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DSV ADAMS CHALLENGE

DP Annual Trials

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FMEA PROVING TRIALS
OF
ADAMS CHALLENGE

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SUMMARY

The vessel's FMEA Proving Trials were conducted for Adams Offshore with the Shipyard representatives also in attendance.

The worst case is the failure of one high voltage switchboard section, which will cause the failure of one tunnel bow thruster and one after azimuth thruster. This will fail the bow retractable thruster if it is connected to the failed section at the time.

The trials highlighted one "A" Recommendation regarding the settings for the generator reverse power, which are set unrealistically high. These should be reset at a more realistic level, and a back up can then be instigated from the Power Management System.

There were twenty four "B" Recommendations made; some of these were due to time constraints on the availability of the vessel, others due to equipment commissioning delays.

Fanbeam manoeuvring accuracy tests are to be undertaken prior to commencing DP Operations using this equipment.

On the basis of compliance with IMO/IMCA Guidelines and Recommendations, the closing out of the "A" Recommendation and the correction of any unexpected results listed as "B" recommendations in section 5 of this report, the vessel meets the requirements for Class 2 DP operations within the normal operational limits of the vessel.

1. INTRODUCTION

1.1 Instructions

1.1.1 Global Maritime received instructions from Adams Offshore to carry out the scope of work identified below, under Purchase Order No.400/0035.

1.2 Scope of work

1.2.1 The scope of work consisted of:-

1. Attend FMEA Trials and record results

1.2.2 This report comprises of item (1) above.

1.3 Objective

1.3.1 The objective of the FMEA Trials is to identify the worst case failures and their effects on the position keeping performance of the vessel. Based on this, recommendations will be made to improve the performance or the safety of the vessel.

1.3.2 The vessel is classed by American Bureau of Shipping (ABS): Class ✠A1, circle E, ✠AMS, ✠DPS-2.

1.3.3 The study was carried out under the guidance of IMO 1994 Guidelines for Vessels with Dynamic Positioning Systems (ref: IMO MSC645 – June 1994).

1.4 Conduct of Trials

1.4.1 During the trials all relevant shipboard equipment was fully operational, with the exception of the Taut Wires which were not fully commissioned.

1.4.2 All tests were co-ordinated by the Shipyard Project Managers, with full regard to the safety of the vessel.

1.4.3 All tests were carried out on full DP, in realistic environmental conditions or with some varying load on the system induced by movements of the vessel. During the trials the shipyard and vessel's staff assisted in recording alarms and failures locally. Locally means not only on the DP console but also at the ECR, thruster room etc.

1.4.4 During failure tests the system was not reinstated until the DP operators, ECR staff and surveyor were satisfied that they understood the full effects of the failure and that all the information or indicators to show what has occurred have been noted.

1.4.5 If there were any doubts about a test, it was repeated. If test results were unexpected, then the test was repeated. Tests continue only when all those involved have been informed and where necessary suitable communications have been set up, e.g. DP console to thruster room. The tests were designed not only to prove power/thruster redundancy and DP capability after failures, but also that the operators have the necessary training and experience to use the system and deal successfully with such failures.

1.5 Personnel

1.5.1 The following personnel were in attendance during the trial:

NAME	POSITION
Artur Dybski	Captain
Joseph Sloman	Captain
Nicholas Cawthorn	Chief Officer
Przemyslaw Sloma	Senior DPO
Peter Kelly	DPO
Brian Eades	Chief Engineer
Antony Poole	Second Engineer
Aleksander Szalczynski	ETO
Alex Brown	Adams Owner's Representative
Rajeev Kumar	Adams Technical Manager
Barnabas Prakash	Adams Technical Superintendent
Jesus Gasalla	AB Technical Director
Miguel Angel Orrico	AB Project Manager
Julius Koefoed	Kongsberg Maritime
David Barton	Global Maritime Auditor
Mathew Bateman	Global Maritime Auditor

1.6 DP Location and Limitations

1.6.1 The trials were conducted, north of Zumaia and San Sebastian, Spain in water depths of about 80m, the prevailing winds at the time of the tests were NNE at 5 knots.

1.7 Reference Documentation

1.7.1 The following documents and drawings were used to assist with these trials:

FMEA – GM-45214-0508-49138.
Vessel Plans and Drawings.

2. VESSEL DETAILS

2.1 General

The vessel's particulars are as follows:-

Vessel Name:	DSV Adams Challenge
Built:	Astilleros Balenciaga S.A., Spain
Class:	ABS Class ✠A1(E)✠AMS
DP Notation:	DPS-2
Flag/Port of Registry:	United Kingdom/Aberdeen
Length Overall	85.74m
Beam	18.0m
Max. Operating Draft	5.75m
IMO No.	9407249

2.2 Trials

2.2.1 During the Trials, the vessel verified its capability to cope adequately with all simulated mechanical, electrical and computer control failures. This demonstrates that the DP control system, thrusters and power systems comply with redundancy requirements as applicable to Class 2 DP vessels.

2.3 Close Out List

No.	Subject	Close Out date
"A" Recommendations		
5.2.1	Generator reverse power tripping level to set.	25-03-09
"B" Recommendations		
5.3.1	Set and test generator frequency trips.	02-04-09
5.3.2	Reset high switchboard load levels on DP.	25-03-09
5.3.3	Commission and test Taut Wires.	25-03-09
5.3.4	Modify DP power available graphs.	25-03-09
5.3.5	Additional rotation points to be inputted to DP system.	25-03-09
5.3.6	Rectify aft thruster room Gyro repeater fault.	02-04-09
5.3.7	Fit protection covers to Emergency frequency converter stops on forward and aft Bridge panels.	02-04-09
5.3.8	Air receiver relief valves to be piped to deck.	

5.3.9	Protect Push buttons on Retractable Thruster CBs.	25-03-09
5.3.10	Alarm to be fitted for PMS field bus failure.	02-04-09
5.3.11	Alarm to be fitted for 440V bus-tie automatic activation.	25-03-09
5.3.12	440V Earth fault to remove.	07-04-09
5.3.13	Repair DP Alert system earth fault.	02-04-09
5.3.14	Remove Auto-pilot power cable from DPC.	02-04-09
5.3.15	Fit an alternative 24VDC supply for IAS alarms and beacons.	25-03-09
5.3.16	Fit telephone directories in thruster rooms.	02-04-09
5.3.17	Rectify fault in Forward Thruster Room alarm beacons and horn.	25-03-09
5.3.18	Rectify IAS server rebooting fault.	02-04-09
5.3.19	Check and correctly label Cable markings in DPU-1 & 2.	02-04-09
5.3.20	Commission Telephone tower lamps.	02-04-09
5.3.21	Replace HPR OS monitor.	25-03-09
5.3.22	Replace DP OS PC.	25-03-09
5.3.23	Test Azimuth feedback signal failures.	25-03-09
5.3.24	Test Wind sensor failures.	02-04-09
5.3.25	Test Fanbeam manoeuvring accuracy before use.	
“C” Recommendations		
5.4.1	Improve communications adjacent to DP Operating Station.	25-03-09

3. TRIALS & FINDINGS

3.1 Power Distribution

3.1.1 The majority of tests undertaken were completed satisfactorily as per the trial programme. The outstanding items are setting and testing of the reverse power and over and under frequency switchboard trips.

3.2 Engine and Machinery Systems

3.2.1 All tests were completed satisfactorily as per the trials programme.

3.3 DP Computers

3.3.1 All tests were completed satisfactorily as per the trials programme.

3.4 Thrusters

3.4.1 The majority of tests were completed satisfactorily as per the trials programme. Azimuth steering feedback failures to DP were not tested.

3.5 DP Reference Systems

3.5.1 All tests were completed satisfactorily as per the trials programme with the exception of the taut wires which were not fully commissioned and the wind sensors (due to lack of wind).

3.6 Personnel

3.6.1 The personnel on board at the time of the trials were mainly from the shipyard and their contractors. Owner's senior personnel were in attendance and they are all well experienced in operation of this type of vessel and displayed the competence necessary to safely operate it.

3.7 Capability Plots

3.7.1 Capability plots are in the program of the Kongsberg Maritime K-Pos, and the page can be viewed at any time.

4. CONCLUSIONS

4.1 Findings

4.1.1 The minimum reverse power setting of the generator circuit breakers is too high, and it is dynamically impossible to achieve this value. A method of reducing this value is to be implemented. PMS settings can be made at an even lower level.

4.1.2 The over and under frequency trips on all generators have yet to be set and tested adequately.

4.1.3 The maximum DP load is 80% of available power, however the high switchboard load alarm is raised at a much lower level. This alarm value is to be reset to a more realistic level.

4.1.4 The taut wires were not fully commissioned and require completion and adequate testing prior to vessel delivery to owners.

4.1.5 The total power graphs depicted on the DPOS can be confusing. At present a bar graph is depicted for each switchboard section even though the bus-tie is connected. A single graph depicting total available power would be more appropriate when the bus-tie is closed, but reverting to the current situation of individual power available graphs when operating with an open bus-tie.

4.1.6 The standard points of rotation in the DP Program are to be increased to include the immersion position of the taut wires and the "A" frame in the lowered condition.

4.1.7 The after thruster room Gyro repeater was not functioning correctly.

4.1.8 The emergency stop push buttons for the frequency converters on the Bridge consoles are too exposed and liable to accidental operation.

4.1.9 All of the compressed air receivers have relief valves that will vent directly into the machinery spaces, which is against the guidelines set down in IMCA M119 Rev.1, (page 4), which recommends that these relief valves vent directly to an open deck.

4.1.10 The on/off buttons on the retractable thruster main circuit breakers on each main switchboard section are too exposed and liable to accidental operation.

4.1.11 A hidden fault exists as an alarm is not raised on the failure of the primary PMS field bus module.

4.1.12 No alarm is raised on the automatic opening of the 440V bus-tie.

4.1.13 There are earth faults displayed on both the 440V switchboard and DP Alert system.

4.1.14 There is an unauthorised power connection to the DP system for the vessel's auto-pilot.

4.1.15 A secondary 24VDC power source is required for the IAS alarm beacons and horns.

4.1.16 There are no telephone directories posted in the forward or after thruster spaces for either the automatic or sound powered telephone systems.

4.1.17 The alarm beacons and horn do not work in the forward thruster room.

4.1.18 The Praxis IAS server No. 1 does not reboot smoothly after a power failure, requiring a minimum of 10 minutes before it can be reset.

4.1.19 The generator alarms on the Praxis IAS panels DPU 1 and DPU 2, have connections that are incorrectly marked.

4.1.20 The engine-room tower lamps for the telephone system have not been commissioned.

4.1.21 HPR OS 1 monitor burnt out during trials, and DP OS 1 computer displayed an intermittent fault and could not be reset for 30 minutes.

4.1.22 Steering Feedback signals from all azimuth thrusters to DP were not tested.

4.1.23 Wind sensor tests were not accomplished due to lack of wind.

4.1.24 Fan Beam manoeuvring accuracy tests were not accomplished. These are to be undertaken prior to commencing DP operations using this equipment.

4.1.25 The after bridge telephones are not adjacent to the DP OS.

5. RECOMMENDATIONS

5.1 General

5.1.1 Recommendations were made after the DP proving trials, in three categories:

- "A" is to comply with Class 2 DP, and to be implemented immediately.
- "B" is for serious consideration.
- "C" is for longer term consideration or for general improvement.

5.2 "A" Recommendations

5.2.1 Disconnection settings for reverse power on the generator circuit breaker are to be reduced. PMS settings can be set at a lower level.

5.3 "B" Recommendations

5.3.1 Test over and under frequency trips on all generators.

5.3.2 High switchboard load alarms on DP system are to be reset to reduce unnecessary alarms.

5.3.3 Taut wire commissioning to be completed and systems tested.

5.3.4 Total available power graphs on DP screen to be modified.

5.3.5 Input additional rotation points into the DP system, as per owner's requirements.

5.3.6 Repair fault on after thruster room gyro repeater.

5.3.7 Protect all frequency converter emergency stops on Bridge consoles.

5.3.8 All machinery space air receivers' relief valves are to be vented to deck.

5.3.9 Protect retractable thruster circuit breaker push buttons.

5.3.10 Fit an alarm for failure of on-line IAS PMS field bus module.

5.3.11 440V bus-tie automatic opening to raise an alarm on the IAS.

5.3.12 Rectify 440V earth fault.

5.3.13 Rectify earth fault on DP Alert system.

5.3.14 Remove unauthorized power supply from DPC.

5.3.15 Alternative 24VDC supply to be fitted to engine-room horns and beacons.

5.3.16 Telephone directories to fit in the thruster rooms.

5.3.17 Alarm beacons and horn to be made operational in the bow thruster room.

5.3.18 Rectify IAS server No. 1 rebooting fault.

5.3.19 Cable markings in DPU-1 and DPU-2 to be checked and marked correctly.

5.3.20 Tower lamps in engine-rooms to commission.

5.3.21 Replace HPR OS monitor.

5.3.22 Replace DP OS 1 PC.

5.3.23 Cable breaks for the steering feedback signals from azimuth thrusters to DP system to be tested and results recorded.

