



## MENAS MARINE SERVICES LTD (MMSL)

### OFFSHORE SUPPORT VESSEL

“RELUME”

DP ANNUAL TRIALS 2006

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## SUMMARY

- 1.1.1 “Relume” is owned by Middle East navigation Aids Service. She is classed as an OSV, carrying out various activities in the offshore industry.
- 1.1.2 The propulsion system consists of two Rolls Royce Aquamaster Azimuth units of 1500 KW each; forward the vessel has two electrically driven tunnel thruster, controllable pitch, of 515 KW each.
- 1.1.3 “Relume” is classed by Lloyds Register under notation DP (AA).
- 1.1.4 This report contains the results of the Annual DP trials 2006, which took place on 19<sup>th</sup> & 20<sup>th</sup> February 2006. Annual DP trials are used to demonstrate the vessel's capability to cope adequately with DP system failures. This demonstrates that the DP system complies with current redundancy requirements as applied to DP vessels Class 2 system.
- 1.1.5 For IMO Class 2 operations the vessel operates with the main Bus tie open. The correct set-up will ensure that the vessel has sufficient manoeuvre capability, after the occurrence of a single failure. During Class 2 DP operations procedures are in place preventing loss of more than 50% thruster capacity after a single failure.
- 1.1.6 The crew showed a very positive attitude to the trials and experience in their duties.
- 1.1.7 All the items that need to be closed out are listed in section 3 enclosed herewith. On the basis of compliance with IMCA Guidelines and Recommendations and the correction of any unexpected results, the vessel is considered fit for the purpose of carrying out Class 2 DP operations within normal operational limits of the vessel without exception.

## **2. INTRODUCTION**

### **2.1 Instructions**

2.1.1 Global Maritime was requested by MMSL to carry out DP Annual trials on the Offshore Support Vessel “Relume”.

### **2.2 Scope of Work**

2.2.1 The Annual Audit programme is intended to demonstrate that the vessel meets the requirements of the 1994 IMO Guidelines for Vessels with Dynamic Positioning.

2.2.2 The Guidelines for the Annual Audit requires that a review of particular onboard documentation is carried out followed by a series of failure trials, which demonstrate the adequacy of the DP System redundancy.

2.2.3 Global Maritime’s scope of work is to witness and document the Annual Trials carried out by the vessels own crew. The Trials procedures have been developed from the FMEA and earlier trials made in 2004.

2.2.4 Issue a report following the conclusion of the trials.

2.2.5 On completion of the annual trials, update the vessels FMEA.

### **2.3 Background**

2.3.1 “Relume is an Offshore Support Vessel built by Damen Shipyards, Vissingen, Holland in 2004. “Relume” has LLOYDS REGISTER class notation ✕ LMC 100A1, UMS, DP (AA), NAV, IBS, Light Tender Occasional Oil Recovery Duties



- 2.6.3 During the trials the key DP personnel were requested to assist in recording any alarms and failures that occurred, not only at the DP console but also at the engine control room, thruster rooms, etc.
- 2.6.4 During the failure tests the system were not reinstated until the DP operators, engine room staff and the surveyor were satisfied they understood the full effects of the failure and that all the information or indicators to show what has occurred had been documented. When there were any doubts about a test, or if test results were unexpected, it was repeated.
- 2.6.5 The tests have been designed to not only prove the capability and redundancy in the vessels systems, but also assist the operators and ships staff in recognising the various types of failures that could occur and their likely effects on the vessels position keeping capability. It also gives the DP operators the chance to test their own knowledge and procedures in a controlled environment, where the consequences of anything going wrong will not jeopardise the safety of the vessel or its crew.
- 2.6.6 In the comment box of the test sheets the text in *Italic* is an explanation or description of the system in exam. The text in **Bold** Regular font is a comment on the test results, which is then reported in the Conclusions and Recommendations.
- 2.6.7 Any the items that needed to be closed out are listed in section 3.

### 3. TRIALS CONCLUSIONS AND FINDINGS

#### 3.1 Conclusions

- 3.1.1 Global Maritime witnessed the DP trials of the OSV “Relume”. The trials produced some unexpected results, but the vessel will be fit for purpose, within its operational capability once the “A” recommendations are closed out satisfactory.

#### 3.2 Trials Conduct and Findings

##### 3.2.1 Power Generation

All tests were completed satisfactorily as per the trials programme, with the exception of **Test .9**. On loss of control air, no alarm was activated for the thruster header tanks, due to there still being adequate pressure in the system. Only a pipe fracture on this system would lead to a loss of pressure on the header tanks.

##### 3.2.2 Power Distribution

All tests were completed satisfactorily as per the trials programme with the exception of **Test 11**. On loss of the Port Side of the main switchboard, there was a loss of “Wind Sensor 1 & 2”.

**Test 13**. ECR monitor is now fitted with a UPS.

**Test 17**. Taut wire and MRU 2 are now connected to UPS1.

##### 3.2.3 Power Management

All tests were completed satisfactorily as per the trials programme with no exceptions.

