	Ethernet/RS485
Power Consumption (W)	45 max.	45 max.
Power Requirement (V DC)	20- 29	20- 29

High resolution 3D imagery made easy for a wide variety of underwater applications. Visit www.blueview.com to view our collection of 3D sonar case studies, movies and imagery.



Detailed 3D Structure Inspection - on demand point cloud generation delivers new levels of data quality with less work.



Full View Imagery - easily add underwater details to above-water laser scan data for full, detailed 3D viewing of structures, objects and sites.

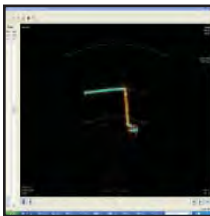


Modeling, Rendering, and Object Identification - improve efficiency and save time by using common laser scanning measurement techniques underwater.

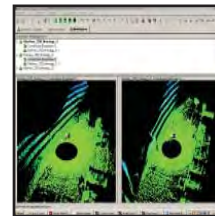


High Resolution Mapping & Imaging - quickly create high-resolution 3D maps and images of underwater scenes for accurate analysis and effective planning.

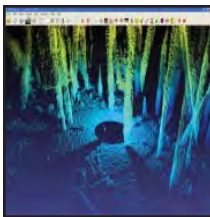
Software



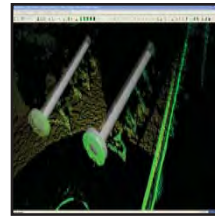
ProScan
BlueView's real-time scan control, monitoring, and post processing software. Exports industry standard point clouds. Comes standard with BV5000 systems.



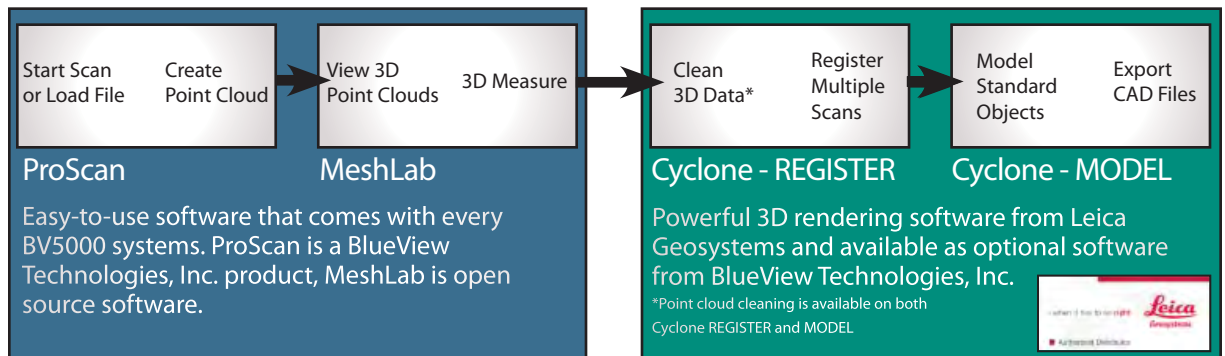
Cyclone-REGISTER
Leica Geosystems' software used to quickly clean 3D data and combine multiple scans together. Optional software for BV5000 systems.



MeshLab
An easy-to-use point cloud viewer with point-to-point measurement capabilities. Included with BV5000 systems.



Cyclone-MODEL
Leica Geosystems' software used to model standard components and export a CAD file. Optional software for BV5000 systems.



BV5000 3D Mechanical Scanning Sonar

Diagrams

DIAGRAM OF BV5000-1350

Dimensions are in inches

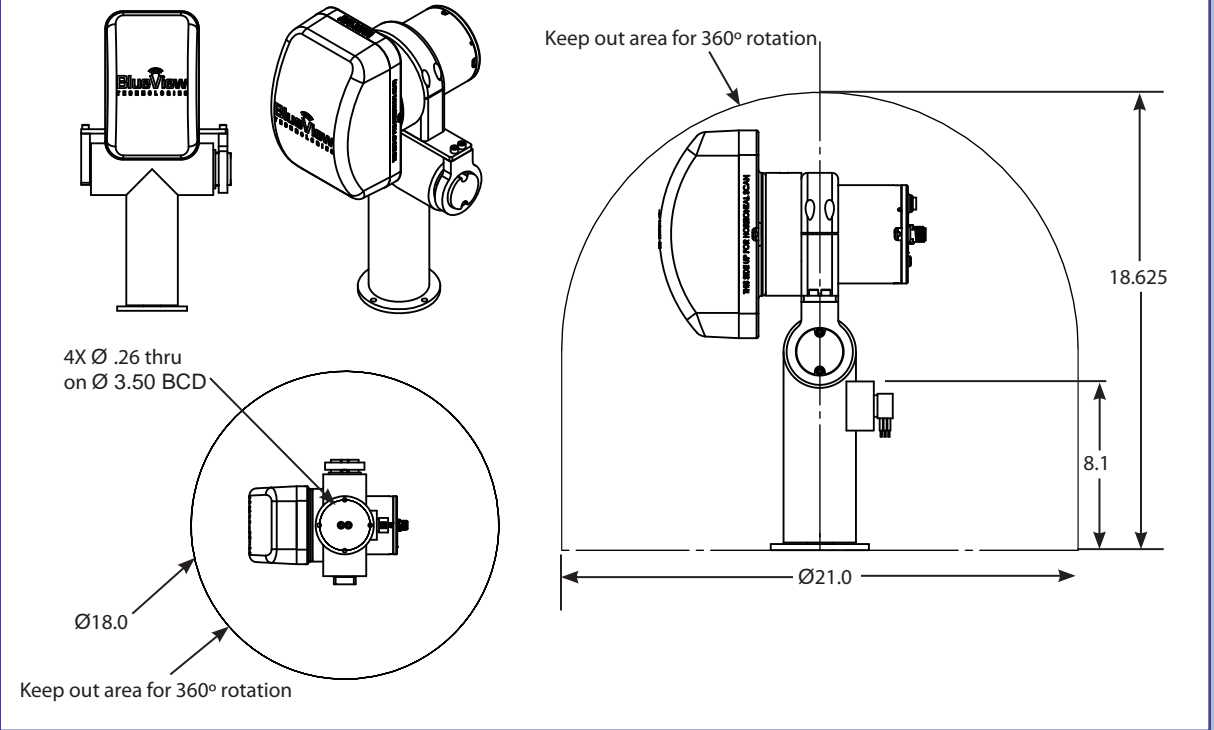
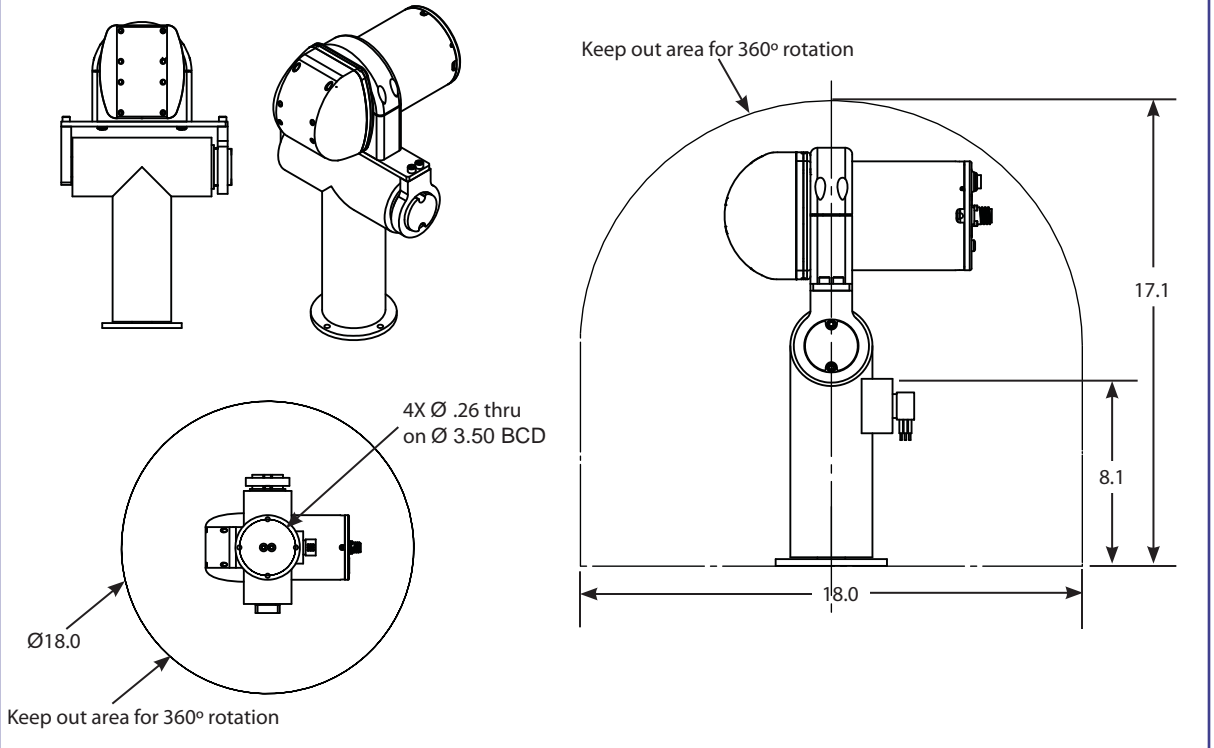