5.3.24 Wind sensors tests to complete.

5.4 "C" Recommendations

5.4.1 Re-site telephones or improve communications to other control stations from the DP OS.

6. EQUIPMENT STATUS

6.1 Thrusters and Propulsion

	BT 1	BT 2	AZ Fwd	AZ Port	AZ Stbd.
MAINTENANCE RECORDS CHECKED					
OUTSTANDING MAINTENANCE					
RUNNING HOURS					
LAST OIL ANALYSIS (DATE)					
LAST OIL ANALYSIS OK					
Remarks: Vessel is new.					

6.2 Diesel Engines

	DG 1	DG 2	DG 3	DG 4
MAINTENANCE RECORDS CHECKED				
OUTSTANDING MAINTENANCE				
LAST OIL ANALYSIS (DATE)				
RUNNING HOURS: AT PRESENT				
LAST MAJOR OVERHAUL				
Remarks: Vessel is new.				

6.3 Electrical Protection

Circuit Breakers (Tested every 2 Yrs)	Location	Date Tested	Company
690V SWB Switchboard Bus Tie		At shipyard	
440V SWB Switchboard Bus Tie		At shipyard	
110V SWB Switchboard Bus Tie		At shipyard	
Generator Breakers		At shipyard	
Thruster Breakers		At shipyard	

Remarks:
Vessel less than 6 months old.

6.4 DP Sensors

Sensor	Records Checked	Remarks
Gyro 1		Vessel is new.
Gyro 2		
Gyro 3		
Wind Sensor 1		
Wind Sensor 2		
Wind Sensor 3		
MRU 1		
MRU 2		
MRU 3		
DGPS 1		
DGPS 2		
HiPAP 350		
HiPAP 500		
LWTW 1		
LWTW 2		
MDL Fan Beam		

Remarks:

6.5 DP Computers

Maintenance checked?	N/A
Last software revision?	As KM supply.
Dates of last DP Control system software upgrade	No upgrades from new
Remarks:	

6.6 UPS

Unit	Battery check	Remarks
UPS 1	Yes	
UPS 2	Yes	
UPS 3	Yes	
All tested as part of KM CAT.		

6.7 Hardware Modification

Have there been any modifications since last annual trials?	No
Have modifications been thoroughly tested?	N/A
Have trials procedures (Part 2) been updated?	N/A

6.8 Capability Plots

Are the correct capability plots onboard?	In KM K-Pos system.
Are there verifying footprints onboard?	Will be added to Owner's DP Operations Manual.

7. FMEA PROVING TRIALS

EQUIPMENT SYSTEM :	**POWER GENERATION**
TEST NO. 1	**SUBSYSTEM: ELECTRICAL** **Port 690V Switchboard**

PURPOSE:

To simulate a short circuit of Port 690V Switchboard

METHOD :

- Vessel on DP.
- All generators on line.
- All thrusters on line.
- All 690/440/230/110V bus-ties open.
- Emergency Generator in automatic start position.

Trip generator(s) supplying Port bus bar.

EXPECTED RESULTS:

1. Blackout of Port 690/440/230/110V Bus bars.
2. Loss of Port Bow Thruster (BT1).
3. Loss of Port Azimuth.
4. Possible loss of Forward Azimuth if connected to the Port 690V bus bar.
5. EDG starts and connects to ESB if port MSB interconnection breaker is engaged.
6. All UPS consumers switch to battery back up. DP UPS1 power failure alarm on DP.
7. DP excursion within limits. Consequence Analysis warning.
8. Loss of LWTW1 winch and HiPAP 1 hoist motor supply. Taut wire rejected from DP.

RESULTS :

1. As expected.
2. As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.
7. As expected.
8. As expected.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 24-03-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 2	SUBSYSTEM: ELECTRICAL Starboard 690V Switchboard

PURPOSE:

To simulate a short circuit of Starboard 690V Switchboard

METHOD :

- Vessel on DP.
- All generators on line.
- All thrusters on line.
- All 690/440/230/110V bus-ties open.
- Emergency Generator in automatic start position.

Trip generator(s) supplying Starboard bus bar.

EXPECTED RESULTS:

1. Blackout of Starboard 690/440/230/110V bus bars.
2. Loss of Starboard Bow Thruster (BT2).
3. Loss of Starboard Azimuth.
4. Possible loss of Forward Azimuth if connected to the Starboard 690V bus bar.
5. EDG starts and connects to ESB if Starboard MSB interconnection breaker is engaged.
6. All UPS consumers switch to battery back up. DP UPS2 power failure alarm on DP.
7. DP excursion within limits. Consequence Analysis warning.
8. Loss of LWTW2 winch and HiPAP 2 hoist motor supply. Taut wire rejected from DP.

RESULTS :

1. As expected.
2. As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.
7. As expected.
8. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 24-03-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 3	SUBSYSTEM: ELECTRICAL Port 440V Switchboard

PURPOSE :

To simulate a short circuit of Port 440V Switchboard

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- 690V bus-tie closed.
- 440/230/110V bus-ties open.
- Emergency Generator in automatic start position.

Open 690/440V Port transformer secondary circuit breaker.

EXPECTED RESULTS :

1. Blackout of Port 440/230/110V bus bars.
2. Loss of BT1.
3. Loss of Port Azimuth.
4. Possible loss of Forward Azimuth if connected to the Port 690V bus bar.
5. EDG starts and connects to ESB if Port MSB interconnection breaker is engaged.
6. DP excursion within limits. Consequence Analysis warning.
7. All UPS consumers switch to battery back up. DP UPS1 power failure alarm on DP.
8. Loss of LWTW1 winch and HiPAP 1 hoist motor supply. Taut wire rejected from DP.

RESULTS :

1. As expected.
2. As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.
7. As expected.
8. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 24-03-09

EQUIPMENT SYSTEM :	**POWER GENERATION**
TEST NO. 4	**SUBSYSTEM: ELECTRICAL** **Starboard 440V Switchboard**

PURPOSE:

To simulate a short circuit of Starboard 440V Switchboard

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- 690V bus-tie closed.
- 440/230/110V bus-ties open.
- Emergency Generator in automatic start position.

1. Open 690/440V Starboard transformer circuit breaker.

EXPECTED RESULTS :

1. Blackout of Starboard 440/230/110V bus bars.
2. Loss of BT2.
3. Loss of Starboard Azimuth.
4. Possible loss of Forward Azimuth if connected to the Starboard 690V bus bar.
5. EDG starts and connects to ESB if Starboard MSB interconnection breaker is engaged.
6. DP excursion within limits. Consequence Analysis warning.
7. All UPS consumers switch to battery back up. DP UPS2 power failure alarm on DP.
8. Loss of LWTW2 winch and HiPAP 2 hoist motor supply. Taut wire rejected from DP.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.
7. As expected.
8. As expected.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 24-03-09

EQUIPMENT SYSTEM :	**POWER GENERATION**
TEST NO. 5	**SUBSYSTEM: ELECTRICAL** **Port 230V Switchboard**

PURPOSE :

To simulate a short circuit of Port 230V Switchboard

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- 690V bus-tie closed.
- 440/230/110V bus-ties open.
- Emergency Generator in automatic start position.

Open 440/230V Port transformer secondary circuit breaker.

EXPECTED RESULTS :

1. Blackout of Port 230V bus bar.
2. Alarm for loss of auxiliary power supplies to BT1, Port and (possibly) Forward Azimuth thrusters. Thrusters 'not ready' to DP.
3. DP excursion within limits. Consequence Analysis warning.
4. DP UPS1 and possibly 3 UPS' to battery back up.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.

COMMENTS :

230V also provides control voltage for frequency converter cooling system, so BT1, Port After Azimuth thrusters and (possibly) Retractable Azimuth are lost.

WITNESSED BY : David Barton	**DATE :** 24-03-09

EQUIPMENT SYSTEM :	**POWER GENERATION**
TEST NO. 6	**SUBSYSTEM: ELECTRICAL** **Starboard 230V Switchboard**

PURPOSE :

To simulate a short circuit of Starboard 230V Switchboard

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- 690V bus-tie closed.
- 440/230/110V bus-ties open.
- Emergency Generator in automatic start position.

Open 440/230V Starboard transformer circuit breaker.

EXPECTED RESULTS :

1. Blackout of Starboard 230V bus bar.
2. Alarm for loss of auxiliary power supplies to BT2, Starboard and (possibly) Forward Azimuth thrusters. Thrusters 'not ready' to DP.
3. DP excursion within limits. Consequence Analysis warning.
4. DP UPS2 and possibly 3 UPS' to battery back up.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.

COMMENTS :

230V also provides control voltage for frequency converter cooling system, so BT 2, Starboard After Azimuth thruster and (possibly) Forward azimuth (BT3) are lost.

WITNESSED BY : David Barton	**DATE :** 24-03-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 7	SUBSYSTEM: ELECTRICAL Port 110V Switchboard

PURPOSE :

To simulate a short circuit of Port 110V Switchboard

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- 690V bus-tie closed.
- 440/230/110V bus ties open.
- Emergency Generator in automatic start position.

1. Open 440/110V Port transformer circuit breaker.

EXPECTED RESULTS :

1. Blackout of Port 110V bus bar.
2. No.5 Transformer tripped.
3. Loss of some Bridge Equipment.
4. Loss of some lighting.
5. No loss of DP.
6. 24VDC ECR UPS No1 will revert to battery backup and should be switched over to ESB.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.

COMMENTS :

Port 110V supply is the primary supply for Bridge equipment. On failing this supply the Bridge equipment supply is transferred to 110V from ESB.

WITNESSED BY : David Barton	DATE : 22-03-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 8	SUBSYSTEM: Starboard 110V Switchboard

PURPOSE :

To simulate a short circuit of Starboard 110V Switchboard

METHOD :

- Vessel on DP.
- All generators on line.
- All thrusters on line.
- 690V bus-tie closed.
- 440/230/110V bus ties open.
- Emergency Generator in automatic start position.

1. Open 440/110V Starboard transformer circuit breaker.

EXPECTED RESULTS :

1. Blackout of Starboard 110V bus bar.
2. Loss of transformer 6.
3. Loss of some lighting.
4. No loss of DP.
5. ECR UPS N2 may revert to battery backup and should be switched over to ESB.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 22-03-09

EQUIPMENT SYSTEM :	**POWER GENERATION**
TEST NO. 9	**SUBSYSTEM: ELECTRICAL** **Engine Room 24V Service UPS 1 and 2**

PURPOSE :

To test endurance of UPS 1 and 2.

METHOD :

- Vessel on DP.
- Three generators on line. All thrusters on line.
- 690V bus-tie closed.
- 440/230/110V bus ties open.
- Emergency Generator in automatic start position.
-

1. With power from main supply, disconnect No.1 UPS supply breaker from Port 110V Lighting Panel QM16. Restore.
2. With power from 110V ESB supply, disconnect No.1 UPS supply breaker from 110V ESB. Restore.
3. With power from main supply, disconnect No.2 UPS supply breaker from Stbd. 110V Lighting Panel QM13. Restore.
4. With power from 110V ESB supply, disconnect No.2 UPS supply breaker from 110V ESB. Restore.
5. Fail UPS1 24V to Main switchboard. Observe results. Restore.
6. Fail UPS2 24V to Main switchboard. Observe results. Restore.
7. Disconnect both No.1 UPS 110V supplies. Test endurance for 30 minutes.
8. Disconnect both No.2 UPS 110V supplies. Test endurance for 30 minutes.

EXPECTED RESULTS :

1. Alarm. Manually switch over to ESB supply.
2. Alarm. Manually switch over to Port 110V supply.
3. Alarm. Manually switch over to ESB supply.
4. Manually switch over to Stbd. 110V supply.
5. No effect on MSB/DP. PMS PLC1 fails and bump less control transfer to PLC2.
6. No effect on MSB/DP. PMS PLC2 fails and bump less control transfer to PLC1.
7. Alarm. Switch to battery back up. 30 minutes endurance test ok.
8. Alarm. Switch to battery back up. 30 minutes endurance test ok.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.
7. As expected.
8. As expected.

COMMENTS :

Switch for Battery charger power sources not marked sufficiently.
Battery duration tested at FMEA Proving Trials on 26-02-09.

WITNESSED BY : David Barton	**DATE :** 02-04-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 10	SUBSYSTEM: ELECTRICAL Power Management System

PURPOSE :

Verify PMS performance with normal DP configuration for diving (3 gens and closed bus tie).