##### 3.2.4 Thrusters

All tests were completed satisfactorily as per the trials programme with the exception, of **Test 24**. T3 & T4, Pitch fails as Set, on loss of feedback signal from thruster to ECU. **Test 26**. On failing the speed reference (command) signal from DP to thruster converter before isolation amplifier, the following was recorded. Alarm “Zero speed”, “Thruster prediction error”, Thruster remains in DP.

**Test 27**. On failing the azimuth feedback signal from thruster to control unit the following was observed “Thruster prediction error”. The thruster was freely rotating with pitch on. Vessel position destabilised.

**Test 30**. On simulating water leakage alarm in converter panel, there was no alarm in the engine control room. An alarm should to be incorporated in Engine room monitoring software.

##### 3.2.5 DP Control Systems

All tests were completed satisfactorily as per the trials programme with the exception of **Test 31**. This test was not carried out due to the ETO being unable to fail either net. This test should be carried out a.s.a.p. to confirm network redundancy.

**Test 34**. There is no indication on the Bridge if the main power supply is lost to the gyros. The only alarm given is at the Gyros, which are located in a void space under the Bridge. This is unacceptable as it is possible to loose the main supply and for personnel to be unaware that it was occurred. On loss of Gyro 1 or Gyro 2 back-up supply, there

is an alarm on the ford bridge. There is no alarm for loss of the back-up supply of Gyro 3.

**Test 35.** Power supplies for the Anemometers was found to be unsatisfactory and MMSL have modified the supplies so they are from separate UPS units (Ref client comments 18/3/06).

**Test 36.** It was confirmed that MRU 1 was powered from the DP, MRU 2 from the UPS. MRU 2 signal goes to the HPR.

#### 3.2.6 Communications

The test was completed satisfactorily as per the trials programme with no exceptions.

#### 3.2.7 Maintenance

There is an AMOS planned maintenance system in use. It was noted that further input is needed to bring the maintenance of the DP equipment into line with manufacturer's recommendations.

#### 3.2.8 Personnel

The ship's staff rendered excellent assistance during the trials, which enabled the vessel to produce the excellent results achieved.

## 4. ACTION LIST

### 4.1 “A” Recommendations: For Immediate Attention

4.1.1 Power supplies to the two wind sensors should be separated. (They can be taken from the two UPS or the two DP consoles.) Closed out Ref Owner information 18/3/06

- Wind 1 UPS 2 F8
- Wind 2 UPS 1 F9

### 4.2 “B” Recommendations: For Serious Consideration

4.2.1 An alarm for loss of an azimuth thruster, in the event of a water leakage in the converter panel should be incorporated into the “Alarm and monitoring software.

4.2.2 Loss of the main power supplies to the gyros to be alarmed on the bridge.

4.2.3 Capability plots should be verified on board.

4.2.4 MRU 1 should be corrected or changed out, so that both MRU’s give a similar value. At present MRU 1 reads about 1.8° different to MRU 2. (The difference alarm should be at 1°)

4.2.5 It was noted that during the trials that an earth fault on the UPS could go undetected. We recommend that an alarm be fitted on the bridge to show if a fault occurs.

Note: Owners have the B recommendations in hand 18/03/06

### 4.3 “C” Recommendations: For Future Attention/Consideration

4.3.1 All DP equipment should be entered in AMOS, with the manufacture’s maintenance periods clearly defined. A stock check should be implemented to ensure that the required consumables and spare parts are available on board. Completed ref Owners comments 18/3/06

4.3.2 Confirmation is required on when the Switchboard, Generator and Thruster breakers will be tested. Owners plan this Q1 2007 ref Owners comments 18/3/06

**PART 1 – EQUIPMENT STATUS**

## EQUIPMENT STATUS

## 1. Thrusters and Propulsion

	<i>T 1(Fwd)</i>	<i>T 2(Aft)</i>	<i>T 3(Port)</i>	<i>T 4(Stbd)</i>
MAINTENANCE RECORDS CHECKED	Satisfactory	Satisfactory	Satisfactory	Satisfactory
OUTSTANDING MAINTENANCE	None	None	None	None
LAST OIL ANALYSIS (DATE)	31/01/06	31/01/06	31/01/06	31/01/06
LAST OIL ANALYSIS OK	Awaiting result of Analysis	Awaiting result of Analysis	Awaiting result of Analysis	Awaiting result of Analysis
<b>Remarks:</b> <i>Previous L.O. analysis 02/07/05 was ok.</i>				

## 2. Diesel Engines

	<u><i>DG 1</i></u>	<u><i>DG 2</i></u>	<u><i>DG 3</i></u>	<u><i>DG 4</i></u>	<u><i>CAT 1</i></u>
MAINTENANCE RECORDS CHECKED	OK	OK	OK	OK	N/A
OUTSTANDING MAINTENANCE	None				
LAST OIL ANALYSIS (DATE)	07/12/05	07/12/05	07/12/05	07/12/05	N/A
LAST OIL ANALYSIS OK	OK	OK	OK	OK	N/A
RUNNING HOURS: AT PRESENT	6968	6104	5195	6178	40
LAST MAJOR OVERHAUL (HRS)	4000	4000	4000	4000	N/A
<b>Remarks:</b> <i>LO renewed every 1500 hrs; Samples sent every 500 Hrs CAT 1 (E.G.) has only 40 hrs running time.</i>					