DIAGRAM OF BV5000-2250

Dimensions are in inches





L3C-550 COLOUR CAMERA

**High Resolution
Colour 550TVL**

10 bit digital processing

**Low Light Sensitivity
0.1 Lux @ f2.0**

**4000 Metre Rating
(with a 6000 metre option)**

Titanium Housing

The Bowtech L3C-550 miniature high resolution colour CCD camera, one of the cameras in our Aqua Vision range, provides a low cost solution to general underwater viewing and observation.

The cameras are manufactured with a high quality Titanium housing rated to 4000 metres operating depth, with a 6000 metre option. The camera is fitted with a fixed focus wide angle lens, giving a diagonal field view of 65 degrees in water through a sapphire window. The camera features built-in reverse polarity and surge protection.

The miniature, high quality Sony 1/3" EX-View HAD CCD sensor offers high resolution and low light level sensitivity achieved by using 10 bit digital processing. It is the ideal camera for underwater viewing tasks.



L3C-550

SPECIFICATIONS

ELECTRICAL

Resolution, Horizontal	550 TV Lines
Limiting Light Sensitivity	0.1 Lux @ f2.0
Sensor Type	1/3" (Sony) EX-View HAD CCD
	10 bit digital processing
Sensor Elements	752 (H) x 582 (V) PAL, 768 (H) x 494 (V) NTSC
Signal to Noise Ratio	>50dB
Scanning	625 Line 50Hz PAL
	525 Line 60Hz NTSC
Power	12 to 24VDC
Current	130ma maximum
Composite Video Output	1.0V pk-pk
Electro-Magnetic Compatibility	EN50081-1 Emission/EN500852-1 Immunity

ENVIRONMENTAL

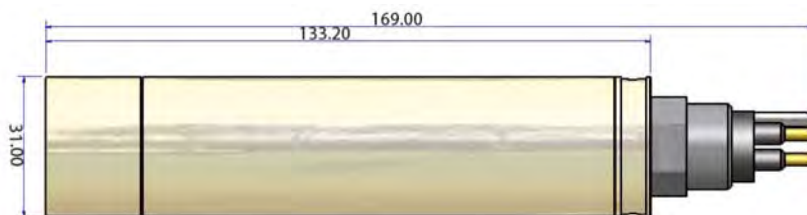
Water Depth	4000 metres / 6000 metre option
Temperature (Operating)	-10°C - +50°C
Shock	3 axis (operating)
	30g peak, 6mS half-sine pulse

OPTICAL

Lens	2.9mm, f2.0
Auto Iris	CCD Iris 1/50 th – 1/100,000 th sec.
Focus	Fixed 100mm – Infinity
Angle of View	91° Diagonal in Air, 65° in Water (2.9mm lens)
	80° Diagonal in Air, 58° in Water (3.6mm lens)
Window	Sapphire Glass

MECHANICAL

Maximum Diameter	31mm (1.2")
Length	133mm (5.2") Excluding Connector
Weight in Air	266 grams (when fitted with MCBH4M)
Weight in Water	157 grams
Standard Housing	Titanium
Standard Connector	WETCON BH-4-MP or MCBH4M
Optional Connectors	Large selection of Seacon Connectors



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Email: bowtech@bowtech.co.uk, Web: www.bowtech.co.uk



LED-1600 UNDERWATER LED LIGHT

The Bowtech LED-1600 was the first commercially available light in our AquaVision range. This light featured the latest LED technology and is now a real alternative to incandescent lamps.

The LED's produce 4 times more light per watt than an incandescent bulb.

The LED-1600 has no fragile filaments, is highly shock resistant, robust, with exceptional longevity. The LED-1600 has an effective lifetime greater than 100,000 hours.

With the exceptional lifetime this leads to an enormous "in service" cost saving over lamps with incandescent bulbs.

The 3000m rated housing is made from hard anodised Aluminium, Titanium and Stainless Steel, which offers proven, corrosive, resistance.

The remotely dimmable LED array used in the light delivers a bright white light of 1600 lumens which is equal to or greater than most incandescent lights of this type.

The light produced is ideal for colour video inspection of viewing tasks.