METHOD :

- Vessel on DP. Three generators and all thrusters on line.
1. Position vessel abeam of the wind/current.
2. With 3 generators online, increase load gradually to 80% and above.
3. Restore. Then increase propulsion demand / network loads abruptly until propulsion cutback or preferential tripping occurs.
4. Restore. With about 80% network load, emergency stop any one running generator with standby generator available.
5. Restore. With about 50% network load, emergency stop any one running generator with no standby generator available.
6. Restore. Simulate loss of kW signal to PMS. Conn. U09, 7 & 8 in DG CB panels. **

EXPECTED RESULTS :

1. System copes with high loads.
2. Power reduction to thrusters initiated by DP when bus loads are about 80% with no requirement for PMS to initiate cutback. Position excursion within limits.
3. At about 80% network load, possible power reduction to thrusters initiated by DP. PMS may initiate preferential tripping in the event DP initiated cutback response is slow. Position excursion within limits. Further increase or sustained load above 80% should result in propulsion cutback by PMS. No network instability. FC does not initiate a thrust reduction unless network instability occurs.
4. Breaker trips on under voltage/frequency. Preferential tripping may occur. Load reduction by PMS to avoid healthy generators being tripped. PMS brings on standby generator and network recovers in short span of time. Position excursion if any within acceptable limits.
5. Breaker trips on under voltage/frequency. Load reduction by DP to avoid healthy generators being tripped. Preferential tripping may occur. Position excursion if any within acceptable limits.
6. Alarm. Affected engine trips on PMS reverse power and standby engine started. Propulsion cutbacks and preferential tripping may occur.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.

COMMENTS : **(U10, 9 & 10 for x-over breakers on DG 2 and 3).

WITNESSED BY :	David Barton	DATE :	24-03-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 11	SUBSYSTEM: ELECTRICAL Power Management System

PURPOSE :

To test PMS Management of 690V Switchboard Sections.

METHOD :

- Vessel on DP.
- All thrusters on line.
- Two generators on line.
- All 690/440/230/110V bus ties open.
- Emergency Generator in automatic start position.

1. With No.1 DG on Port 690V bus bar and No.2 DG on standby, increase Port switchboard loading gradually until PMS starts and synchronises No.2 DG.
2. With No.2 DG on Port 690V bus bar and No.1 DG on standby, increase Port switchboard loading gradually until PMS starts and synchronises No.1 DG.
3. Repeat tests for Starboard Bus bar with Nos. 3 and 4 DGs.
4. Simulate a false bus tie status to PMS (Signal bus tie closed).

EXPECTED RESULTS :

1. No.2 DG starts and synchronises. Possible power reduction on thrusters if load is too high prior to extra DG coming on-line.
2. No.1 DG starts and synchronises. Possible power reduction on thrusters if load is too high prior to extra DG coming on-line.
3. As with DG 1 and 2 above for DG 3 and 4.
4. If the MSB droop/isochronous selection switch is in isochronous mode then, false bus tie status to PMS will result in shifting from droop to isochronous. This is visible in IAS mimic panels. One generator (priority 4) will shut down after few seconds.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.

COMMENTS :

Check Isochronous/Droop switch is in Isochronous position. If in Droop mode, then all generators will remain on line.

WITNESSED BY : David Barton	DATE : 23-02-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 12	SUBSYSTEM: Switchboard Performance on high load.

PURPOSE:

To check switchboard performance when subjected to high loads.

METHOD :

- Vessel on DP.
- All generators on line.
- All thrusters on line.
- 690V bustie closed
- 440/230/110V bus ties open.
- Emergency Generator in automatic start position.

1. Position vessel abeam of the wind/current.
2. Using Joystick thrust hard to port for 3 minutes.
3. Using Joystick thrust hard to starboard for 3 minutes.
4. Using Joystick thrust hard to port for 3 minutes.

EXPECTED RESULTS :

1. System copes with high loads. Possible power reduction to thrusters.

RESULTS :

1. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 25-02-09

EQUIPMENT SYSTEM :	**POWER GENERATION**
TEST NO. 13	**SUBSYSTEM: ELECTRICAL** **440V and 110V Emergency Switchboards**

PURPOSE :

To simulate a short circuit of the 440V and 110V Emergency Switchboards

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- 690V bus-tie closed.
- 440/230/110V bus ties open.
- Emergency Generator in automatic start position.

1. Disconnect supply from MSB by setting interconnect breakers in manual and open.
2. Stop EDG.

EXPECTED RESULTS :

1. EDG starts and restores ESB supply.
2. Blackout of 440V and 110V switchboard. Connected UPS(s) revert to battery backup.
3. No loss of DP.

RESULTS :

1. As expected.
2 As expected.
3. As expected.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 22-03-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 14	SUBSYSTEM: ELECTRICAL Automatic Voltage Regulators

PURPOSE :

To simulate AVR failure in droop mode.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- 690V bus-tie closed.
- 440/230/110V bus ties open.
- Emergency Generator in automatic start position.

1. Increase RPM manually on one generator.
2. Decrease RPM manually on one generator.
3. Simulate AVR failure over excitation. Relay K32 in back of DG panel.
4. Simulate AVR failure under excitation. Relay K31 in back of DG panel.

EXPECTED RESULTS :

1. Alarm. The engine will trip off of the switchboard on over frequency. Standby generator starts and connects.
2. Alarm. The engine will trip off of the switchboard on reverse power / under frequency. Standby generator starts and connects.
3. Alarm. The effected engine will trip off of the switchboard. Standby generator starts and connects. 'Open/loop cable alarm gen' may occur.
4. Alarm. The effected engine will trip off of the switchboard. Standby generator starts and connects. 'Open/loop cable alarm gen' may occur.

RESULTS :

1. As expected.
2 As expected.
3. As expected.**
4. As expected.**

COMMENTS :

**AVR Breaker Q01E also trips in front panel. Reset CB Fault button on MSB each time. High frequency of 63Hz and low frequency of 54Hz settings on generator Circuit Breakers. Switchboard trips on -225kW on reverse power. PMS trip set at -300kW.

WITNESSED BY : David Barton	DATE : 24-03-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 15	SUBSYSTEM:ELECTRICAL Frequency Converters

PURPOSE :

To test FC coolant pressure and high temperature cut outs.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.

Raise auxiliary LTFW temperature to allowable maximum (42°C).
For each thruster:

1. Increase thruster load to 100% and monitor time before FC coolant high temperature alarm is raised. (Thruster fails).
2. Let thruster idle until FC coolant temperature stabilizes, then fail auxiliary LTFW and increase load to 100% and monitor time until high temperature alarm is raised.
3. Test secondary coolant low pressure alarm in FC.

EXPECTED RESULTS :

1. FC HT alarm in appx 85 seconds. (50°C).
2. Thruster fails in appx 125 seconds. (55°C).
3. Thruster fails immediately (FC Shutdown). (Low Pressure Alarm set at 3bar).

RESULTS :

1. As expected.
2 As expected.
3. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 26-02-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 16	SUBSYSTEM:ELECTRICAL Frequency Converters

PURPOSE :

To test effect of control voltage failure from FC UPS.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.

For each Frequency Converter:

1. Disconnect main supply to UPS and test duration of batteries.
2. Disconnect output from UPS.

EXPECTED RESULTS :

1. Battery power for 30 minutes.
2. Converter fails.

RESULTS :

1. As expected.
2 As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 22-03-09

EQUIPMENT SYSTEM :	**POWER GENERATION**
TEST NO. 17	**SUBSYSTEM: ELECTRICAL** **Alarm System**

PURPOSE :

Check status of central alarm system and effect on DP.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- Main bus-tie closed.

1. Local test for audible/visual alarms.
2. Simulate failure of field bus main. (Terminals 18 on Field Bus panel under ECR IAS console).
3. Restore and fail backup field bus line. (Terminals 18 on Field Bus panel under ECR IAS console).
4. Restore and fail primary supply. QM 22 in 24V Port DC panel.
5. Restore and fail backup supply. (F4 in Praxis Panel).
6. Fail both supplies.
7. Restore and fail any one DPU. (QM 15 in Stbd. 24V Stbd. DC Panel and breaker F4 in Praxis Panel.

EXPECTED RESULTS :

1. Fully functional.
2. Change over to backup field bus. Alarms and printout. No effect on D.P.
3. Alarm.
4. Alarm. Printout. IAS functional. No effect on D.P.
5. Alarm. Printout. IAS functional. No effect on D.P.
6. Alarm. No effect on D.P.
7. Alarms. Failure of DPU detected. No other DPU / field bus failure.

RESULTS :

1. As expected.
2 As expected. XP Main Link Not Present Alarm and each DPU in alarm on System Diagnostics page.
3. As expected. Alarms as (2).
4. No Alarm – **See Recommendation**.
5. As expected. 24VDC Alarm System Failure. (After 20 minutes also an alarm under console).
6. As expected. Server 1 does not reboot immediately – **See Recommendation.**
7. As expected. Many alarms of type “FB1 Board 1 Not Present”.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 23-02-09

EQUIPMENT SYSTEM :	**POWER GENERATION**
TEST NO. 18	**SUBSYSTEM: GENERATORS** **Fuel System**

PURPOSE :

Testing of Fuel Tank Low Level Alarms.

METHOD :

1. Lower set point on alarm system to above actual tank level on Port service tank, restore.
2. Lower set point on alarm system to above actual tank level on Port settling tank, restore.
3. Lower set point on alarm system to above actual tank level on Stbd. service tank, restore.
4. Lower set point on alarm system to above actual tank level on Stbd. settling tank, restore.
5. Open circuit fuel tank low-level sensor on emergency gen. tank, restore by disconnecting one wire at level switch..

EXPECTED RESULTS :

1. Alarm activated.
2. Alarm activated.
3. Alarm activated.
4. Alarm activated.
5. Alarm activated.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 20-02-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 19	SUBSYSTEM: GENERATORS Fuel System

PURPOSE :

Simulate failure of Fuel filter differential alarms.

METHOD :

1. Test fuel filter differential alarms for all DGs. Disconnect terminal XM7-11in control panel on engine.
2. Test fuel low pressure alarms for all DGs. Close valve on PX101 and slacken adjacent pipe union.

EXPECTED RESULTS :

1. Alarm activated.
2. Alarm activated.
3. Alarm activated.
4. Alarm activated.

RESULTS :

Test	DG 1	DG 2	DG 3	DG 4
1. Diff. Alarm.	As expected.	As expected.	As expected.	As expected.
2. LP. Alarm.	As expected.	As expected.	As expected.	As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 20-02-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 20	SUBSYSTEM: GENERATORS Cooling System

PURPOSE :

Testing of HTFW and LTFW Systems.

METHOD :

- Vessel on DP.
- All generators on line.

1. Open circuit low level alarm on Port LTFW header tank, restore.
2. Open circuit low level alarm on Stbd. LTFW header tank, restore.
3. Open circuit low level alarm on Port HTFW No. 1 header tank, restore.
4. Open circuit low level alarm on Port HTFW No. 2 header tank, restore.
5. Open circuit low level alarm on Stbd. HTFW No. 3 header tank, restore.
6. Open circuit low level alarm on Stbd. HTFW No. 4 header tank, restore.

EXPECTED RESULTS :

1. Alarm activated.
2. Alarm activated.
3. Alarm activated.
4. Alarm activated.
5. Alarm activated.
6. Alarm activated.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.

COMMENTS :

Method: Disconnect one cable at each level switch.

WITNESSED BY : David Barton	DATE : 20-02-09

EQUIPMENT SYSTEM :	**POWER GENERATION**
TEST NO. 21	**SUBSYSTEM: GENERATORS** **Cooling System**

PURPOSE :

Simulate failure of HTFW and LTFW systems.

METHOD :

1. Test LTFW low pressure alarm on all Generator Engines. Close valve to PX 471 and slacken adjacent pipe union.
2. Test HTFW low pressure alarm on all Generator Engines. Close valve to PX 401 and slacken adjacent pipe union.
3. Test Auxiliary LTFW low pressure alarms on Port and Starboard systems. Close cock to pressure switch supply line from LTFW main outboard of port and starboard pump discharges.

EXPECTED RESULTS :

1. LTFW Alarms function correctly.
2. HTFW Alarms function correctly.
3. Auxiliary LTFW Alarms function correctly.

RESULTS :

Test	DG 1	DG 2	DG 3	DG 4
1. LTFW	As expected.	As expected.	As expected.	As expected.
2 HTFW	As expected.	As expected.	As expected.	As expected.
3. Port Auxy LTFW	As expected.			
4. Stbd. Auxy LTFW	As expected.			

COMMENTS :

Standby pump started locally.