**3. Electrical Protection**

<b>Circuit Breakers</b>	<b>Date</b>	<b>Company</b>
Switchboard Bus Ties		Two Yearly- Due 2006
Generator Breakers		Two Yearly- Due 2006
Thruster Breakers		Two Yearly- Due 2006
<b>Remarks: Confirmation is required on when the Circuit Breakers will be tested.</b>		

**4. DP Sensors**

<b>Sensor</b>	<b>Records Checked</b>	<b>Remarks</b>
Gyro 1	Yes	AMOS Planned maintenance up to date
Gyro 2	Yes	AMOS Planned maintenance up to date
Gyro 3	Yes	AMOS Planned maintenance up to date
Wind Sensor 1	Yes	AMOS Planned maintenance up to date
Wind Sensor 2	Yes	AMOS Planned maintenance up to date
MRU 1	Yes	AMOS Planned maintenance up to date
MRU 2	Yes	AMOS Planned maintenance up to date
DGPS 1	Yes	AMOS Planned maintenance up to date
DGPS 2	Yes	AMOS Planned maintenance up to date
DGPS 3	N/A	Fitted 18 <sup>th</sup> February 2006
Taut Wire	Yes	AMOS Planned maintenance up to date
HPR	Yes	AMOS Planned maintenance up to date
<b>Remarks: Fan Beam unit not on board.</b>		

**5. DP Computers**

Maintenance checked?	Yes- Amos Planned maintenance up to date
Last software revision?	1.9 Update 9 (Build 13810)
Dates of last DP Control system software upgrade	SDP OS exe generated 2004/9/04
<b>Remarks:</b>	

**6. UPS**

Unit	Battery check	Remarks
UPS 1	Yes	Six monthly load test carried out.
UPS 2	Yes	Six monthly load test carried out.
<b>Remarks:</b>		

**7. Hardware Modification**

Have there been any modifications since last annual trials?	Yes
Have modifications been thoroughly tested?	Yes
Have trials procedures (Part 2) been updated?	Yes
<b>Remarks:</b>	
<ul style="list-style-type: none"> <li>• <i>MRU No. 2 connected to DP UPS No.1 (F8)</i></li> <li>• <i>PNC 100 keyboard decoder card replaced in all operator stations.</i></li> <li>• <i>24V isolator fitted to secondary supply from MSB1.</i></li> </ul>	

**8. Capability Plots**

Are the correct capability plots onboard?	Yes
Have capability plots been verified?	No
Are there verifying footprints onboard?	No

**PART 2 – 2006 DP TRIALS SHEETS**

Test	System	Subsystem	Component	Comment
1	Power Generation	Fuel Oil System	Q/C V/Vs	
2	Power Generation	Fuel Oil System	Boost P/ps	
3	Power Generation	Fuel Oil System	Tk. level and filter alarms	
4	Power Generation	Lub. Oil System	Pre lub test	
5	Power Generation	SW Cooling	P/P auto start A101 & A102	
6	Power Generation	SW Cooling	Loss and temp rise	
7	Power Generation	FW Cooling	FW P/p speed change	
8	Power Generation	FW Cooling	Loss of FW cooling	
9	Power Generation	Control Air	Loss of Control	
10	Power Generation	DG	Loss of speed sensor	
11	Power Distribution	Main Switchboard	Loss of Port Section	
12	Power Distribution	Main Switchboard	Loss of Stbd. Section	
13	Power Distribution	440V switchboard	Loss of Port & Stbd. Sections	
14	Power Distribution	220V switchboard	Loss of T1 and T2	
15	Power Distribution	Emergency. Switchboard	Loss of switchboard	
16	Power Distribution	24V dc	Loss of supply	
17	Power Distribution	UPS 1	Loss of UPS	
18	Power Distribution	UPS 2	Loss of UPS	
19	Power Management	Power Supply	Loss of supply	
20	Power Management	PMS Function	Blackout recovery	
21	Power Management	kW signal	Loss of kW & bus tie signals	
22	Power Management	CAN Bus	Loss of CAN Bus	
23	Power Management	DPU	Loss of DPU	
24	Thrusters	Thrusters No. 1 & 2	Pitch signals (KS)	
25	Thrusters	Thrusters No. 1 & 2	Pitch signals (Imtech)	
26	Thrusters	Thruster No. 3 & 4 (Azi)	Speed signal	
27	Thrusters	Thruster No. 4 (Azi)	Azimuth signal	
28	Thrusters	Hydraulics	Loss of hydraulics	
29	Thrusters	Emergency Stops	Function test	
30	Thrusters	Frequency Drives	Alarms	
31	DP Control	Networks	Loss of network	
32	DP Control	DP Consoles	Loss of consoles	
33	DP Control	Computer Failure	Loss of one computer	
34	DP Control	Gyros	Loss of gyros	
35	DP Control	Anemometers	Loss of anemometers	
36	DP Control	MRU	Loss of MRU	
37	DP Control	DGPS Capability	Loss of DGPS	
38	DP Control	HiPAP	Loss of HPR	
39	DP Control	Taut Wire	Test	
40	DP Control	Fan Beam	Test	
41	DP Control	Model Control	Test	
42	DP Control	BLANK		
43	DP Control	Consequence Analysis	Test	
44	DP Control	Operational modes	Test	
45	DP Control	Control Modes	Test	
46	DP Control	DP/ Joystick	Test transfer	
47	DP Control	Communications	Test	
48				
49				
50				