Long Life, 100,000 hours

**Rugged Construction
Shock & Vibration Resistant**

Operates in Air or Underwater

3000 Metre Rating

High Intensity & Dimmable

Low Operating Cost

Auto Temperature Regulated



LED-1600

SPECIFICATIONS

Housing Materials:

Hard Anodized 6082-T6 Aluminium
Titanium
Stainless Steel

Length:
Diameter

89mm (3.5in) excluding connector
76.0mm (3in) front end
31.75mm (1.25in) body

Window/Lens:

Acrylic

Lamp Type:

Bowtech LED array

Weights in Air

Aluminium 0.460kg
Titanium 0.670kg
Stainless Steel 1.080kg
Aluminium 0.240kg
Titanium 0.450kg
Stainless Steel 0.860kg

Weights in Water:

Operating Depth:

3000m (9842ft)

Mounts:

Optional mounting bracket with a variety of thread mounts

Typical Beam Angle:

75 Degrees to 50% power points

Power Requirement:

24Vdc, 1600mA

Typical Luminous Flux:

1600 lumens

Typical Luminous Intensity @ 1m:

800 Lux

Dimming:

0-5Vdc, 0-10Vdc, Bi-polar, RS-485

Typical Colour Temperature:

6600 kelvin (options available)

Standard Connector:

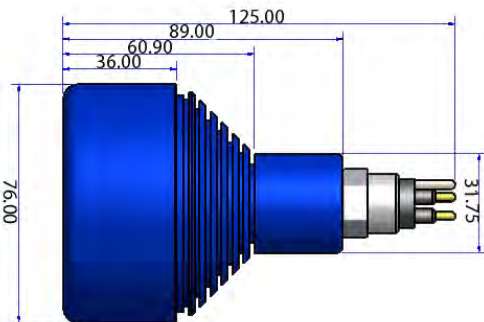
MCBH3M

Optional Connectors:

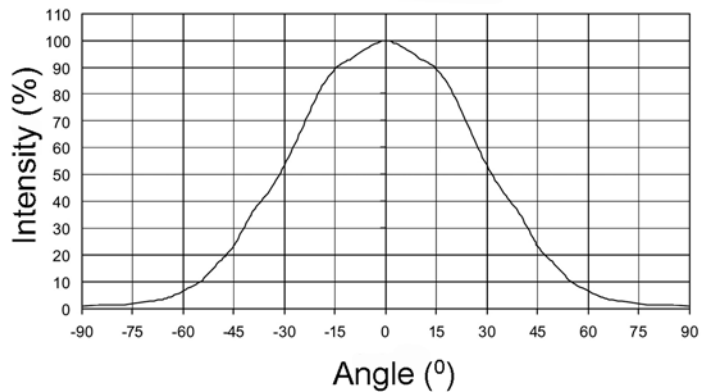
A wide range of Connectors

Lumen Maintenance (70%):

50,000 hours



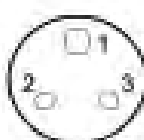
LED-1600 Far Field Pattern



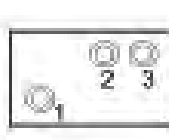
Standard Connector Options:



MCBH3M



XSG-3-BCL



LPMBH-3-MP



BH-3-MP



MSAJ-3-BCR



Howe Moss Crescent, Dyce, Aberdeen, AB21 0GN, Tel: +44 (0)1224 772345, Fax: +44 (0)1224 772900,
Email: bowtech@bowtech.co.uk, Web: www.bowtech.co.uk

RovADCP US Patent ¹

RovADCP - full ocean-depth current profiles for subsea operations:

- utilizes existing rig infrastructure,
- minimal installation engineering or deck space required, and
- cost effective.

Extreme currents can lead to costly delays in deepwater and ultra deepwater oil and gas operations. On-the-spot current information can pay for itself by providing a basis for operational planning and enhancing operational efficiency and safety.

RovADCP is an innovative approach to the accurate measurement of ocean currents in deepwater areas. It is an integrated hardware and software package that measures current profiles as a Remotely Operated Vehicle (ROV) cage is lowered through the water column. It can:

- measure current profiles over the full ocean depth, down to 6000m (over 18000 feet);
- provide real-time current information to support exploration, development and production operations.



300KHz Sentinel Workhorse



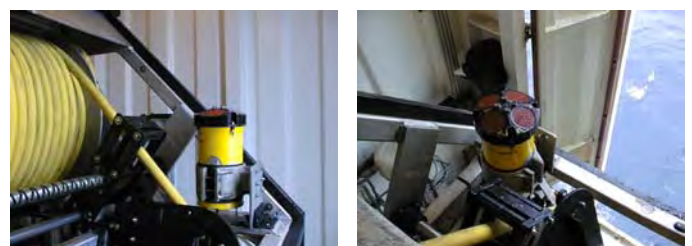
ADCP attached to ROV cage

RovADCP Hardware

A 6000m-rated, Acoustic Doppler Current Profiler (ADCP) is custom-mounted on the outside of a ROV cage. Data from the ADCP, including its depth and heading, are transferred through the ROV's umbilical onto a PC in the ROV shack. The information is then processed and displayed by the user-friendly RovADCP software.

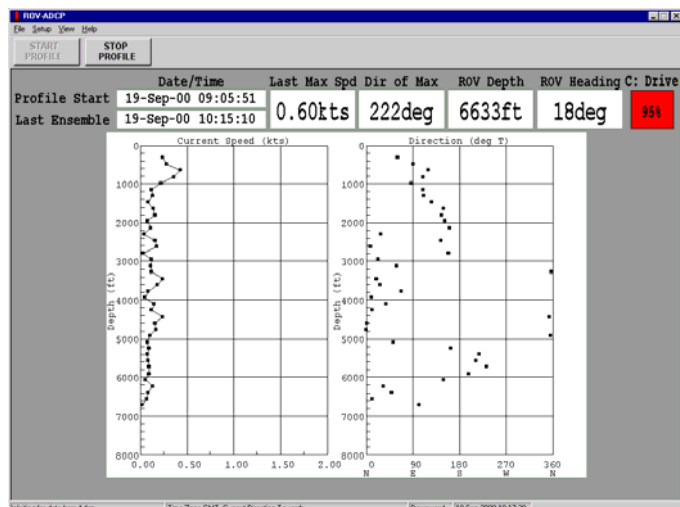
RovADCP operation

The profiling range of the ADCP is between 80 and 100m (260 and 330 feet). As the ROV cage descends from the surface to the seabed individual profiles, and the instrument's depth and heading, are transmitted to the PC. The RovADCP software uses this to build-up a composite profile covering the entire water column.



Alternative ADCP mounting direct to ROV cage

¹US Patent No. 6,820,008 B1



RovADCP screen display

How long this takes will depend on the time for the ROV to be lowered. During this period the RovADCP software updates the display constantly to build the composite profile in near real-time.