WITNESSED BY : David Barton	**DATE :** 20-02-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 22	SUBSYSTEM: GENERATORS Cooling System

PURPOSE :

Simulate failure of Sea Water Cooling systems.

METHOD :

1. Test Port SW system low pressure alarm. Open cock on LTFW cooler inlet.
2. Test Stbd. SW System low pressure alarm. Open cock on LTFW cooler inlet.

EXPECTED RESULTS :

1. Alarm functions correctly – stand by pump to be started manually.
2. Alarm functions correctly – stand by pump to be started manually.

RESULTS :

1. As expected.
2 As expected.

COMMENTS :

Standby pump started locally.

WITNESSED BY : David Barton	DATE : 20-02-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 23	SUBSYSTEM: GENERATORS Compressed Air System

PURPOSE :

Simulate failure of Compressed Air systems.

METHOD :

- Vessel on DP.
- All generators on line.
- All thrusters on line.

1. Isolate the start air system and drain the system (isolation valves on receivers).
2. Isolate the working air receiver and drain the system.

EXPECTED RESULTS :

1. Alarm – generators continue to run.
2. Alarm – generators continue to run. Retractable thruster remains clutched. Brakes for azis / retractable remain disengaged. LWTW if in operation will continue operation until internal reservoir is depleted.

RESULTS :

1. As expected.
2 As expected.

COMMENTS :

Engines can only be stopped manually by fuel lever.

WITNESSED BY : David Barton	DATE : 26-02-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 24	SUBSYSTEM: GENERATORS Lubricating Oil System

PURPOSE :

To simulate failure of Lub Oil system.

METHOD :

For each generator:

1. Simulate low LO pressure alarm. Close valve to PT201 and valve below, then slacken adjacent pipe union.
2. Simulate low low LO pressure alarm. Close valve to PSZ 201 and slacken adjacent pipe union. Located starboard aft of each engine adjacent to flywheel.
3. Open circuit low sump level alarm. Open circuit alarm, so short across terminals in table below:

	Praxis Panel and connection no.
No.1 DG	DPU-1, X107.6 A and B
No.2 DG	DPU-1, X113.6 A and B
No.3 DG	DPU-2, X119.6A and B
No.4 DG	DPU-2, X125.6A and B

EXPECTED RESULTS :

1. Alarm. NB this pressure transmitter can cause the engine to shut down if too much pressure is lost.
2. Shutdown alarm in ECR and on Local control panel fwd. outboard of main engines.
3. Alarm.

RESULTS :

Test	DG 1	DG 2	DG 3	DG 4
1	As expected.	As expected.	As expected.	As expected.
2	As expected.	As expected.	As expected.	As expected.
3	As expected.	As expected.	As expected.	As expected.

COMMENTS :

Nos. 2 & 3 sump low level alarms are not correctly marked in Praxis panels.

WITNESSED BY : David Barton	DATE : 20-02-09

EQUIPMENT SYSTEM :	**POWER GENERATION**
TEST NO. 25	**SUBSYSTEM: GENERATORS** **Governor Systems**

PURPOSE :

To simulate governor failures.

METHOD :

- Vessel on DP.
- Three generators and all thrusters on line.

For all generators:

1. Disconnect main supply to Woodward 723 Digital Control. Restore.
2. Disconnect auxiliary supply to Woodward 723 Digital Control. Restore.
3. Disconnect Woodward 723 Digital Control output to governor. (Conn. 21).
4. Disconnect load sharing link between Woodward 723 Digital Controls. (Conn 9).
5. Short circuit load sharing line. (Conn. 9/10).
6. Disconnect one speed pick up to Woodward 723 Digital Control. (Conn 11).
7. Disconnect second speed pick up to Woodward 723 Digital Control. (Conn 13).
8. Disconnect both speed pick ups to Woodward 723 Digital Control. (Conn. 11& 13?.

EXPECTED RESULTS :

1. Alarm.
2. Alarm.
3. Engine shuts down. PMS may reduce power/thrusters until system stabilises.
4. Alarm. Load imbalance will occur between generators. Affected generator generally loses power, ultimately being disconnect from the SWBD on reverse power. However, generator response may differ based on generator settings / characteristics.
5. Bus frequency will drop the magnitude of which will be about 2.0 – 2.5Hz depending on system load. (More load, more drop).
6. Minor Governor Alarm. Engine continues as normal.
7. Minor Governor Alarm. Engine continues as normal.
8. Major Governor Alarm, engine shuts down.

RESULTS :

Test	DG 1	DG 2	DG 3	DG 4
1	As expected.	As expected.	As expected.	As expected.
2	As expected.	As expected.	As expected.	As expected.
3	As expected.	As expected.	As expected.	As expected.
4	As expected.	As expected.	As expected.	As expected.
5	As expected.	As expected.	As expected.	As expected.
6	As expected.	As expected.	As expected.	As expected.
7	As expected.	As expected.	As expected.	As expected.
8	As expected.	As expected.	As expected.	As expected.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 26-02-09

EQUIPMENT SYSTEM :	**POWER GENERATION**
TEST NO. 26	**SUBSYSTEM: GENERATORS** **Governor Systems**

PURPOSE :

To simulate governor failures. (Continued from Test 25).

METHOD :

- Vessel on DP.
- Three generators and all thrusters on line.

For all generators:

9. Disconnect Run/Stop Input line. (Conn. 29).
10. Disconnect Increase Speed input. (Conn. 30).
11. Disconnect Decrease Speed input. (Conn. 31).
12. Disconnect Circuit Breaker Input line. (Conn. 32).
13. Disconnect Unload Input line. (Conn. 33).
14. Disconnect Isochronous/droop input line. (Conn 34).
15. Disconnect Generator Load Feedback signal line. (Conn. 43).

EXPECTED RESULTS :

9. Engine stop cannot be activated by 723, only by engine electro-pneumatic stop.
10. No effect on running engine, (used for synchronization purposes).
11. No effect on running engine, (used for synchronization purposes).
12. Engine will go to droop mode. (It will gradually increase or decrease load depending on system load and frequency).
13. No effect on running engine.
14. Engine will switch to droop mode. Imbalances may develop with other online generators.
15. Engine will switch to droop mode. Imbalances may develop with other online generators. Minor WW723alarm and 5% load differential alarms activated.

RESULTS :

Test	DG 1	DG 2	DG 3	DG 4
9	As expected.	As expected.	As expected.	As expected.
10	As expected.	As expected.	As expected.	As expected.
11	As expected.	As expected.	As expected.	As expected.
12	As expected.	As expected.	As expected.	As expected.
13	As expected.	As expected.	As expected.	As expected.
14	As expected.	As expected.	As expected.	As expected.
15	As expected.	As expected.	As expected.	As expected.

COMMENTS :

Item 14 & 15 - Affected generator generally loses power, ultimately being disconnect from the SWBD on reverse power. However, generator response may differ based on generator settings / characteristics.

WITNESSED BY : David Barton	**DATE :** 26-02-09

EQUIPMENT SYSTEM :	**POWER GENERATION**
TEST NO. 27	**SUBSYSTEM: GENERATORS** **Power Management System**

PURPOSE :

Verify effect of PMS failures.

METHOD :

- Vessel on DP.
- Three generators and all thrusters on line.

1. Fail primary PMS unit. (PLC units A-100 or A-200 in PMS panel).
2. Restore and fail backup PMS unit. (PLC units A-100 or A-200 in PMS panel).
3. Fail one of the redundant field bus communication lines. (Cables under A-100 and A 200).
4. While on PMS, force bus-tie open.
5. Fail both PMS units.

EXPECTED RESULTS :

1. Alarms and fails over to backup unit.
2. Alarms.
3. Alarms. No loss of PMS functionality.
4. Alarms. Cutback on any section with inadequate generators. PMS connects standby generator to concerned section if necessary. All generators on droop mode.
5. Droop alarms on IAS for all online generators. Switchboard reverts to manual control on droop mode with no DP position excursion.

RESULTS :

1. As expected. Fail Redundancy System Alarm on PMS. PMS Failure Alarm on IAS.
2 As expected. Fail Redundancy System Alarm on PMS. PMS Failure Alarm on IAS.
3. Not as expected. Fail Controlnet Channel # Alarm did not sound.
4. As expected.
5 As expected.

COMMENTS :

F100 = A-100 supply. F200 = A-200 supply. F300 = supply for monitor panel.
To restart PLC it takes about one minute whilst PLC starts, synchronizes and on line.
Item 4. Operator may need to balance loads. With rapid variation in loads manual synchronization and generator connection may be required.

WITNESSED BY : David Barton	**DATE :** 23-02-09

EQUIPMENT SYSTEM :	THRUSTERS
TEST NO. 28	SUBSYSTEM: BOW TUNNEL THRUSTERS Signal and Hydraulic Failures

PURPOSE :

To simulate thruster signal failures.

METHOD :

- Vessel on DP.
- Three generators on line. All thrusters on line.

For each tunnel thruster:

1. Fail RPM command signal from DP to TCU. (X6, 1/2 in TCU) Restore.
2. Fail RPM command signal from TCU to FC. (X4,11/12 in TCU) Restore.
3. Fail RPM feedback from FC. (X4, 15/16 in TCU).
4. Fail RPM feedback signal from TCU to DP. (X6, 3/4 in TCU) Restore.
5. Fail motor running signal FC to TCU. (X06, 51/52 in FC) Restore.
6. Fail Encoder feedback to FC. (X05, 2 in FC) Restore.
7. Test gravity tank low level alarm. (Remove plug).

EXPECTED RESULTS :

1. Thruster 'Not Ready' Alarm and rejected from DP. FU Major and Minor Alarms on TCU panel.
2. Feedback frozen at last known value. RPM Prediction Error on DP. Remained in DP. Speed reference alarm on FC panel.
3. RPM frozen. FU Minor alarm on TCU panel. RPM Prediction Error on DP. Wire break Eng. TCU alarm.
4. Thruster # Open Loop Cable Break Alarm. RPM indication frozen on TCU/FC. DP prediction alarms may occur and revert to estimated feedback. Thruster # Input RPM error alarm.
5. Thruster 'Not Ready', Rejected from DP.
6. Rejected from DP. FC stopped. Failure Alarm on FC start panel on Fwd Bridge Console. Glitch – Error Encoder on FC panel.
7. Alarm working. BT1 - inboard tank. BT2 – outboard tank.

RESULTS :

1. As expected.
2. As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.
7. As expected.

COMMENTS : Alarms identical for both tunnel thrusters**.**

WITNESSED BY : David Barton	DATE : 24-03-09

EQUIPMENT SYSTEM :	THRUSTERS
TEST NO. 29	SUBSYSTEM: RETRACTABLE AZIMUTH THRUSTER Power Supplies

PURPOSE :

To check that 690V and 440V power supplies are sourced from the same side of the switchboards.

METHOD :

1. Bus-tie cascading.
2. Ensure retractable thruster 690V and 440V supplies are sourced from the same side of switchboard.
3. Ensure dual breakers supplying same consumers are interlocked.
   (690V ROV / Retractable / 440V ESB / Retractable / ROV.
4. Ensure dual breakers for Nos. 2 & 3 generators are interlocked.

EXPECTED RESULTS :

1. All lower voltage bus-ties open and alarms on IAS.
2. Thruster supplies are correctly configured.
3. Two circuit breakers from each SWBD side cannot be engaged simultaneously.
4. Breakers from one generator to each SWBD section cannot be engaged simultaneously.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 02-04-09

EQUIPMENT SYSTEM :	**THRUSTERS**
TEST NO. 30	**SUBSYSTEM: RETRACTABLE AZIMUTH THRUSTER** **Hydraulic System**

PURPOSE :

To simulate hydraulic system failure.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.

1. Simulate complete loss of steering pressure, restore.
2. Simulate steering pump failure of pump 1. Restore and repeat for steering pump 2. Restore.
3. Check start inhibits by low oil pressure and zero position, restore.
4. Simulate low-level of HPU tank, restore.
5. Simulate gearbox header tank low level alarms.

EXPECTED RESULTS :

1. Alarm thruster stops. FC remains running.
2. Thruster continues to steer, but more slowly when one pump in operation.
3. Thruster will not start.
4. Alarm, HPU tank low level.
5. Alarm: Upper /Lower Gearbox tank low level.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 26-02-09

EQUIPMENT SYSTEM :	THRUSTERS
TEST NO. 31	SUBSYSTEM: RETRACTABLE AZIMUTH THRUSTER Signal Failures

PURPOSE :

To simulate signal failures.

METHOD :

- Vessel on DP.
- Three generators on line. All thrusters on line.