**EQUIPMENT SYSTEM : POWER GENERATION**

<b>TEST NO.</b> 1	<b>SUBSYSTEM:</b> FUEL OIL SYSTEM
<b>PURPOSE :</b> 1. Check operation of Quick Closing Valves.	
<b>METHOD :</b> 1) Operate controls for quick-closing valves located at the Emergency Headquarters. 2) Monitor the action of each valve and record result	
<b>EXPECTED RESULTS :</b> 1) Valves closes and fuel supply shut off. 2) Quick closing valves close as per test schedule.	
<b>RESULTS:</b>  1.        As Expected.  2.        As Expected.	
<b>COMMENTS :</b> <i>Emergency Generator and Work boat fuel tank valves tested.</i>	
<b>WITNESSED BY :</b> A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : POWER GENERATION**

<b>TEST NO.</b>	<b>2</b>	<b>SUBSYSTEM:</b> Fuel Oil
<b>PURPOSE :</b> Check operation of ME FO Boost Pumps, Auto stand-by start.		
<b>METHOD :</b> With generators on normal load, 1) Stop pump (A12), reinstate 2) Stop pump (A10), reinstate 3) Stop pump (A11), reinstate 4) Stop pump (A13), reinstate		
<b>EXPECTED RESULTS :</b> 1) Alarm, low fuel supply pressure, Stand-by pump starts. 2) Alarm, low fuel supply pressure, Stand-by pump starts. 3) Alarm, low fuel supply pressure, Stand-by pump starts. 4) Alarm, low fuel supply pressure, Stand-by pump starts.		
<b>RESULTS :</b>  1. As Expected.  2. As Expected.  3. As Expected.  4. As Expected.		
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b>	A.J.Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : POWER GENERATION**

<b>TEST NO.</b>	<b>3</b>	<b>SUBSYSTEM:</b> Fuel Oil
<b>PURPOSE :</b> Check operation of Daily Service Tank port and starboard low-level alarms. Check operation of high differential pressure across fuel filters.		
<b>METHOD :</b> 1) Simulate low level alarm sensor on port fuel oil service tank. 2) Simulate low level alarm sensor on starboard fuel oil service tank. 3) Simulate high differential pressure across filter port side 4) Simulate high differential pressure across filter starboard side		
<b>EXPECTED RESULTS :</b> 1) Alarm. 2) Alarm. 3) Alarm 4) Alarm		
<b>RESULTS :</b>  1. As Expected.  2. As Expected.  3. As Expected. No1. PS Fwd.  4. As Expected. No.4 Stbd Aft.		
<b>COMMENTS :</b>     		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : POWER GENERATION**

<b>TEST NO.</b>	<b>4</b>	<b>SUBSYSTEM:</b> Lubricating Oil
<b>PURPOSE :</b> 1) Test operation of low-low lub oil sensor 2) Check operation of diesel generator pre-lube oil pump. 3) Check operation of auto generator start, following loss of pre lub pump		
<b>METHOD :</b> 1) Isolate low-low lub oil sensor and drain 2) Check pre-lube pump start/stop at engine stop/start. 3) Isolate pre lub pump and try to start generator engine.		
<b>EXPECTED RESULTS :</b> 1) Alarm, generator sheds load, trips and shuts down. 2) Pre-lube pump starts when DG stops, and stops when DG starts. 3) Generator will not start if pre lub pump has not run in the previous 4 minutes.		
<b>RESULTS :</b>  1. As Expected.  2. As Expected.  3. As Expected.		
<b>COMMENTS :</b>  <i>Generator sheds load only when one generator is running.</i>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM :** POWER GENERATION

<b>TEST NO.</b>	<b>5</b>	<b>SUBSYSTEM:</b> SW Cooling
<b>PURPOSE :</b> Simulate low SW pressure Check for SW stand-by pump auto start.		
<b>METHOD :</b> For each sea suction in turn: 1) Isolate SW low-pressure switch and drain. Restore and stop the pump before test of the next pump.		
<b>EXPECTED RESULTS :</b> 1) Alarm SW low pressure. 2) Pump auto starts. Standby pump start alarm		
<b>RESULTS :</b>  Sea water pump A101 1. As Expected. 2. As Expected.  Sea water pump A102 1. As Expected. 2. As Expected.		
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : POWER GENERATION**