System Features

- User-friendly software and clear displays.
- Compact ADCP unit for easy handling, storage and attachment to ROV cage.
- Uses existing ROV telemetry system to transmit data.
- Low maintenance.
- Operator requirement is to simply press “Start Profile” or “Stop Profile” button.

Software Features

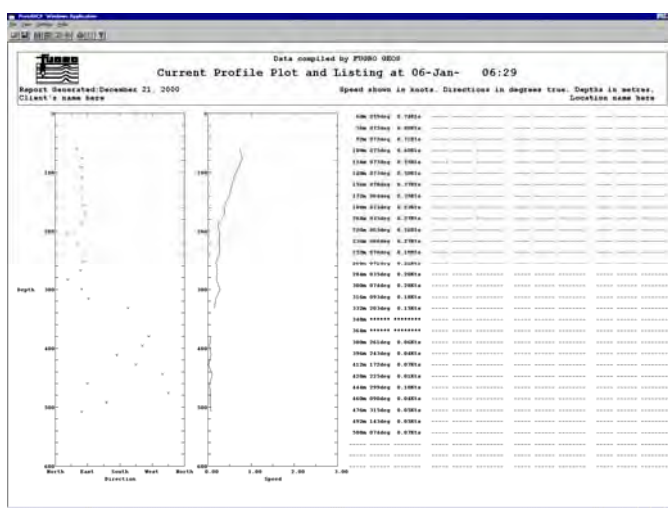
- Profile updates (typically) every 2 seconds.
- All data are logged to the PC's hard disk.
- Summary data are easily transferable to Fugro GEOS' offices for review and archiving.
- “RigPres” application provided to view historic profiles.
- Option to print profile automatically when application is finished.
- Option to export data to ASCII file for reading in Microsoft Word or Excel.

Requirements

- RD Instruments 300kHz Sentinel WH ADCP.
- Mounting bracket on ROV cage.
- 24VDC power supply to ADCP.
- Output of ADCP serial data from ROV umbilical in ROV shack.
- PC running “RovADCP” application.

Note:

- Data can only be collected when the ROV cage is deployed;
- Data is for operational support and is not suitable for the definition of design extremes or operating criteria;
- Continuous, real-time current profiles can be provided by Fugro RigADCP systems.



RigPres display

Fugro is the world's largest and most experienced provider of offshore oceanographic data and services. We have a range of ADCP-based systems to provide high-quality current data for offshore exploration activities. For further information, please contact us at one of our offices below.

Fugro GEOS Ltd, Wallingford, UK
Tel: +44 870 402 1500
Email: uk@geos.com

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Email: fsm@geos.com

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Fugro GEOS Inc, Houston, USA
Tel: +1 713 346 3600
Email: geosusa@fugro.com

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Email: trondheim@oceanor.com

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Email: sandnes@oceanor.com

Appendix 6
PRELIMINARY VESSEL LISTING

Monohull Vessels considered for the OSPRAG EERD

Notes:

The information in the lists below has been obtained by speaking with the relevant vessel operators.

Only monohulls have been considered.

A separate spreadsheet shall be prepared that will contain the detailed specifications of the vessels.

The first list contains vessels considered suitable to launch and recover the capping device through a working Moonpool, or over the side.

The second list contains vessels considered suitable to launch and recover the capping device only over the side.

A third list includes vessel owner/operator contact details, and a fourth list details of boat brokers found useful by JPKenny.

List 1 – Vessels Capable of Moonpool or Over the Side Tree Launching

	Name	Operator	Comments
1	Seawell	Helix /WellOps	Expected to be working for BP until end of June and Fairfield in July
2	Well Enhancer	Helix /WellOps	Currently available, but a number of operators (including BP and Total) have first refusal between May and September
3	Normand Subsea	Subsea7	On long term Shell IRM contract
4	Island Constructor	Island Offshore	Working for BP West of Shetland in June, August and September. In July in Norway
5	Skandi Aker	Aker Solutions	Available July and August

List 2 - Vessels Capable of Over the Side Tree Launching

	Name	Operator	Comments
1	Subsea Viking	Subsea7	On long term contract to BP West of Shetland
2	Orelia	Technip	Working for TAQA/BP in July
3	Boa Deep C	Aker Solutions	Available first half of July. From 1 st August working for BP.
4	Acergy Viking	Subsea7	
5	Geosund	DOF Subsea	Available July
6	Skandi Skolten	DOF Subsea	Currently available July
7	Fugro Symphony	Fugro	Available July

List 3 - Vessel Owner/Operator Contact Details

	Company	Contact Details
1	Subsea 7	Don Shaw Tel: 01224 526000 Email: Don.shaw@subsea7.com Address: Subsea 7 Prospect Road Arnhall Business Park Westhill, Aberdeenshire A B32 6FE
2	Technip	Craig Read Tel: 01224 271949 Email: Craig.read@technip.com Address: Technip UK Ltd Enterprise Drive Westhill Ind Estate Aberdeenshire AB32 6TQ
3	Aker Solutions	Jan S. Schanke-Jørgensen Tel: Mob: +47 901 21 695 Email: jan.sand.schanke-jorgensen@akersolutions.com Aker Marine Contractors AS Aker House, Snarøyveien 36, 1364 Fornebu PO Box 247 - Lilleaker, 0216 Oslo, Norway
4	Island Offshore	Hallgeir Reitan Tel: 0047 70 00 86 23 Fax: 0047 94 80 06 62 Email: chartering@islandoffshore.com Island Offshore Management AS Stalhaugen 12 6065 Ulsteinvik Norway
5	Helix/ Well Ops	Iain W. Morrice Tel: 01224 351990 Mobile: 07884 183228 Email: imorrice@helixesg.com Address: Helix House, Kirkton Drive, Pitmedden Ind Estate, Dyce Aberdeen AB21 0BG
6	DOF Subsea	Olav Dronen Tel: 0047 5525 2200 Fax: 0047 55 25 22 01 Email: olav.dronen@dofsubsea.com DOF Subsea AS Thormøhlens gate 53 C 5006 Bergen Norway
7	Fugro	Derek A. Cruickshank Tel: 01224 257674 Mob: 07968 316314

		Email: d.cruickshank@fugro.com Fugro Subsea Services Limited Denmore Road Bridge of Don Aberdeen AB23 8JW United Kingdom
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Boat Brokers (Who may be of help)

	Company	Contact Details
1	Derrick Offshore	Michael Braid Tel: +44 1224 766 173 Mob: +44 7887 843 997 Fax: +44 1483 53259 Email: crew@deroff.com Address: 17 Abercrombie Court, Prospect Road, Arnhall Business Park, Westhill AB32 6FE
2	Stewart Offshore Services	Bruce Robertson / Adam Brown Tel: 01224 646574 Fax: 01224 635724 Email: Aberdeen@stewartgroup.co.uk Address: 254 Union Street Aberdeen AB10 1TN

Information as of 1 March 2011

Appendix 8 – Vessel availability table

In order to ascertain the scale of the number of vessels that would be available to deploy the OSPRAG capping device in an emergency situation, we asked one company (Subsea7) to provide a list of their fleet that is currently (September 2011) available in or very near to the North Sea. The tables overleaf show the results.