1. Fail RPM command signal from DP to TCU, (X6, 3/4 TCU) restore.
2. Fail RPM command signal from TCU to FC, (X7, 1/2 in FC) restore.
3. Fail RPM feedback signal from FC to TCU, (X7, 7/8 in FC) restore.
4. Fail RPM feedback signal from FC to DP, (X7, 11/12 in FC) restore.
5. Fail steering signal from DP to TCU, (X6, 1/2 in TCU) restore.
6. Fail steering feedback from Thruster to DP, (WU3 U35, X2, 1, 3, 4 & 6) restore.
7. Fail Motor running feedback signal FC to TCU, (X6, 51/52 in FC) restore.

EXPECTED RESULTS :

1. Azimuth Not Ready Alarm, RPM frozen. Deselected from DP.
2. RPM Prediction Error Alarm on DP. RPM frozen. FU Major and Minor Alarms on TCU.
3. FU Minor Alarm on TCU. RPM normal.
4. Azi input error RPM. RPM frozen. Open Loop Cable Break Alarm on DP. Thruster working normally on estimated feedback.
5. Thruster Not Ready Alarm and rejected from DP. FU Major and Minor Alarms on TCU.
6. Aximuth frozen on DP, but still working. RPM OK. Prediction alarm.
7. Thruster not ready azimuth deselected from DP, also Azimuth failure alarm on IAS.

RESULTS :

1. As expected.
2. As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.
7. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 26-02-09

EQUIPMENT SYSTEM :	**THRUSTERS**
TEST NO. 32	**SUBSYSTEM:PROPULSION THRUSTERS AFT** **Hydraulic System**

PURPOSE :

To simulate hydraulic system failure.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.

1. Simulate loss of steering pump. Restore.
2. Check start inhibits by low oil pressure and zero position, restore.
3. Simulate low-level of HPU tank, restore.

EXPECTED RESULTS :

1. Alarm. Steering not working, thruster continues to run.
2. Thruster will not start.
3. Alarm, 'Gravity tank low level.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 26-02-09

EQUIPMENT SYSTEM :	THRUSTERS
TEST NO. 33	SUBSYSTEM: PROPULSION THRUSTERS AFT Signal Failures

PURPOSE :

To simulate signal failures.

METHOD :

- Vessel on DP.
- Three generators on line. All thrusters on line.

1. Fail rpm command signal from DP to TCU, (X6, 3/4 TCU) restore.
2. Fail rpm command signal from TCU to FC, (X7, 1/2 in FC) restore.
3. Fail rpm feedback signal from FC to TCU, (X7, 7/8 in FC) restore.
4. Fail rpm feedback signal from FC to DP, (X7, 9/10 in FC) restore.
5. Fail steering signal from DP to TCU, (X6, 1/2 in TCU) restore.
6. Fail steering feedback from TCU to DP, (Port WU3 U37,X2, 1,3,4 & 6. Stbd WU6 U65) restore.
7. Fail Motor running feedback signal FC to TCU, (X6, 45/46 in FC) restore.

EXPECTED RESULTS :

1. Thruster Not ReadyAlarm, deselected from DP, RPM fails set. Consequence analysis alarm.
2. RPM Prediction Error Alarm on DP. RPM fails set. FU Major and Minor Alarms on TCU.
3. Thruster input error RPM alarm, thruster works as normal. FU Minor Alarm on TCU.
4. Thruster input error RPM and Open Loop Cable Break Alarm on DP.RPM feedback indication frozen on DP, thruster works as normal on estimated feedback.
5. Thruster Not Ready Alarm and rejected from DP. FU Major and Minor Alarms on TCU.
6. Thruster frozen on DP. Prediction alarm.
7. Thruster not ready azimuth deselected from DP, also Azimuth failure alarm on IAS. Consequence analysis alarm.

RESULTS :

1. As expected.
2. As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.
7. As expected.

COMMENTS :

Port and Starboard Thruster test results the same.

WITNESSED BY :	David Barton	DATE :	24-03-09

EQUIPMENT SYSTEM :	THRUSTERS
TEST NO. 34	SUBSYSTEM:THRUSTER CONTROL CABINETS Power Supplies

PURPOSE :

To simulate failure of power supplies to Thruster Control Cabinets.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.

For all thrusters:

1. Fail main 24VDC supply. Restore.
2. Fail back up 24VDC supply. Restore.

EXPECTED RESULTS :

1. Alarm, system reverts to back up supply.
2. Alarm, system operates on mains supply.

RESULTS :

Test	Port Bow	Stbd. Bow	Fwd Azi	Port Azi	Stbd.Azi
1	As expected.	As expected.	As expected.	As expected.	As expected.
2	As expected.	As expected.	As expected.	As expected.	As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 24-03-09

EQUIPMENT SYSTEM :	THRUSTERS
TEST NO. 35	SUBSYSTEM:THRUSTER CONTROL Control and Emergency Stops

PURPOSE :

To check controls stations and emergency stops.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.

For each thruster:

1. Activate start/stop on bridge.
2. Activate Thruster emergency stops from DPOS, Bridge Aft, Bridge Fwd. ECR and locally.
3. Activate the emergency operation of each thruster. (Back Up).
4. Activate commands of thrusters from the different locations.
5. Test all wheelhouse controls while in DP.
6. Verify that all push buttons/controls that could impact the operation of a thruster while in DP by accidental manual operation are capped for protection.
7. Activate Generator emergency stops from Engine, Engine Control Panel and ECR.

EXPECTED RESULTS :

1. Thruster starts/stops.
2. Thrusters stop.
3. The thruster deselected from DP, operation by lever locally.
4. The commands are transferred to required location.
5. Control working from all stations.
6. All such controls are capped.
7. Generators stop.

RESULTS :

Test	Start/Stop	Emergency Stop	Emergency Operation	Thruster Commands
Bow 1	As expected.	As expected.	N/A	As expected.
Bow 2	As expected.	As expected.	N/A	As expected.
Azimuth Fwd	As expected.	As expected.	As expected.	As expected.
Azimuth Port	As expected.	As expected.	As expected.	As expected.
Azimuth Stbd	As expected.	As expected.	As expected.	As expected.
Generators	N/A	As expected.	N/A	N/A

COMMENTS :

WITNESSED BY : David Barton	DATE : 20-02-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 36	SUBSYSTEM: POWER SUPPLY UPS 1

PURPOSE :

To simulate failure of UPS 1.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Simulate mains failure.
2. Test battery endurance for 30 min.
3. Simulate fuse failure at fuses in battery box and cabinet (short circuit).

EXPECTED RESULTS :

1. UPS alarms local and on DP.
2. UPS runs on battery for 30 min.
3. Alarms on DP, connected equipment fails one by one.

F1 DPC-1
F2 K-Pos-1
F3 Alarm Printer
F4 DGPS-2 Power & Spotbeam Demodulator
F5 LTW-1 Power
F6 Spare
F7 Spare
F8 Fanbeam Power
F9 Fanbeam Display
F10 Gyro-1
F11 Wind Display 1
F12 DP Alert System

RESULTS :

1. As expected.
2 As expected.
3. As expected.

COMMENTS :

Output Voltage: 230.5VAC. Normal load: 3.7A.

WITNESSED BY : David Barton	DATE : 25-02-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 37	SUBSYSTEM: POWER SUPPLY UPS 2

PURPOSE :

To simulate failure of UPS 2.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Simulate mains failure.
2. Test battery endurance for 30 min.
3. Simulate fuse failure at fuses in battery box and cabinet (short circuit).

EXPECTED RESULTS :

1. UPS alarms local and on DP.
2. UPS runs on battery for 30 min.
3. Alarms on DP, connected equipment fails one by one.

F1 DPC-2
F2 K-Pos-2
F3 DGPS-1 Power
F4 DGPS-1 Inmarsat Demodulator
F5 HiPAP OS-2
F6 HiPAP Transceiver-2
F7 Gyro-2
F8 Wind Display -2
F9 Spare
F10 Hardcopy Printer
F11 Spare
F12 Spare

RESULTS :

1. As expected.
2 As expected.
3. As expected.

COMMENTS :

Output Voltage: 231.0VAC. Normal load: 5.3A.

WITNESSED BY : David Barton	DATE : 25-02-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 38	SUBSYSTEM: POWER SUPPLY UPS 3

PURPOSE :

To simulate failure of UPS 3.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Simulate mains failure.
2. Test battery endurance for 30 min.
3. Simulate fuse failure at fuses in battery box and cabinet (short circuit).

EXPECTED RESULTS :

1. UPS alarms local and on DP.
2. UPS runs on battery for 30 min.
3. Alarms on DP, connected equipment fails one by one.

F1 HiPAP OS-1
F2 HiPAP Transceiver-1
F3 HMS Pressure Sensor
F4 LTW-2 Power
F5 Gyro-3
F6 Wind Display -3
F7 HMS 100
F8 Spare
F9 Spare
F10 Spare
F11 Spare
F12 DP Alert System

RESULTS :

1. As expected.
2 As expected.
3. As expected.

COMMENTS :

Output Voltage: 231.0VAC. Normal load: 2.8A.

WITNESSED BY : David Barton	DATE : 25-02-09

EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 39	**SUBSYSTEM: NETWORK** **Network Control**

PURPOSE :

To simulate network failure of Networks A and B.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Fail comm. on Network A, restore.
2. Fail comm. on Network B, restore.

EXPECTED RESULTS :

1. Alarm, no affect on station keeping still comm. via net B.
2. Alarm, no affect on station keeping still comm. via net A.

RESULTS :

1. As expected.
2 As expected.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 25-03-09

EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 40	**SUBSYSTEM:COMPUTERS** **DP Computers**

PURPOSE :

To Simulate Computer Failure.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- Select all available reference systems.

DPC A On line:

1. Trip power supply to DPC-A and Observe position accuracy.

DPC B On line:

2. Trip power supply to DPC B and Observe position accuracy.

EXPECTED RESULTS :

1. Alarm, Loss of DPC A, automatic changeover to DPC B.
2. Alarm, Loss of DPC B, automatic changeover to DPC-A.

RESULTS :

1. As expected.
2 As expected.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 25-03-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 41	SUBSYSTEM: DP OPERATING STATIONS DP Console Operation.

PURPOSE :

To check correct operation of DP Operating Stations.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Fail supply to K-Pos OS-2 when OS-2 in use.
2. Fail supply to K-Pos OS-1 when OS-1 in use.
3. Check all pages on screen.
4. Change range and speed.
5. Lamp test.
6. Print page.

EXPECTED RESULTS :

1. Alarm, DPO to take control on OS-1 by pressing “Take” button.
2. Alarm, DPO to take control on OS-2 by pressing “Take” button.
3. All satisfactory.
4. OK.
5. OK.
6. OK.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 24-03-09

EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 42	**SUBSYSTEM: DPC CABINET** **DPC Power Supplies.**

PURPOSE :

To simulate fuse failure in DPC Cabinet.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Fail each fuse, by disconnecting one at a time, for each wait 30 seconds before reconnecting. If red LED light in operation, replace fuse with defective item.

EXPECTED RESULTS :

1. Alarm for fuse failure and loss of respective equipment if single supplied. No loss of position.

RESULTS :

Fuse	WU3-X11	WU3-X13	WU6-X81	WU6-X83
1	DPC-A	DPC-B	DPC-A	DPC-B
2	MRU2	Spare.	MRU1	
3	RSER + RMP power A.	RSER + RMP power A.	RSER + RMP power A.	RSER + RMP power A.
4	Rio Power A Failure.	Rio Power A Failure.	Rio Power B Failure.	Rio Power B Failure.
5	Spare.	Spare.	MRU3	Spare.
6	Spare.	Spare.	Spare.	Spare.
7	Spare.	Spare.	Spare.	Spare.

COMMENTS :

A rogue connection to supply the auto-pilot is connected – to be removed.

WITNESSED BY : David Barton	**DATE :** 24-03-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 43	SUBSYSTEM: COMPUTER CONTROL I/O Modules.

PURPOSE :

To simulate I/O module failure.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Fail each I/O board one by one, wait for possible longer term consequences and restore.

EXPECTED RESULTS :

1. Alarm, no affect on DP.

U31 RBUS connection lost to Hub A	U61 RBUS connection lost to Hub B
U32 1RSER Power Fail. RIO Power Fail.	U62 1RSER Power Fail. RIO Power Fail.
U33 2RSER Power Fail. RIO Power Fail.	U63 2RSER Power Fail. RIO Power Fail.
U34 34RMP Power Fail. RIO Power Fail.	U64 64RMP Power Fail. RIO Power Fail.
U35 35RMP Power Fail. RIO Power Fail.	U65 65RMP Power Fail. RIO Power Fail.
U36 36RMP Power Fail. RIO Power Fail.	U66 66RMP Power Fail. RIO Power Fail.
U37 37RMP Power Fail. RIO Power Fail.	U67 67RMP Power Fail. RIO Power Fail.
U41 41RMP Power Fail. RIO Power Fail.	U71 71RMP Power Fail. RIO Power Fail.