<b>TEST NO.</b>	<b>6</b>	<b>SUBSYSTEM:</b> SW Cooling
<b>PURPOSE :</b> Simulate loss of SW pressure Engines running at 50% load, measure subsequent temperature rise.		
<b>METHOD :</b> 1. Stop each seawater pump.		
<b>EXPECTED RESULTS :</b> 1) Alarm SW low pressure. 2) Alarm of High temperature, FW Low Temperature circuit, after five minutes.		
<b>RESULTS :</b>  1. As Expected.  2. Test commenced 1045 hrs, concluded 1045 hrs.  HT Temperature readings: Start 91/92degrees. Stop: 89/89 degrees.  LT Temperature readings: Start 37/37degrees. Stop: 40/41 degrees.		
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : POWER GENERATION**

<b>TEST NO.</b>	<b>7</b>	<b>SUBSYSTEM:</b> FW Cooling Generator engines
<b>PURPOSE :</b> With each diesel generator running, simulate failure of one FW circulation pump. Check for FW cooling alarm and auto start of standby pump.		
<b>METHOD :</b> For each circulation pump in turn 1) Stop FW pump No. 1. Restore. 2) Stop FW pump No. 2. Restore.		
<b>EXPECTED RESULTS :</b> 1) Alarm FW low pressure. Auto start of standby pump. 2) Alarm FW low pressure. Auto start of standby pump.		
<b>RESULTS :</b> 1.) As Expected 2.) As Expected.		
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : POWER GENERATION**

<b>TEST NO.</b>	<b>8</b>	<b>SUBSYSTEM:</b> FW Cooling System
<b>PURPOSE :</b> Simulate loss of FW circulation pumps. Check for temperature rise over five minutes.		
<b>METHOD :</b> Stop both circulation pumps and monitor temperature rise. For each circulation pump in turn 1) Stop FW pump No. 1 & No. 2. Monitor temperature rise on engines and thrusters		
<b>EXPECTED RESULTS :</b> 1) Alarm FW low pressure. Gradual increase in temperature on engines and thrusters 2) Loss of cooling water to frequency converters result in immediate shut of converter and loss of associated azimuth thruster		
<b>RESULTS :</b>		
1.	As Expected.  Test commenced 1050 hrs, concluded 1056 hrs.  HT Temperature readings: Start 91/90degrees. Stop: 85/85 degrees.  LT Temperature readings: Start 36/36degrees. Stop: 38/38 degrees.	
2.		
<b>COMMENTS :</b> <i>Frequency Converter Alarm HT 105 ° C, Shutdown 110 ° C.</i>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM :** POWER GENERATION

<b>TEST NO.</b> <b>9</b>	<b>SUBSYSTEM:</b> Control Air		
<b>PURPOSE :</b> Simulate loss of control air.			
<b>METHOD :</b> 1) Isolate control air system.			
<b>EXPECTED RESULTS :</b> 1) No effect on cooling water system, no pneumatic valves fitted. 2) Low pressure alarm on Thruster header tank.			
<b>RESULTS :</b>  1. As Expected.  2. No loss of pressure on thruster header tank.			
<b>COMMENTS :</b> <i>Low service air; alarm set at 5 Bar.</i>			
<b>WITNESSED BY :</b> A.J. Cumming		<b>DATE :</b> 19-February 2006	

**EQUIPMENT SYSTEM :** POWER GENERATION

<b>TEST NO.</b> <b>10</b>	<b>SUBSYSTEM:</b> Diesel Engines, speed Sensors		
<b>PURPOSE :</b> Simulate failure of Speed Sensor.			
<b>METHOD :</b> 1) To each engine in turn fail one speed sensor. Restore before continuing.			
<b>EXPECTED RESULTS :</b> 1) Alarm only, no effect on engine.			
<b>RESULTS :</b> Main sensors disconnected. 1) DG 1    As Expected. 2) DG2    As Expected. 3) DG 3    As Expected. 4) DG 4    As Expected.			
<b>COMMENTS :</b> <i>Top Sensor – Main, Bottom sensor – back up.</i>			
<b>WITNESSED BY :</b> A.J. Cumming		<b>DATE :</b> 19-February 2006	