Additionally, we know from the EERD exercise that Well Ops have two vessels available in the North Sea that would be appropriate for deployment of the OSPRAG capping device.

These vessels, along with those from other marine contractors (such as Fugro or Technip), would be capable of deploying the OSPRAG capping device, thus demonstrating that, should the need arise, it is unlikely that any delay to capping the well would be due to an unavailability of suitable vessels.



FLEET STATISTICS (North Sea)

Vessel Name	Owned / Chartered	Type	Owner	Managed by	Class Society	Notation	DP Class	Thrusters - No. /Size/ Make/Type	DP System Make	DP System Model	Main Engines - No. /Size/Make/Type	LOA (m)	LBP (m)	Brdth (m)	Op. Draught (m)	Deck Area (m ²)	Lay/Dive Eqpt
Seven Pelican	Owned	Diving	Subsea 7(Cayman Vessel Company)	N/A	DNV	1A1 SF HELDK DSV-I and III E0 F-AMC DYNPOS-AUTRO	3	2*2757kW azimuth (Liaanen), 3*1100kW (Brunvoll), 1*912kW (Brunvoll)	Kongsberg	SDP 521+11	4 * 3000kW (Wichman)	94.1	79.5	18	6.55	670	Saturation System 18 man at 370m
Seven Pacific	Owned	Pipelay / Construction	Subsea 7 Limited	N/A	LR	+100A1, +LMC, UMS, DP(AA), CAC(3), EPN (N), ICC, UD strength for load of 10+/m2	2	3*2500kW azimuth (Wartsila), 1*2400kW retractable bow azimuth (Wartsila), 2*1500kW bow tunnel thrusters (Wartsila)	Kongsberg Simrad	SDP22	2*3360kW + 2*3840kW Diesel Electric	133.15		24	6.5	1700	2 * 1250 t carousels below deck and 3000t carousel or multiple reels on deck
Seven Navica	Owned	Pipelay	Subsea7 Vessel Company Ltd	N/A	DNV	1A1, SF, DYNPOS, AUTR, HL(2,8) DK+ HELDK-S	2	2*3000kW contra rotating azimuth (Aquamaster), 2*1300kW (Kamewa), 1*1200kW azimuth	Kongsberg	SDP-22	2*2600kW (Diesel Electric), 2*3700kW (Diesel Electric)	108.53	100.55	22.03	7.6	300	1*2200 te main reel, 1*250te piggy back reel, lay ramp system
Acergy Falcon	Owned	Pipelay	Acergy Shipping Ltd	N/A	DNV	1A1 ICE-1B HELDK DYNPOS-AUTR	2	5*LIPS CM-16 tunnel thrusters, 1305kW. 2*Aquamaster UL2001/6100 azimuth propulsion thrusters, 1*1200kW 1*1540kW.	Kongsberg	K-Chief 500 monitoring and control system	2*AEG 7000HP	152.85	139.2	21.37	7.516		Flex lay system. 1*carousel, capacity 1600t (depending on load spread) Rigid lay system. From 4-12", pipe welded, tested and coated through
Subsea Viking	Chartered	Construction	Eidesvik Shipping AS	Eidesvik AS	DNV	+1A1, SF, EO DYNPOS AUTRO, ICE-C LFL, SBM HELDK-SH, CRANE	3	2*2750kW Ulstein azimuth 2*1200kW Brunvoll tunnel, 1*1200kW Ulstein	Kongsberg	SDP 22 + 12	4*2610kW (MAK 9M25)	103	88.8	22	7.85	1100	1,200t underdeck product carousel. 2 WROVs
Normand Subsea	Chartered	ROV / Survey	Solstad Rederi	Solstad Shipping	DNV	+1A1, EO, DYNPOS, AUTR, SF, DK+, HELDK-SH, ICE-1C, CRANE, CLEAN DESIGN, DEICE, COMF-V (2), COMF-C(2), DK (+), PMS	2	2 * 3500kW azipods, 1 * 1500kW tunnel aft, 2 * 1500kW retractable azimuths, 1 * 2000kW tunnel forward	Kongsberg	SDP-21	4 * 3840 kW Wartsila	113.05	100.7	24	TBD	710	2 WROVs and 4 ObsROVs
Skandi Seven	Chartered	Construction	DOF CON AS	DOF Mgt	DNV	+1A1, SF, EO, DYNPOS AUTRO, DK+, Comf-V(3)C(3), HELDK, NAUT-AW, CRANE, ICE-C, CLEAN	3	1 * 1500kW tunnel, 2 * 1090kW gyro, 2 * 3000kW main azimuths with open fixed propellor	Kongsberg	SDP-21	4 * 2820 kW (MAN) 1 * 370kW emergency generator	120.7	105.2	23	7	1300	2 WROVs
Skandi Acergy	Chartered	Construction /Flexlay	DOF CON AS	DOF Mgt AS	DNV	1A1 ICE-C SF COMF-V(3)C(3) HELDK-SH CRANE EO DYNPOS-AUTRO NAUT-AW CLEAN DESIGN DK(+) TMON	2	Total 7. 2*1920kW tunnel thrusters. 2*1500kW retractable azimuths. 2*3000kW contra-rotating azimuths. 1*4000kW shaft propeller+rudder.			6*Man, 2*8L32/40, 4*6L32/40	156.9	137.7	27.00	8.5	2100	Flexlay system. 125t max tension, 4 and 2 track mode, tensioner length 3.5m, storage capacity 3000t on under deck carousel. 1*Carousel 23.6m diameter. Capacity for 8*300t deck reels (product dependent)
Far Saga	Chartered	IMR/ Survey	Farstad Supply AS	Farstad Shipping ASA	DNV	+1A1, SF, EO, DK(+), HL(2.8), COMF-V(3)C(3), Clean, DYNPOS-AUTR, FiFi I, FiFi II, HELDK-SH	2	4*Rolls Royce Marine AS tunnel +1 azimuth. 2*bow tunnel thruster 2400Hp, 2*stern tunnel thrusters 2100Hp, 1*azimuth bow thruster			2*RR Bergen (5400 eacj)	89.4	80.75	18.83	6.157	Main 665 & A-deck 197	N/A



FLEET STATISTICS (North Sea)