No single module failure results in a total loss of DP. Loss of sensors / references / thrusters and other signals in accordance with IO schedule.

RESULTS :

1. As expected.

COMMENTS :

After restoring each module, ensure to enable all sensors and select all thrusters.

WITNESSED BY : David Barton	DATE : 26-02-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 44	SUBSYSTEM: MANOEUVRING STATIONS cJoy Independent Joystick Control.

PURPOSE :

To test correct function of cJoy.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Take command fwd bridge location.
2. Take command aft bridge location.
3. Take command each wing location.
4. Take command on Joystick and test each position.
5. Test auto heading function.
6. Fail wind sensor input. (U31 X1 ½)
7. Fail Gyro input. (U31 X2 ½)
8. Take command on DP.

EXPECTED RESULTS :

1. Command transferred to fwd bridge.
2. Command transferred to aft bridge.
3. Command transferred to wing location.
4. Command transferred to Joystick.
5. Auto heading function working.
6. Alarm.
7. Alarm.
8. Command transferred to DP.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.
7. As expected.
8. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 25-02-09

EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 45	**SUBSYSTEM: JOYSTICK** **KPOS Manual Joystick function.**

PURPOSE :

Check function of DPOS joystick.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Move vessel by operating joystick, using sway, surge and yaw controls in turn.
2. Test joystick at local. Test environment compensation function.
3. Test joystick increase load on thrusters, simulate worst case failure, restore.
4. Test for short circuit on joystick change-over switch. (Shorted out terminals 6 and 7 on terminal block in DPOS 1 on inboard side).

EXPECTED RESULTS :

1. Vessel moves to commands.
2. DP takes care of environmental forces.
3. Check that the load increase/decrease for remaining thrusters.
4. No effect on DP system, control remains on main DP system.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. Control remained at the DPOS and could not be taken at the joystick.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 24-03-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 46	SUBSYSTEM: DP CONTROL Control Function

PURPOSE :

To test DP control function.

METHOD :

- Vessel on DP.
- Three generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Make a 20 metre move with the cursor.
2. When the vessel is half way, press present position. Try with low / medium / high gain settings.
3. When the vessel has stabilized, press previous set point.
4. Test low, medium and high gain setting functions.

EXPECTED RESULTS :

1. The vessel moves satisfactory towards the wanted position.
2. The vessel stops at present position, increased thruster activity to stop the vessel from original movement.
3. The vessel continues to move towards the previous set point.
4. Normal operation in all modes.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 24-03-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 47	SUBSYSTEM: DP CONTROL Rotation Centres

PURPOSE :

To check changing of centres of rotation.

METHOD :

- Vessel on DP.
- All generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Rotate 180^{o} and observe the reference systems offsets on the OS screen.
2. Note deviation from present position, change rotation centre and check changes of deviation.
3. Change rotation point (not CG) initiate rotation then take command on slave console.

EXPECTED RESULTS :

1. The reference system should stay within 2-3 metres from zero position.
2. Deviation to zero.
3. The rotation point remains as set.

RESULTS :

1. As expected.
2 As expected.
3. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 25-02-09

EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 48	**SUBSYSTEM: DP CONTROL** Mathematical Model.

PURPOSE :

To check mathematical model.

METHOD :

- Vessel on DP for at least 30 minutes.
- Three generators on line.
- All thrusters on line.
- Deselect all reference systems.

1. Observe vessel movements using DGPS. Stop after 5 mins.

EXPECTED RESULTS :

1. Vessel moves off position slowly. Record at 1 minute intervals.

RESULTS :

	Northing	*Easting*	*Weather Conditions:*	
Start	480748	558141	Heading:	330°
1 minute	747	141	Water Depth:	97m
2 minutes	747	141	Wind:	11kn 321°
3 minutes	747	140	Current:	1kn 001°
4 minutes	747	139		
5 minutes	747	138	As expected.	

COMMENTS :

Net movement 2m.

WITNESSED BY : David Barton	**DATE :** 24-03-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 49	SUBSYSTEM: DP CONTROL Consequence Analysis

PURPOSE :

To check system generation of relevant Consequence Analysis warnings.

METHOD :

- Vessel on DP.
- All generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Vessel stabilised on full DP. Stop one thruster. Wait three minutes. Restore thrusters.
2. Shut down or deselect one generator from system.

EXPECTED RESULTS :

1. Consequence analysis alarms.
2. Consequence analysis alarms.

RESULTS :

1. As expected.
2 As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 24-03-09

EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 50	**SUBSYSTEM: SENSORS** **MRU**

PURPOSE :

To simulate MRU failure.

METHOD :

- Vessel on DP.
- All generators on line.
- All thrusters on line.
- Select all available reference systems.

Select MRU 1
1. Switch off MRU 1. Restore.

Select MRU 2
2. Switch off MRU 2. Restore.

Select MRU 3
For MRUs
3. Simulate failure of MRU roll signal.
4. Simulate failure of MRU pitch signal.
5. Simulate failure of MRU heave signal.
6. Tilt one unit (if possible).

EXPECTED RESULTS :

1. Alarm for failure & Automatic change over.
2. Alarm for failure & Automatic change over.
3. Alarm, DP deselects faulty MRU.
4. Alarm, DP deselects faulty MRU.
5. Alarm, DP deselects faulty MRU.
6. MRU deselected.

RESULTS :

1. As expected.
2 As expected.
3. Weather too calm to initiate an alarm.
4. Weather too calm to initiate an alarm.
5. Weather too calm to initiate an alarm.
6. As expected. Tilted Nos. 1 and 2 units.

COMMENTS :

MRU 1 (typeMRU-5) is after unit. MRU 2 (type MRU-2) is middle unit. MRU 3 (type MRU-2) is forward unit.

WITNESSED BY : David Barton	**DATE :** 26-02-09

EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 51	**SUBSYSTEM: SENSORS** **Gyros.**

PURPOSE :

To simulate gyro failure.

METHOD :

- Vessel on DP.
- All generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Check Gyro headings.

Select Gyro 1.

2. Interrupt supply, restore. Disconnect serial line U32 X2.

Select Gyro 2.

3. Interrupt supply, restore. Disconnect serial line U62 X2.

Select Gyro 3.

4. Interrupt supply, restore. Disconnect serial line U33 X2.
5. Check settings for Gyro difference alarm and test it.

EXPECTED RESULTS :

1. Gyro headings agree.
2. Alarm for loss of Gyro.
3. Alarm for loss of Gyro.
4. Alarm for loss of Gyro.
5. Gyro difference alarm is set to 3^{o}, alarm in DP for difference.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 25-02-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 52	SUBSYSTEM: SENSORS Wind Sensors.

PURPOSE :

METHOD :

- Vessel on DP.
- All generators on line.
- All thrusters on line.
- Select all available reference systems.

For each wind sensor:

1. Interrupt signal or put hand in between sensor, check different alarms for speed and direction.
2. Check possible shielding.
3. Fail power to wind sensor.
4. Disconnect signal from any one wind sensor and verify deselection.

EXPECTED RESULTS :

1. Wind sensor mismatch alarm for speed and direction.
2. No obstructions.
3. Alarm. Faulty sensor voted out.
4. Alarms and rejected.

RESULTS :

Test	Wind 1 (Stbd. Fwd)	Wind 2 (Stbd. Aft)	Wind 3 (Port side)
1			
2	No obstruction.	No obstruction.	No obstruction.
3			
4	U32 X1	U62 X1	U33 X1

COMMENTS :

WITNESSED BY : David Barton	DATE : 26-02-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 53	SUBSYSTEM: SENSORS DGPS 1

PURPOSE :

To simulate failures of DGPS 1.

METHOD :

- Vessel on DP.
- All generators on line.
- All thrusters on line.
- Select all available reference systems.

For each DGPS:

1. Fail each differential link signal one at a time (Inmarsat, Spotbeam, IALA). Restore.
2. Fail all diff link signals.
3. Fail power supply to DGPS system. Restore.
4. Compare performance and take plots.
5. Rotate 180^{o} high speed.
6. Have both DGPS enabled in DP then rotate 360^{o} check blind spots.

EXPECTED RESULTS :

1. Only one correction lost. Other diff. correction signal still available.
2. Alarm DGPS rejected from DP.
3. Loss of DGPS alarm in DP.
4. Sufficient performance to the satisfaction of the auditor.
5. Stays in DP and no rejection. Set point held.
6. No blind spots.

RESULTS :

1. As expected.
2 As expected. No Differential Data Received Alarm.
3. As expected. Telegram Time Out Alarm on DP. Speed Error Alarm on Gyro1 and 3.
4. As expected.
5. As expected.
6. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 26-02-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 54	SUBSYSTEM: SENSORS DGPS 2

PURPOSE :

To simulate failures of DGPS 2.

METHOD :

- Vessel on DP.
- All generators on line.
- All thrusters on line.
- Select all available reference systems.

For each DGPS:

1. Fail each differential link signal one at a time (Inmarsat, Spotbeam, IALA). Restore.
2. Fail all diff link signals.
3. Fail power supply to DGPS system. Restore.
4. Compare performance and take plots.
5. Rotate 180^{o} high speed.
6. Have both DGPS enabled in DP then rotate 360^{o} check blind spots.

EXPECTED RESULTS :

1. Only one correction lost. Other diff. correction signal still available.
2. Alarm DGPS rejected from DP.
3. Loss of DGPS alarm in DP.
4. Sufficient performance to the satisfaction of the auditor.
5. Stays in DP and no rejection. Set point held.
6. No blind spots.

RESULTS :

1. As expected.
2 As expected. No Differential Data Received Alarm.
3. As expected. Telegram Time Out Alarm on DP. Speed Error Alarm on Gyro2.
4. As expected.
5. As expected.
6. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 26-02-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 55	SUBSYSTEM: SENSORS Fan Beam

PURPOSE :

To simulate failure of Fan Beam unit.

METHOD :

- Vessel on DP.
- All generators on line.
- All thrusters on line.
- Select all available reference systems.

1. Trip fuse to power supply. Restore.
2. Execute a 20 metre "box" manoeuvre by keeping one heading; observe DGPS co-ordinates to check orientation.
3. Make a 50 degrees heading change on the MDL.

EXPECTED RESULTS :

1. Alarm on DP and de-selection.
2. Satisfactory DP performance.
3. Satisfactory DP performance.

RESULTS :

1. F8 & F9 on UPS 1. As expected.
2 As expected.
3. As expected.

.

COMMENTS :

WITNESSED BY : David Barton	DATE : 23-02-09

EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 56	**SUBSYSTEM: SENSORS** **HiPAP 350.**

PURPOSE :

To simulate HiPAP failures.

METHOD :

- Vessel on DP. 3 generators on line. All thrusters on line. 690V bus-tie closed others open.
- Select all available reference systems.

1. Test HPR input to DP.
2. Lift one used for DP without deselecting.
3. Select transponder to DP when suspended to test voting.
4. Box move – compare with other references.
5. Fail power to HPR transceiver unit. (F2 on DP UPS3).
6. Fail power to HiPAP console.(F1 on DP UPS3 for HPR OS1).
7. Fail MRU input.
8. Fail Gyro Input.
9. Fail GPS Input.

EXPECTED RESULTS :

1. All transponders work.
2. Transponder rejected when moved.
3. Transponder rejected when suspended.
4. No excursions.
5. Alarm, HPR rejected on power failure.
6. Alarm, HPR rejected.
7. Alarm, HPR rejected.
8. Alarm. Heading info frozen.
9. Alarm. Position info frozen.
10. All transponders work.

HPR OS 1 Inputs
Gyro 1 = Com 9 Gyro 2 = Com 10 MRU 1 = Com 7 MRU 2 = Com 8 Gyro has to be connected before the system can accept MRU information.

RESULTS :

1. As expected.
2 As expected. Prediction Error and Reference Median Rejected Warning alarms.
3. As expected. Prediction Error and Reference Median Rejected Warning alarms.
4. As expected.
5. As expected.
6. As expected.
7. As expected. HPR frozen. Position Status Invalid Alarm.
8. As expected. HPR frozen. Position Status Invalid Alarm.
9. Loss of DGPS signal has no effect. A small red indication is seen at the bottom RH side of HPR monitor.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 25-02-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 57	SUBSYSTEM: SENSORS HiPAP 500.

PURPOSE :

To simulate HiPAP failures.

METHOD :

- Vessel on DP. 3 generators on line. All thrusters on line. 690V bustie closed others open.
- Select all available reference systems.

1. Test HPR input to DP.
2. Lift one used for DP without deselecting.
3. Select transponder to DP when suspended to test voting.
4. Box move – compare with other references.
5. Stabilise. Fail power to HPR transceiver unit. (F2 on DP UPS3).
6. Fail power to HiPAP console. (F1 on DP UPS3 for HPR OS1).
7. Fail MRU input.
8. Fail Gyro Input.
9. Fail GPS Input.