**EQUIPMENT SYSTEM : POWER DISTRIBUTION**

<b>TEST NO.</b> <b>11</b>	<b>SUBSYSTEM:</b> Main Switchboard, Port Section	
<b>PURPOSE :</b> Simulate loss of port section of the main switchboard.		
<b>METHOD :</b> Set up with the bustie breaker open, in DP mode. Reduce number of DG on line to one; trip the breaker of the remaining DG.		
<b>EXPECTED RESULTS :</b> Partial Blackout 1) Loss of BT fwd when DG3 breaker is open, loss of connected consumers. Two servo failure and loss of hydraulics. 2) Switchboard section blacked out, loss of Bow Thruster and Port Azimuth, Pumps supplied from port switchboard stop, alarms and auto change over to standby pumps. 3) Momentary loss of 220V main switchboard until supply changeover to transformer T2. 4) Alarm for DP UPS, transfer to internal power. 5) Consequence alarm on DP. Vessel maintains position with remaining thrusters.		
<b>RESULTS :</b>  1. As Expected.  2. As Expected.  3. As Expected.  4. As Expected.		
<b>COMMENTS :</b> Wind sensor 1 & 2 were reported as “Not ready”. Modifications to the power supplies have since been done Ref Owner’s comments 18/3/06		
<b>WITNESSED BY :</b> A.J. Cumming	<b>DATE :</b> 19-February 2006	

**EQUIPMENT SYSTEM : POWER DISTRIBUTION**

<b>TEST NO.</b>	<b>12</b>	<b>SUBSYSTEM:</b> Main Switchboard, Stbd. Section
<b>PURPOSE :</b> Simulate loss of Stbd. section of the main switchboard.		
<b>METHOD :</b> Set up with the bustie breaker open, normal DP configuration.		
<b>EXPECTED RESULTS :</b> Loss of BT Aft when No. 4 DG shut down Partial Blackout when switchboard section s/d. Emergency generation starts 1) Loss of Bow thruster (T2) and Stbd. Azimuth (T4). 2) Connected pumps stop, alarms and change over to pumps powered from port switchboard. 3) Momentary loss of 220V main switchboard until manual supply changeover to transformer T1. 4) Consequence alarm on DP. Vessel maintains position with remaining thrusters.		
<b>RESULTS :</b>  1. As Expected.  2. As Expected.  3. As Expected.  4. As Expected.		
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : POWER DISTRIBUTION**

<b>TEST NO.</b>	<b>13</b>	<b>SUBSYSTEM:</b> 440V Main Switchboard
<b>PURPOSE :</b> Simulate loss of 440V Switchboard Port. Simulate loss of 440V Switchboard Stbd.		
<b>METHOD :</b> Set up with 440V switchboard bus tie open 1) Trip supply to Port Section, restore 2) Trip supply to Stbd. Section, restore.		
<b>EXPECTED RESULTS :</b> 1) Loss of Port Azimuth, Fwd BT, Loss of ECR monitor. Loss of consumers from Port Section, no loss of position. 2) Loss of Stbd Azimuth, Aft BT, and consumers from Starboard Section, no loss of position. Auto start of emergency generator.  No effects to DP.		
<b>RESULTS :</b>  1. As Expected, except no loss of ECR monitor. 2. As per test 12.		
<b>COMMENTS :</b> <b>ECR monitor is now fitted with UPS.</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : POWER DISTRIBUTION**

<b>TEST NO.</b>	<b>14</b>	<b>SUBSYSTEM:</b> 220V Main Switchboard
<b>PURPOSE :</b> Simulate loss of 440V/220V transformers T1 and T2		
<b>METHOD :</b> Set up with transformer T1 online, 1) Trip the breaker supplying T1, restore Set up with transformer T2 online, 2) Trip the breaker supplying T2, restore No effect on DP		
<b>EXPECTED RESULTS :</b> 1) Loss of ECR monitor, BT fwd and aft electrical cabinet system failure, Azimuth PS & SS ATU converter No. 1 gear fail. Momentary loss of 220V main distribution until manual changeover to other transformer. 2) Client No. 12 communication Ethernet main & back up fail. 3) Alarms for engine room 24VDC battery systems Nos. 1 and 2. (on batteries). 4) Loss of supply to forward bridge distribution panel (no effects, change over to 220V emergency).  No effects to DP.		
<b>RESULTS :</b>  1. As Expected.  2. As Expected.  3. As Expected.  4. As Expected.		
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : POWER DISTRIBUTION**

<b>TEST NO.</b>	<b>15</b>	<b>SUBSYSTEM:</b> Emergency Distribution
<b>PURPOSE :</b> Simulate loss of supply to emergency switchboard.		
<b>METHOD :</b> Switch emergency generator to manual. Trip the supply breaker on the main switchboard. Activate emergency generator		
<b>EXPECTED RESULTS :</b> Loss of 440V and 220V emergency distribution. 1) Loss of Stbd Azimuth due to loss of lub oil pressure. Loss of 220V backup supply to forward bridge distribution panel (no effects, main 220V still available, no alarm). 2) Alarm, loss of port and stbd. back up 220V supplies. Loss of backup supply to engine room 24VDC battery systems nos. 1 and 2 (no effects, main 220V still available, no alarm). 3) Above consumers restored.  No effects to DP.		
<b>RESULTS :</b>  1. As Expected.  2. As Expected.  3. As Expected.		
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : POWER DISTRIBUTION**