Vessel Name	ROVs On Board	LAR's System Depth (m) Rating	TMS Type	Vehicle Depth (m) Rating	Winch Max Capacity (m)	Umbilical Length (m)	LAR's Type	Cranes - Primary	Cranes - 2nd	Cranes - 3rd	Bunks
Seven Pelican	Lynx 1111		Garage					National Oilwell Telescope Jib SWL 120 Te	Hydralift Telescopic 5 Te @ 8-12m	Hydralift Telescopic 5 Te @ 8-12m	105
Seven Pacific	HER 18 HER 25	3000 3000	Top Hat Top Hat	3000 3000	3500 3500	3500 2996		Huisman Main Deck 250t @ 13m / 60t @ 36m,	Auxiliary deck crane 1 (Kenz) 30t @ 15m		100
Seven Navica								TTS - Norlift 60T @ 18m, 30T @ 29m 1040m	Hydramarine 2 * 3Te provision cranes	Grove crane 8.25 Te @ 1m	73
Acergy Falcon								National Oilwell max capacity 64t at 13M, wire	Bucyrus-Erie Co. Max capacity	Hydralift max capacity 30t at 10 M, wire	141
Subsea Viking	HER 4 HER 5 HER 10	3000 3000 3000	Top Hat Top Hat Top Hat	3000 3000 3000	3300 3500 3500	2500 1101 2500	Over the side launch Side door launch curser Moonpool	Huisman Jib SWL 100 Te @10m, 50Te @ 20m	N/A	N/A	70
Normand Subsea	Coug 1405, 1406, 1416 and 1417. HER 26 HER 27	1200 1200	Top Hat Top Hat	2000 2000	3500 3500	1600 1500	Moonpool Moonpool	National Oilwell AHC knuckle boom 140 Te	N/A	N/A	90
Skandi Seven								National Oilwell AHC knuckle boom 250 Te	2 * 3Te @ 15m auxiliary knuckle	N/A	120
Skandi Acergy	ACV 6 ACV 7	3000 3000	Top Hat Top Hat	3000 3000	3000 3000	3000 3000	Moonpool Moonpool	400t National Oilwell Varco, knuckle boom crane rated 3000msw with AHC. Harbour:	50t port side forward. 50t 100t AHC knuckle boom crane, 2000 msw.		140
Far Saga	SCV 27	3000	Top Hat	1500 (3000 but 1500 buoyancy)	3000	2000	Over the side launch	Hydramarine 100t HC and AHC. Main deck	#1 20t 600m wire, main deck port side.		63

Appendix 9 – OSPRAG Capping Device Brief

OSPRAG Capping Device

Information Brief

Date: August 12th 2011

Objective

This document was put together with the aim of providing operators who have subscribed to the development of the OSPRAG Capping Device with key information pertaining to the design of the system and its applicability as a North Sea drilling safety contingency. Amongst other areas, the intent is to assist operators in providing input to their OPEPs relating specifically to the Capping Device and how it fits into the operator's response plans.

This document does not cover all of the particulars associated with the OSPRAG Capping Device or all the considerations that need to be made for its deployment. A notable design document to be produced by the OSPRAG Capping device project team is the Functional Design Specification (FDS). As well an Operations & Maintenance Manual will be produced to outline key considerations associated with the utilization of the Capping Device. These two documents are however much more detailed and technical in nature than this brief.

Design Basis

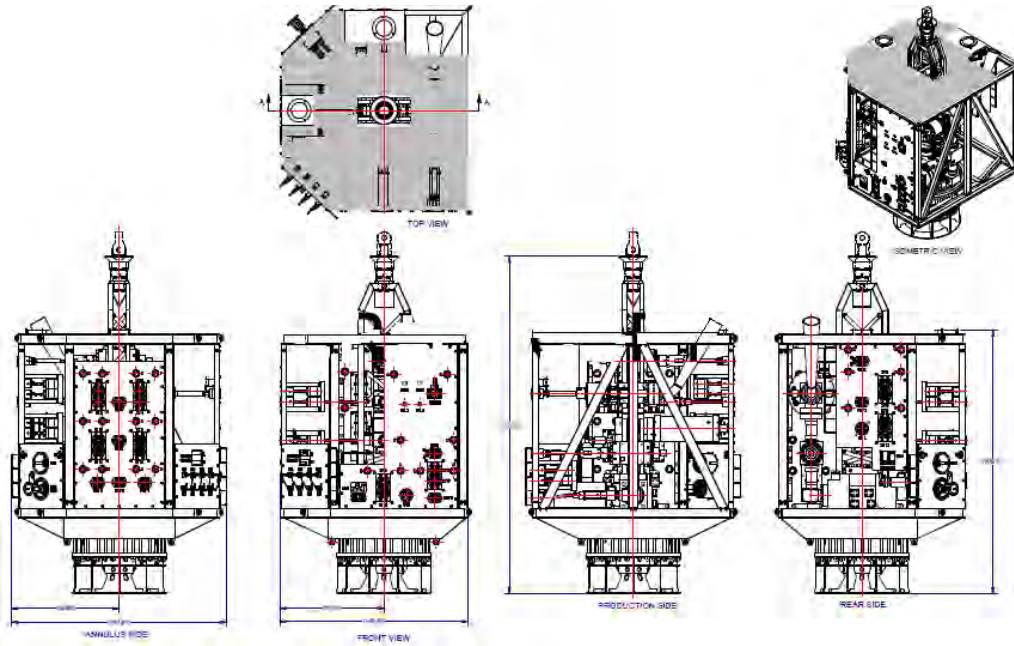
The OSPRAG Capping Device is designed to shut-in (and hold pressure) on a blown-out oil well. The major design particulars are summarized below. A schematic is also included, representing a view of the final design of the system (excluding Frame Assembly).

The Capping Device is designed and currently being built to accepted industry standards (or greater); any exceptions are approved by OSPRAG TRG. The fit, form, and function of each component within the system will be confirmed to meet or exceed design specifications through a Factory Acceptance Test (FAT) performed at assembly completion. A successful FAT will signify readiness and availability for utilization of the OSPRAG Capping Device.

- 15,000 psi / 250F rated throughout;
- 75,000bbls/day fluid handling capability – Flow Dynamics analyzed at well compositions up to GOR 3000 i.e. oil wells;
- Modular design, low weight (approx. 43t), road transportable;
- L=4.6m, W=3.9m, H=7.1m (~2m removable for transport);
 - Footprint=15.8m²; 9m² with no bottom plating used
- 5 1/8" vertical bore and 5 1/8" wing bore nominal size;
- Dual barrier redundant failure mode philosophy (ROV manual and hot stab actuated valves in series);
- Wellhead connector: H4 mandrel, 18.3/4" 15000 WP Annular piston design, lower gasket VX inlaid with alloy 625;
 - Transition adaptor, Vetco 18 3/4" H4 (VX-2) to API (BX-164), alongside
- Water depth specification 3,048m (10,000ft);
- Wire and drill pipe deployable - installation capability confirmed against wide range of North Sea available vessels and rigs;
- H₂S service material specification;
- Multiple P/T sensing and chemical injection points;
 - Six point hydrate inhibitor injection ring around wellhead connector
- Hydraulic fluid provision through ROV hot stab delivery and hydrate inhibitor through separate delivery system;
- 20 year design life - 1 year continuous immersion.