EXPECTED RESULTS :

1. All transponders work.
2. Transponder rejected when moved.
3. Transponder rejected when suspended.
4. No excursions.
5. Alarm, HPR rejected on power failure.
6. Alarm, HPR rejected.
7. Alarm, HPR rejected.
8. Alarm. Heading info frozen.
9. Alarm. Position info frozen.

HPR OS 2 Inputs
Gyro 1 = Com 8 Gyro 2 = Com 70 MRU 1 = Com 10 MRU 2 = Com 9 Gyro has to be connected before the system can accept MRU information.

RESULTS :

1. As expected.
2. As expected. Prediction Error and Reference Median Rejected Warning alarms.
3. As expected. Prediction Error and Reference Median Rejected Warning alarms.
4. As expected.
5. As expected.
6. As expected.
7. As expected. HPR frozen. Position Status Invalid Alarm.
8. As expected. HPR frozen. Position Status Invalid Alarm.
9. Loss of DGPS signal has no effect. A small red indication is seen at the bottom RH side of HPR monitor.

COMMENTS :

WITNESSED BY : David Barton	DATE : 25-02-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 58	SUBSYSTEM: SENSORS Light Weight Taut Wire 1.

PURPOSE :

To simulate LWTW failures.

METHOD :

- Vessel on DP.
- 3 generators on line. All thrusters on line. 690 V bus-tie closed, others open.
- Select all available reference systems.

1. Move vessel to check limits.
2. Box Move (Depending on water depth) and compare with another reference.
3. Fail 440V supply.
4. Fail 220V supply.
5. Check shallow water alarm.
6. Fail Length signal (WU3 – U36 – X2 – 3/2).
7. Fail Beam signal (WU3 – U36 – X1 – 6/5).
8. Fail Alongship signal (WU3 – U36 – X1 – 3/2).
9. With centre of rotation as LWTW1 make a 90 degree turn.

EXPECTED RESULTS :

1. Alarm for out of limits.
2. No alarms / excursions.
3. 'Mooring not on' alarm and LTW1 rejected.
4. Alarm and deselected from DP.
5. Alarm if less than 25m.
6. Minimum wire length not reached warning. Operator to deselect affected LTW.
7. Alarms – Reference prediction error. Median Rejected.
8. Alarms – Reference prediction error. Median Rejected.
9. Smooth response. No alarms.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.
7. As expected.
8. As expected.
9. As expected. Response better with Thruster biasing enabled.

COMMENTS :

WITNESSED BY : David Barton	DATE : 02-04-09

EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 59	**SUBSYSTEM: SENSORS** **Light Weight Taut Wire 2.**

PURPOSE :

To simulate LWTW failures.

METHOD :

- Vessel on DP.
- 3 generators on line. All thrusters on line. 690 V bus-tie closed, others open.
- Select all available reference systems.

1. Move vessel to check limits.
2. Box Move (Depending on water depth) and compare with another reference.
3. Fail 440V supply.
4. Fail 220V supply.
5. Check shallow water alarm.
6. Fail Length signal (WU7 – U71 – X2 – 3/2).
7. Fail Beam signal (WU7 – U71 – X1 – 6/5).
8. Fail Alongship signal(WU7 – U71 – X1 – 3/2).
9. With centre of rotation as LWTW2 make a 90 degree turn.

EXPECTED RESULTS :

10. Alarm for out of limits.
11. No alarms / excursions.
12. 'Mooring not on' alarm and LTW2 rejected.
13. Alarm and deselected from DP.
14. Alarm if less than 25m.
15. Minimum wire length not reached warning. Operator to deselect affected LTW
16. Alarms – Reference prediction error. Median Rejected.
17. Alarms – Reference prediction error. Median Rejected.
1. Smooth response. No alarms.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.
7. As expected.
8. As expected.
9. As expected. Response better with Thruster biasing enabled.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 02-04-09

EQUIPMENT SYSTEM :	COMMUNICATIONS
TEST NO. 60	SUBSYSTEM: Communications within vessel.

PURPOSE :

To check adequate communications within the vessel and ergonomics.

METHOD :

1. Test calls between Bridge/ECR/Captain/CE/Sat and Dive Control Centres/ROV/Dive Supdt cabin etc using telephones / sound powered telephones / walkie talkies and all other available means of communication.
2. Visual and audible check of DP status lights.
3. Visual and audible check of ECR tower lights.
4. Check date / time in DP OS, IAS, PMS, MSB breakers etc to ensure that they are in synch.
5. Check that printouts from DP / IAS are ok and adequate paper supply available.

EXPECTED RESULTS :

1. All in working condition.
2. All in working condition.
3. All in working condition.
4. In synch.
5. Prints out legibly.

RESULTS :

1. As expected.
2 As expected.
3. As expected.
4. As expected.
5. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 26-02-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 61	SUBSYSTEM: Position Reference, DGPS 1 (Accuracy Alongship)

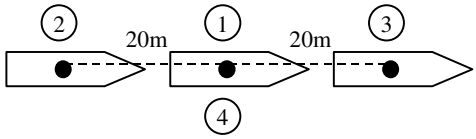
PURPOSE :

Check positioning accuracy of DGPS 1 system.

METHOD :

Using DGPS 1 as reference system, make moves of ±20m alongship.

Use other reference systems as comparison.
Repeat for backup DP control system.



EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*
Pos.①	4804483	583269	
Pos.②	464	278	1.6m
Pos.③	500	258	1.6m
Pos.④	483	269	0.4m

Weather Conditions:	
Heading:	330°
Water Depth:	95m
Wind:	4.8kn 323°
Current:	0.2kn 340°

COMMENTS :

.

WITNESSED BY :	David Barton	DATE :	23-03-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 62	SUBSYSTEM: Position Reference, DGPS 1 (Accuracy Athwartship)

PURPOSE :

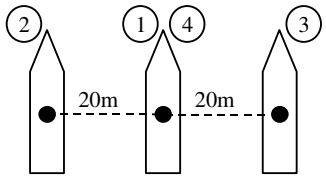
Check positioning accuracy of DGPS 1 system.

METHOD :

Using DGPS 1 as reference system, make moves of ±20m athwartship.

Use other reference systems as comparison.

- Repeat for backup DP control system.



EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*
Pos.①	4804482	583269	
Pos.②	472	250	0.8m
Pos.③	493	286	0.7m
Pos.④	483	269	0.5m

Weather Conditions:	
Heading:	330°
Water Depth:	94m
Wind:	5.2kn 304°
Current:	0.6kn 230°

COMMENTS :

.

WITNESSED BY : David Barton	DATE : 23-03-09

EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 63	**SUBSYSTEM:** **Position Reference, DGPS 2 (Accuracy Alongship)**

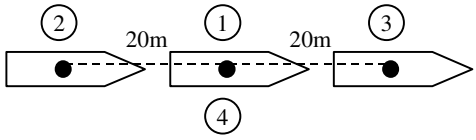
PURPOSE :

Check positioning accuracy of DGPS 2 system.

METHOD :

Using DGPS 2 as reference system, make moves of ±20m alongship.

Use other reference systems as comparison.
Repeat for backup DP control system.



EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*	*Weather Conditions:*	
Pos.①	4804482	583269		Heading:	330°
Pos.②	464	279	0.6m	Water Depth:	94m
Pos.③	500	258	0.3m	Wind:	4.8kn 296°
Pos.④	482	269	0.1m	Current:	0.4kn 250°

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 23-03-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 64	SUBSYSTEM: Position Reference, DGPS 2 (Accuracy Athwartship)

PURPOSE :

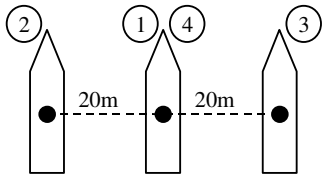
Check positioning accuracy of DGPS 2 system.

METHOD :

Using DGPS 2 as reference system, make moves of ±20m athwartship.

Use other reference systems as comparison.

- Repeat for backup DP control system.



EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*
Pos.①	4804481	583269	
Pos.②	471	251	0.0m
Pos.③	493	286	0.5m
Pos.④	482	268	0.3m

Weather Conditions:	
Heading:	330°
Water Depth:	94m
Wind:	4.5kn 285°
Current:	0.5kn 230°

COMMENTS :

WITNESSED BY :	David Barton	DATE :	23-03-09

EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 65	**SUBSYSTEM:** **Position Reference, Fanbeam (Accuracy Alongship)**

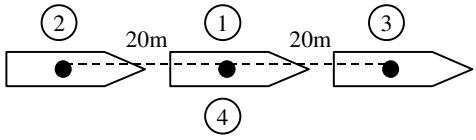
PURPOSE :

Check positioning accuracy of Fanbeam system.

METHOD :

Using Fanbeam as reference system, make moves of ±20m alongship.

Use other reference systems as comparison.
Repeat for backup DP control system.



EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*	*Weather Conditions:*
Pos.①				Heading:
Pos.②				Water Depth:
Pos.③				Wind:
Pos.④				Current:

COMMENTS :

This test to be undertaken prior to commencing DP Class 2 operations using fanbeam.

WITNESSED BY : David Barton	**DATE :**

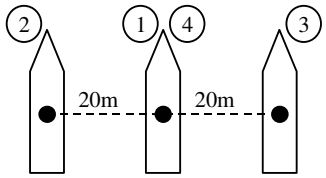
EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 66	SUBSYSTEM: Position Reference, Fanbeam (Accuracy Athwartship)

PURPOSE :

Check positioning accuracy of Fanbeam system.

METHOD :

Using Fanbeam as reference system, make moves of ±20m athwartship.



Use other reference systems as comparison.

- Repeat for backup DP control system.

EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*	*Weather Conditions:*
Pos.①				Heading:
Pos.②			0	Water Depth:
Pos.③				Wind:
Pos.④			0	Current:

COMMENTS :

This test to be undertaken prior to commencing DP Class 2 operations using fanbeam.

WITNESSED BY : David Barton	DATE :

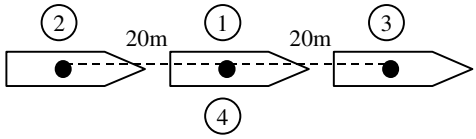
EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 67	SUBSYSTEM: HPR OS 1 with HiPAP 350 (Accuracy Alongship)

PURPOSE :

Check positioning accuracy of HiPAP system.

METHOD :

Using HPR OS 1 with HiPAP 350 as reference system, make moves of ±20m alongship.



Use other reference systems as comparison.
Repeat for backup DP control system.

EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*	*Weather Conditions:*	
Pos.①	4800200	562111		Heading:	150°
Pos.②	217	102	0.9m	Water Depth:	81m
Pos.③	182	123	0.6m	Wind:	2.5m/s 013°
Pos.④	200	113	0.6m	Current:	0.4m/s 206°

COMMENTS :

WITNESSED BY :	David Barton	DATE :	25-02-09

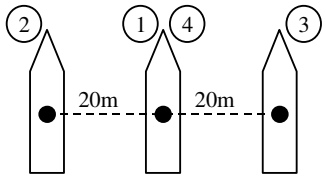
EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 68	SUBSYSTEM: HPR OS 1 with HiPAP 350 (Accuracy Athwartship)

PURPOSE :

Check positioning accuracy of HiPAP system.

METHOD :

Using HPR OS 1 with HiPAP 350 as reference system, make moves of ±20m athwartship.



Use other reference systems as comparison.

- Repeat for backup DP control system.

EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*
Pos.①	4800200	4800199	
Pos.②	211	210	0.8m
Pos.③	191	189	0.5m
Pos.④	200	198	0.6m

Weather Conditions:	
Heading:	150°
Water Depth:	82m
Wind:	2.4m/s 021°
Current:	0.4m/s 220°

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 25-02-09

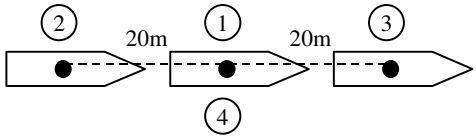
EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 69	SUBSYSTEM: HPR OS 1 with HiPAP 500 (Accuracy Alongship)

PURPOSE :

Check positioning accuracy of HiPAP system.

METHOD :

Using HPR OS 1 with HiPAP 500 as reference system, make moves of ±20m alongship.



Use other reference systems as comparison.
Repeat for backup DP control system.

EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*	*Weather Conditions:*	
Pos.①	4804480	563272		Heading:	330°
Pos.②	464	282	0.9m	Water Depth:	95m
Pos.③	498	260	0.4m	Wind:	4.2kn 279°
Pos.④	479	271	0.3m	Current:	0.4kn 278°

COMMENTS :

WITNESSED BY : David Barton	DATE : 23-03-09

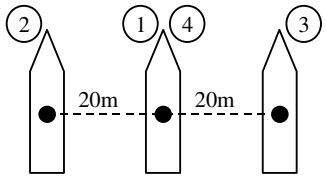
EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 70	SUBSYSTEM: HPR OS 1 with HiPAP 500 (Accuracy Athwartship)

PURPOSE :

Check positioning accuracy of HiPAP system.

METHOD :

Using HPR OS 1 with HiPAP 500 as reference system, make moves of ±20m athwartship.



Use other reference systems as comparison.

- Repeat for backup DP control system.

EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*
Pos.①	4804478	583272	
Pos.②	469	254	0.4m
Pos.③	491	288	0.5m
Pos.④	479	272	0.4m

Weather Conditions:	
Heading:	330°
Water Depth:	95m
Wind:	4.7kn 261°
Current:	0.5kn 242°

COMMENTS :

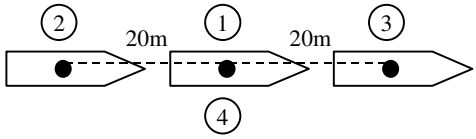
WITNESSED BY : David Barton	DATE : 23-03-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 71	SUBSYSTEM: HPR OS 2 with HiPAP 350 (Accuracy Athwartship)

PURPOSE :
Check positioning accuracy of HiPAP system.

METHOD :

Using HPR OS 2 with HiPAP 350 as reference system, make moves of ±20m alongship.



Use other reference systems as comparison.
Repeat for backup DP control system.

EXPECTED RESULTS :
Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*
Pos.①	4804482	583269	
Pos.②	465	279	1.2m
Pos.③	500	257	0.6m
Pos.④	482	269	0.3m

Weather Conditions:	
Heading:	330°
Water Depth:	9m
Wind:	5.4kn 280°
Current:	0.5kn 282°

COMMENTS :

WITNESSED BY : David Barton	DATE : 23-03-09

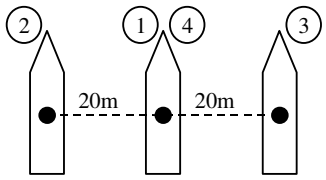
EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 72	SUBSYSTEM: HPR OS 2 with HiPAP 350 (Accuracy Athwartship)

PURPOSE :

Check positioning accuracy of HiPAP 1 system.

METHOD :

Using HPR OS 2 with HiPAP 350 as reference system, make moves of ±20m athwartship.



Use other reference systems as comparison.

- Repeat for backup DP control system.

EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*
Pos.①	4804478	583272	
Pos.②	467	255	0.7m
Pos.③	489	289	0.6m
Pos.④	479	272	1.4m

Weather Conditions:	
Heading:	330°
Water Depth:	95m
Wind:	4.4kn 268°
Current:	0.5m/s 256°

COMMENTS :

WITNESSED BY :	David Barton	DATE :	23-03-09

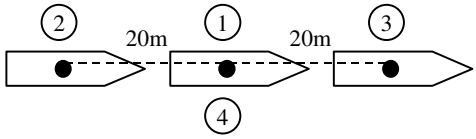
EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 73	**SUBSYSTEM:** **HPR OS 2 with HiPAP 500 (Accuracy Athwartship)**

PURPOSE :

Check positioning accuracy of HiPAP 1 system.

METHOD :

Using HPR OS 2 with HiPAP 500 as reference system, make moves of ±20m alongship.



Use other reference systems as comparison.
Repeat for backup DP control system.

EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*
Pos.①	4800199	562110	
Pos.②	216	101	0.4m
Pos.③	181	122	0.9m
Pos.④	199	111	0.6m

Weather Conditions:	
Heading:	150°
Water Depth:	83m
Wind:	2.3m/s 064°
Current:	0.4m/s 116°

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 25-02-09

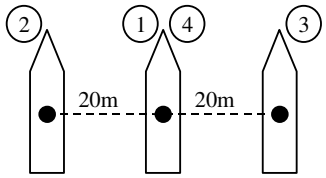
EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 74	SUBSYSTEM: HPR OS 2 with HiPAP 500 (Accuracy Athwartship)

PURPOSE :

Check positioning accuracy of HiPAP 1 system.

METHOD :

Using HPR OS 2 with HiPAP 500 as reference system, make moves of ±20m athwartship.



Use other reference systems as comparison.

- Repeat for backup DP control system.

EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*
Pos.①	4800200	562111	
Pos.②	210	128	0.6m
Pos.③	190	095	0.3m
Pos.④	200	112	0.8m

Weather Conditions:	
Heading:	150°
Water Depth:	83m
Wind:	3.5m/s 075°
Current:	0.4m/s 227°

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 25-02-09

EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 75	**SUBSYSTEM:** **Position Reference, Taut wire 1 Port (Accuracy Alongship)**

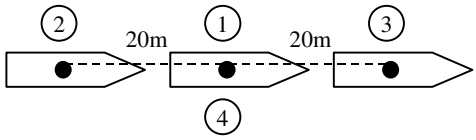
PURPOSE :

Check positioning accuracy of Taut wire 1 system.

METHOD :

Using Taut wire 1 as reference system, make moves of ±20m alongship.

Use other reference systems as comparison.
Repeat for backup DP control system.



EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*
Pos.①	4804747	583142	
Pos.②	732	152	1.0m
Pos.③	762	129	0.7m
Pos.④	747	140	0.4m

Weather Conditions:	
Heading:	330°
Water Depth:	96m
Wind:	13.8kn 319°
Current:	1.0kn 357°

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 24-03-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 76	SUBSYSTEM: Position Reference, Taut wire 1 Port (Accuracy Athwartship)

PURPOSE :

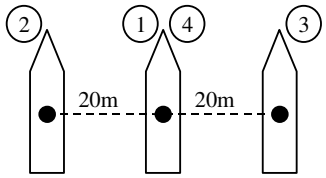
Check positioning accuracy of Taut wire 1 system.

METHOD :

Using Taut wire 1 as reference system, make moves of ±20m athwartship.

Use other reference systems as comparison.

- Repeat for backup DP control system.



EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*
Pos.①	4804755	583155	
Pos.②	768	171	1.1m
Pos.③	746	140	1.7m
Pos.④	756	155	0.8m

Weather Conditions:	
Heading:	330°
Water Depth:	96m
Wind:	13.8kn 331°
Current:	0.9kn 320°

COMMENTS :

WITNESSED BY :	David Barton	DATE :	24-03-09

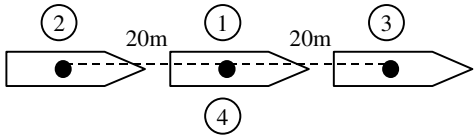
EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 77	SUBSYSTEM: Position Reference, Taut wire 2 Stbd. (Accuracy Alongship)

PURPOSE :

Check positioning accuracy of Taut wire 2 system.

METHOD :

1.Using Taut wire 2 as reference system, make moves of ±20m alongship.



Use other reference systems as comparison.
Repeat for backup DP control system.

EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*	*Weather Conditions:*	
Pos.①	4804754	583162		Heading:	330°
Pos.②	737	155	0.8m	Water Depth:	96m
Pos.③	771	173	1.0m	Wind:	10.0kn 292°
Pos.④	755	163	0.7m	Current:	1.1kn 279°

COMMENTS :

WITNESSED BY : David Barton	DATE : 24-03-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 78	SUBSYSTEM: Position Reference, Taut wire 2 Stbd. (Accuracy Athwartship)

PURPOSE :

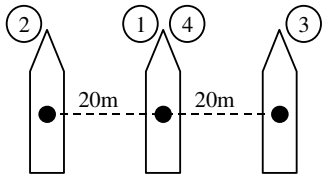
Check positioning accuracy of Taut wire 2 system.

METHOD :

Using Taut wire 2 as reference system, make moves of ±20m athwartship.

Use other reference systems as comparison.

- Repeat for backup DP control system.



EXPECTED RESULTS :

Maximum overshoot <3m.

RESULTS :

	Northing	*Easting*	*Overshoot*
Pos.①	4804750	583142	
Pos.②	738	125	0.6m
Pos.③	759	157	0.8m
Pos.④	749	141	0.7m

Weather Conditions:	
Heading:	330°
Water Depth:	96m
Wind:	16.5kn 327°
Current:	1.1kn 324°

COMMENTS :

WITNESSED BY :	David Barton	DATE :	24-03-09

EQUIPMENT SYSTEM :	**DP CONTROL**
TEST NO. 79	**SUBSYSTEM:** **Heading Control**

PURPOSE :

Test the operation of the heading control.

METHOD :

Stabilise with one position reference:

- Make ±15° heading change at Low Gain/Medium Gain/High Gain

Allow to stabilise between heading changes.

EXPECTED RESULTS :

Correct heading changes.

RESULTS :

As expected.

COMMENTS :

WITNESSED BY : David Barton	**DATE :** 23-03-09

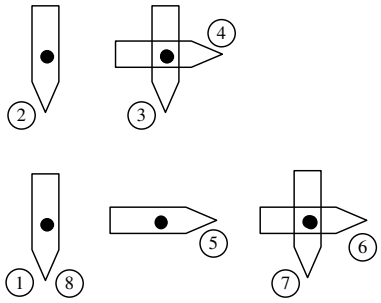
EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 80	SUBSYSTEM: DP Control (Square)

PURPOSE :

Test position reference stability and overshoot.

METHOD :

Make 20m square, for each leg use one position reference and with selections of thrusters failed.
Change heading 90° for each leg.
Compare with another reference system.



EXPECTED RESULTS :

Position loss recovered (<20m) back at start position correct.

RESULTS :

	Vessel Movement	*Thrusters deselected during manoeuvre*
Pos.①	0	
Pos.②	20m Astern	Port After Azimuth and Bowthruster 2.
Pos.③	20m Port	Bowthrusters 1 and 2, Starboard After Azimuth.
Pos.④	90°Port	Bowthruster 2, Port After Azimuth.
Pos.⑤	20m Starboard	Bowthrusters 1 and 2, Starboard After Azimuth.
Pos.⑥	20m Ahead	Bowthruster 1, forward Azimuth, and Port After Azimuth.
Pos.⑦	90°Starboard	All thrusters.
Pos.⑧	40m Starboard	All thrusters.

COMMENTS :
Original position = 4803806N, 584194E. Final position = 4803804N, 584194E. Vessel 2m from original position.

WITNESSED BY : David Barton	DATE : 24-03-09

EQUIPMENT SYSTEM :	DP CONTROL
TEST NO. 81	SUBSYSTEM: Position References (Weighting)

PURPOSE :

Check software voting routines.

METHOD :

1. Select DGPS 1.
2. Select DGPS 2.
3. Select Fanbeam.
4. Select HPR HiPAP Port.
5. Select HPR HiPAP Stbd.
6. Select Taut wire 1.
7. Select Taut wire 2

- Observe voting changes, weighting and performance.
- Degrade reference origin. Observe.

EXPECTED RESULTS :

1. Voting matches performance.
2. Degraded reference rejected by voting.

RESULTS :

1. As expected.
2. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 25-03-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 82	SUBSYSTEM: GENERATORS Fuel System

PURPOSE :

To check correct operation of Oil Tank Quick Closing Valves and pump and fan shut offs.

METHOD :

1. Check operation of Port FO Service tank QCV and reset.
2. Check operation of Port FO Settling tank QCV and reset.
3. Check operation of Stbd. FO Service tank QCV and reset.
4. Check operation of Stbd. FO Service tank QCV and reset.
5. Check operation of LO tank QCVs and reset.
6. Check operation of emergency pump shut off switches.
7. Check operation of emergency fan shut off switches.

EXPECTED RESULTS :

1. QCV closes.
2. QCV closes.
3. QCV closes.
4. QCV closes.
5. QCV closes.
6. Pumps shut down.
7. Fans stop.

RESULTS :

1. As expected.
2. As expected.
3. As expected.
4. As expected.
5. As expected.
6. As expected.
7. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 27-02-09

EQUIPMENT SYSTEM :	POWER GENERATION
TEST NO. 83	SUBSYSTEM: 24V SWITCHBOARDS 24V Bridge Services Failure

PURPOSE :

To verify whether failure of this switchboard can cause total loss of DP.

METHOD :

Trip all breakers from the switchboard.

EXPECTED RESULTS :

1. Wind 1 not ready on DP.
2. Gyros secondary supply failure alarm.
3. Loss of fixed VHF Comms.
4. Loss of MRU signal (Splitter failure) to HMS & Survey box.
5. All Freq convertors bridge control panels indication lamps supply loss.

RESULTS :

1. As expected.
2. As expected.
3. As expected.
4. As expected.
5. As expected.

COMMENTS :

WITNESSED BY : David Barton	DATE : 27-02-09

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