<b>TEST NO.</b>	<b>16</b>	<b>SUBSYSTEM:</b> Engine Room 24VDC Distribution	
<b>PURPOSE :</b> Simulate failures to the engine room 24VDC systems. Test batteries.			
<b>METHOD :</b> To each engine room 24VDC distribution system in turn: 1) 24VDC UPS, fail supply from 220V main switchboard (Praxis ER monitoring) 2) 24VDC battery charger, fail supply from 220V main switchboard; 3) 24VDC battery charger, fail supply from 220V emergency switchboard; 4) Test batteries for 30 minutes.			
<b>EXPECTED RESULTS :</b> 1) Alarm. Breaker within distribution panel automatically closes, supply to 24VDC UPS consumers from battery charger. 2) 220V supply changes over 220V emergency. 3) 24VDC consumers on batteries. 4) 30 minutes OK.			
<b>RESULTS :</b>			
	<u>ER system No. 2 (MSB)</u>		<u>ER system No. 1 (wheelhouse)</u>
1.	Charging Voltage 27.0V Start 25.40 V, Finish 24.12V Current 50.0A		
2.			
3.			
4.	Charging Voltage 28.2 V Start 25.51 V, Finish 24.79V Current 10.0A		Charging Voltage 28.2 V Start 25.4V, Finish 24.3V Current 19A
<b>COMMENTS :</b> <i>Complete list of consumers detailed below.</i>			
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b>	19-February 2006

**POWER DISTRIBUTION 24V DC CONSUMERS WHEELHOUSE ECR SUPPLY MSB1****Located in Void space under Bridge**

<b>Breaker</b>	<b>Consumer</b>
Q1	TLDP1 (See list of consumers below)
Q2	DP 24V ER Port Side
Q3	Docking Console PS wheelhouse – no alarm upon loss of supply
Q4	Docking Console SS wheelhouse – no alarm upon loss of supply
Q5	Magnetic Compass Lamp – no alarm upon loss of supply
Q6	Master Compass Gyro 1 – alarm “fail dc supply” + horn – c/o to backup supply
Q7	Master Compass Gyro 2 - alarm “fail dc supply” + horn – c/o to backup supply
Q8	Rate of Turn repeater wheelhouse – no alarm – back up supply to be identified.
Q9	Steering Control Unit Wheelhouse – alarmed – Auto c/o to backup supply
Q10	Sound Reception System Wheelhouse – no alarm
Q11	SDP – OS Mounting Plate Combined Prop Control – Alarm in centre DP Control Panel
Q12	PS – OS Mounting Plate Combined Prop Control – Alarm in centre and PS DP Control Panel
Q13	SS – OS Mounting Plate Combined Prop Control – Alarm in centre and SS DP Control Panel
Q14	Hull Mounted Sonar display unit – no alarm upon loss of supply
Q15	Echo Sounder digital repeater, - no alarm – backup supply? identify
Q16	Speed log digital display wheelhouse no alarm
Q17	Speed log analogue display wheelhouse port side no alarm
Q18	Speed log analogue display wheelhouse stbd side no alarm
Q19	CapSat Fleet 77 electric unit comms console (Sat Comms)– no alarm
Q20	Emergency Table Mounted Console – no alarm – backup supply?
Q21	Aquamaster Control Unit – loss of Port side Azi, - alarms and deselected from DP desk
Q22	Combined propulsion and steering console – no alarm
Q23	Alarm and monitoring System DPU5 - Loss of Bow Thruster Aft, - no ECR alarms – Alarms on bridge with associated BT alarms - No DPU5 supply c/o alarm. - When power restored to DPU5 BT aft restarted without intervention.
Q24	Master Compass Gyro 3 – DP system alarm – gyro still functional
Q25	Speed log master display wheel house – still working – no alarm
Q26	Sensor unit GPS Hydro Console off during test due to earth fault

**MSB2 24V DC – UPS Consumers. E.Room – Port Upper**

Q1	TLDP 3 – see below
Q2	Spare
Q3	Engine PS Fwd relay module
Q4	Engine SS Fwd relay module
Q5	FW Preheater Control Voltage – Alarm Control voltage loss, common alarm Stbd Fwd Engine.
Q6	DDG set A003 PS Aft backup supply – alarm “PS Aft relay module failure”
Q7	Stbd. Aft Common alarm Loss of A004 Stbd Aft Main supply.
Q8	PMS Genr. SB aft – alarm “DG4 CB Control Supply Fail.
Q9	MBS 690V Stbd. Fwd. Alarm “ DG3 CB Control Supply Fail.
Q10	Mach. Control Room Console ECR indication lights only
Q11	Steering Control Unit wheelhouse – no alarm, no effect on DP – secondary supply to autopilot provided from UPS.