Adding to the above schematic is a cross sectional view layout drawing shown below. This shows multiple dimensions of the OSPRAG Capping Device including a fully plated Frame Assembly and ROV intervention skid. The plating will likely be reduced to a minimum following completion of a hydrate analysis.

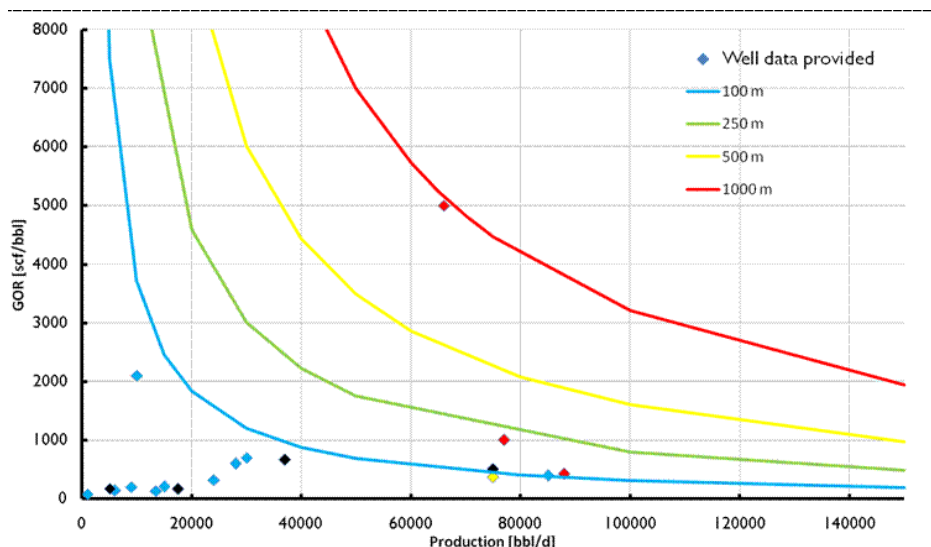


Computational Flow Dynamics (CFD)

Detailed CFD analysis was performed in order to assess land-out capability of the OSPRA Capping Device on a flowing (blown-out) well. This modelling of uplift force was done at various assumed operating conditions and well characteristics and verified through services of two independent engineering contractors using their own model calibrations. Additionally, forecast well characteristic data was solicited from UKCS operators (shallow water, high GOR data) and modelled to form an 'operating envelope' view of the CFD analysis. A detailed Technical Note on the CFD analysis is being produced by the project team.

The below graph summarizes the uplift force operating envelope within the variables of well flowrate and GOR, considered at four different water depths. A safety factor of x2 is applied in that an uplift force of 20 tonnes-forces (i.e. 196,200 N) is assumed as an upper limit whereas the total weight of the Capping Device in water is 40 tonnes.

While there is a high degree of confidence in the CFD analysis conducted, it should be held that the conclusions drawn are based purely on modelling and therefore carry a degree of error potential. The actual land-out capability of the Capping Device will be dependant on the exact blow-out scenario faced and the characteristics and conditions around it. It should also be noted that a hydrate mitigation analysis is being performed by the project team and will be integrated into the Technical Note.

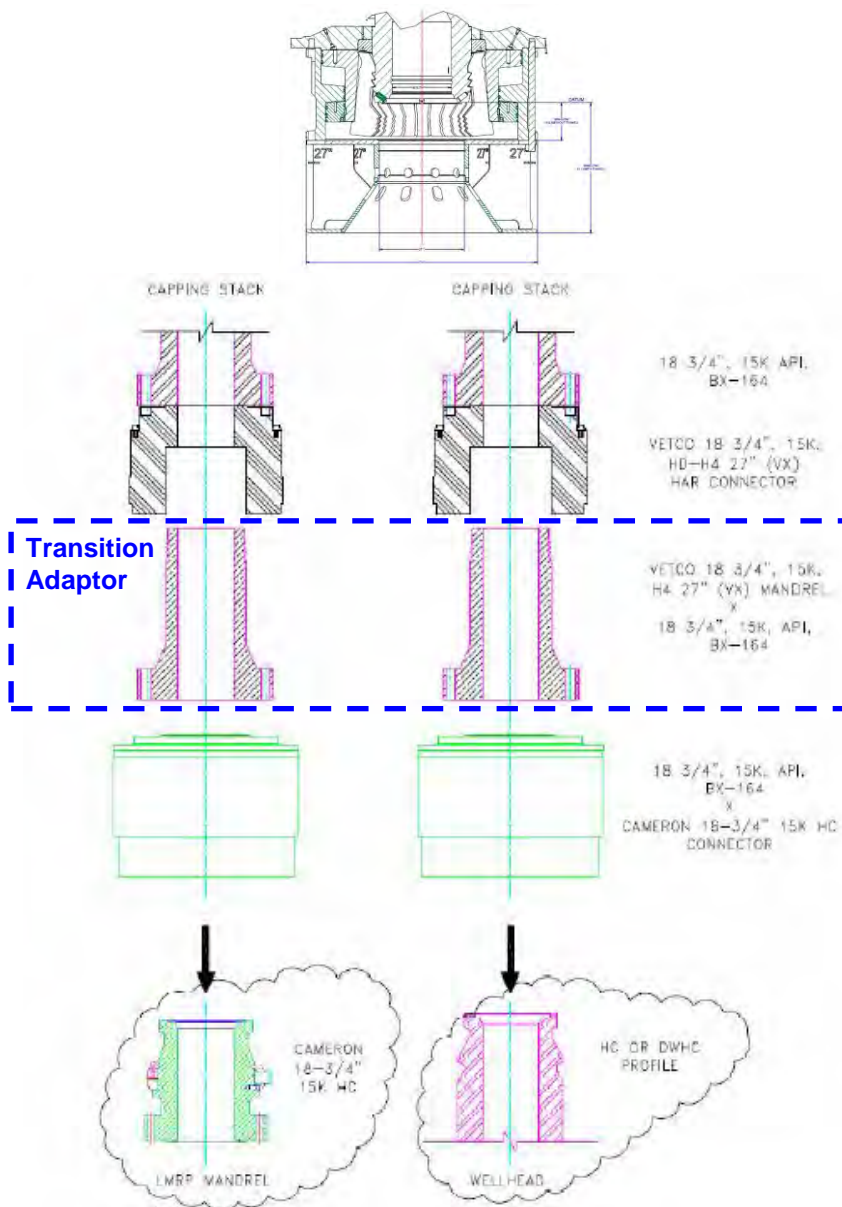


Connector Interface

The OSPRAG Capping Device includes an integrated bottom connector profiled to lock through hydraulic actuation onto a 18 3/4" (27" O.D.) type Vetco H4 Mandrel. The connector provides a metal to metal environmental seal with the wellhead housing, using a VX2 or VX/VT2 gasket which is retained within the Capping Device body.

Additionally, the OSPRAG Capping Device project team is working to deliver a transition adaptor from an H4 mandrel general profile to a an API standard flange (BX-164) connection. This to allow for flexibility to transition from the Capping Device to the widest possible range of wellhead connectors, most notably including the Cameron Hub profile. This is based on a review of wellhead, BOP and LMRP connector designs most common in the North Sea and a desire to cater to the most common interfaces, understanding that operators and/or rig contractors may need to carry-out additional work or have ancillary equipment on-hand in order to ensure compatibility to either the device connector or transition adaptor.

Below is a layout of the base case Vetco H4 Mandrel followed by a schematic displaying the functionality of the transition adaptor to be stored alongside the Capping Device.



Deployment

Provided below is a high level outline of the major steps envisaged as need in deploying the OSPRAAG Capping Device with the intention of well shut-in. These relate to an assumed 'base case' scenario, understanding that deployment plans need to allow for variations. The development of detailed deployment procedures is not within the scope of project team, most importantly because of the need for specificity in those procedures as it relates to supporting systems and logistics which will be in the remit of the utilizing operator to make available (guidance provided in next section).

1

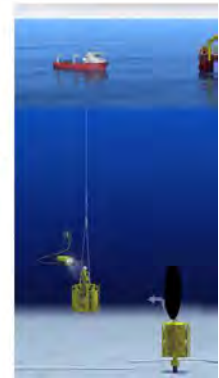
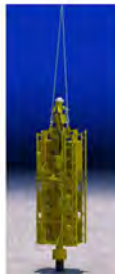
Assumptions

- Confirmation of loss of well control established
- Rig systems shut-in attempts confirmed unsuccessful
- Emergency Response and recovery of personnel/equipment/environment ongoing
- Determination made that well can and should be shut-in
- Equipment mobilization
 - Vessel(s), personnel – In accordance with a 'plan'
 - Subsea and surface dispersant capability
 - Subsea tooling – Survey, clearing, cutting
 - Capping Device
- Site ready for deployment of a capping system
- Capping Device offshore ready for deployment

2

Recover LMRP (if applicable/possible)

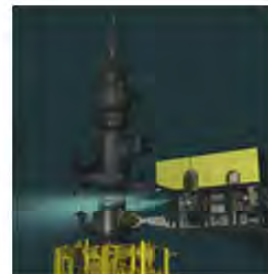
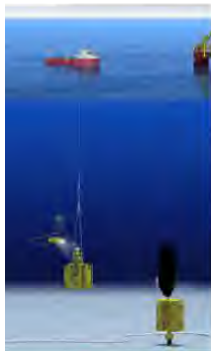
- Overboard and connect replacement MUX to LMRP
- Attach lifting slings to LMRP
- Unlock LMRP from BOP
- Recover LMRP to vessel



3

Installation

- Lower Cap offset from well until around 5m above and alongside BOP
- Ensure vertical bore valves are open
- Begin pumping methanol to base of Cap and translate over well centre; note that methanol is assumed given that is the most effective hydrate inhibitor but alternatives such as glycol would also work
- Lower Cap onto BOP whilst continuing pumping methanol (or alternative)
- Slack off lift wire tension
- Lock Capping Device to BOP using ROV
- Execute valve closure sequence while continuing to pump methanol (or alternative); monitor pressures thereafter



Notes:

- Required methanol volumes will be estimated by project team and documented in hydrate mitigation analysis of CFD Technical Note.
- ROV interfaces for the Capping Device (industry standard for subsea trees) to be documented in FDS document.

Operational Considerations

The following list includes key work fronts that should be considered by operators in planning for deployment of the OSPRAG Capping Device. Much of these considerations are outside of the scope of the OSPRAG Capping Device project so the list is intended to help operators' planning processes. These do not cover all possible considerations; rather they are a selection based on the evaluation of the project team.

- Transport of Capping Device from storage location to dock to move offshore.
- Site safety considerations for people given hazardous conditions presented. Notable provisions are for gas detection systems and Breathing Apparatus.
- Severe weather readiness, sea state evaluation and ability to keep vessels on station. Maintaining a tight watch circle and minimizing heave is a critical issue.
- Initial site survey, debris clearance around key access locations and possible cutting operations.
- Possible need for subsea dispersant injection to keep people able to safely work above plume.
- Nature of blow-out and wellhead/LMRP assembly integrity and orientation; readying wellhead/LMRP/BOP interface for connection with Capping Device. This includes availability of the needed adaptors (cross over mandrels) and connectors, matching-up with the relevant wellhead or rig interface requirements.
- Installation vessel availability including installation capability (drill pipe, wire) to meet Capping Device specifications. Crane capability and heave compensation is notably important.
- The need for any well condition specific Computational Flow Dynamics analysis for Capping Device land-out, both for uplift force considerations and hydrate inhibition. This specific analysis could identify minor modifications that could be implemented to the Capping Device ahead of deployment to make it optimally ready it for the scenario at hand. Examples include:
 - The addition of frame plating (fabricated and stored with Capping Device) to the bottom of the Capping Device frame assembly to optimize hydrate management. It should be noted that adding plates increases the bottom footprint of the Capping Device and therefore has an impact on its uplift force resistance capacity.
 - Tubing modifications to the hydrate inhibitor injection system integral to the Capping Device to expand the inhibitor injection capacity to accommodate pressure/temperature conditions.
 - The use of the guidance funnel on the Capping Device bottom. Various considerations apply in this regard but the general recommendation is that the use of the funnel is a beneficial feature.
- Lifting Frame capacity – the OPSRAG Capping Device Lifting Frame and Running Tool were designed to lift the device itself with some additional margin and so were rated up to 50 tonnes. It is recognised that operators may have an operational preference to deploy the Capping Device together with ancillary equipment (adaptor, connector, funnel etc) deemed needed for their well scenario. In that circumstance, the operator may need to consider a Lifting Frame (and related equipment) capable of greater lifting capacity or alternate means of lifting the Capping Device.
- ROV availability for visibility at leak source and guidance during installation as well as continuous monitoring (pressure, temperature, acoustic etc) and close surveillance at and around operating site. Generally, redundancy in ROV availability is important.
- Hydrate inhibition capability during initial installation; this will require provision of a delivery system (pumping spread, down line etc) for the selected fluid, needed fluid volumes and other interface details related to the completion of the selected delivery system.
- Information Technology infrastructure supporting data transmission (subsea-vessels-onshore) to facilitate effective and timely decision making.
- Possible need for local (subsea) hydraulic fluid banks to supplement ROV hot stab delivery for valve actuation. This is especially useful in scenarios of high water depth.



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