**DP 24V DC Supply. E.Room – Stbd Upper**

<b>Breaker</b>	<b>Consumer</b>
Q1	DG A001 PS Fwd Main supply - Loss of indication (run) engine stays running – alarm “relay module, coms error”
Q2	DG A002 SB Fwd Backup supply, running indication maintained by primary supply – additional alarms (see printout)
Q3	DG A003 PS Aft Main supply - alarm “relay module comm error, common alarm turbo rpm indication” – running indication lost
Q4	DG A004 Stbd. Aft – retained running indication. Via backup supply – alarm “eng stbd aft relay module fail” other alarms”Start air, LO inlet press. Relay module fail, LT and HT FW inlet
Q5	Fresh water Preheater Control – no alarm upon loss of supply
Q6	Alarm- “Bow Thruster Fwd. Electrical Cabinet System failure” alarms stay up – restore and reset at panel in Bow Thruster Room
Q7	Bow Thruster Forward alarm indications only, Alarms for Seal Tk Low, Gravity Tk low, Servo oil pressure low, motor O/L, high filter diff pressure – Thruster continues running
Q8	PMS Port side Aft Alarms – “DG1 CB Control Supply fail” – engine keeps running
Q9	PMS PS Fwd Alarms – “DG2 CB Control Supply fail – engine keeps running – failure of indication in the one line diagram

**TLDP 1**

Breaker	Consumer
Q1	Lighting
Q2	Lighting
Q3	Lighting
Q4	Lighting
Q5	Lighting
Q6	WT doors control alarm – “Power Failure” (doors close automatically)
Q7	WT doors – alarm/indication – alarm – “WT doors power failure”
Q8	WT door magnets – no alarm
Q9	Emergency Telegraph – loss of indication - no alarm
Q10	Bridge Control Unit for thrusters Warnings for: Stbd Azimuth ACU unit Port Azimuth ACU unit Azimuth master /slave bridge warning. Thrusters continue to run.
Q11	Spare
Q12	Provisional deck crane – no effect on DP.
Q13	Navigation light panel – alarm “Nav. Light panel main supply missing”
Q14	Junction box for Aldis lamp - alarm “Aldis Lamp main supply missing”
Q15	Talkback – inoperative due to loss of power – no alarm
Q16	Hospital Call Unit – not commissioned yet.
Q17	Ship’s security alarm system DSAJ – not commissioned
Q18	Emergency Whistle – no alarm
Q19	Switchover unit (gyro) - no alarm

**TLDP3**

Breaker	Consumer
Q1	Lighting
Q2	Lighting
Q3	Lighting
Q4	Aquamaster control supply. Loss of Stbd. Azimuth Alarms on DP
Q5	PLC Panel Alarm “Loss of buoy handling power winch”

**EQUIPMENT SYSTEM : POWER DISTRIBUTION**

<b>TEST NO.</b>	<b>17</b>	<b>SUBSYSTEM:</b> UPS Systems No. 1 for DP
<b>PURPOSE :</b> Simulate failure of the UPS No. 1 for DP. Test batteries.		
<b>METHOD :</b> 1) Fail 440V main supply to UPS 1. 2) Test batteries for 30 minutes. 3) Turn off power supply to DP consumers.		
<b>EXPECTED RESULTS :</b> 1. Output to consumers change over to battery supply. 2. 30 minutes OK. 3. Loss of: <u>UPS 1</u> Consumers: F1 DPC 21 (Controller A) F2 OS1 (Fwd Bridge) F3 DGPS 1 F4 Fan beam power (not currently fitted) F5 DP alarm printer F6 Gyro 1 .....F7 Taut Wire 220V F8 MRU 2		
<b>RESULTS :</b>  <u>DP UPS no. 1</u> 1. As Expected. 2. Start 2120: 98.5V, Stop 2150: 98.1V Current 6 A 3. As Expected.		
<b>COMMENTS :</b> <b>Power not turned off to F3, DGPS 1.</b> <b>F7 Taut Wire and F8 MRU 2 now on UPS 1.</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : POWER DISTRIBUTION**

<b>TEST NO.</b>	<b>18</b>	<b>SUBSYSTEM:</b> UPS Systems No. 2 for DP									
<b>PURPOSE :</b> Simulate failure of the UPS No. 2 for DP. Test batteries.											
<b>METHOD :</b> 1) Fail 440V main supply to UPS 2. 2) Test batteries for 30 minutes. 3) Turn off power supply to DP consumers.											
<b>EXPECTED RESULTS :</b> 1) Output to consumers change over to battery supply. 2) 30 minutes OK. 3) Loss of: <u>UPS 2</u> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Consumers: F1 DPC 21 Controller B)</td> <td style="width: 50%;">F5 OS 3</td> </tr> <tr> <td>F2 OS2</td> <td>F6 HiPAP Transducer</td> </tr> <tr> <td>F3 Screen capture printer</td> <td>F7 Gyro 2</td> </tr> <tr> <td>F4 APC 10 &amp; HiPAP display</td> <td></td> </tr> </table>				Consumers: F1 DPC 21 Controller B)	F5 OS 3	F2 OS2	F6 HiPAP Transducer	F3 Screen capture printer	F7 Gyro 2	F4 APC 10 & HiPAP display	
Consumers: F1 DPC 21 Controller B)	F5 OS 3										
F2 OS2	F6 HiPAP Transducer										
F3 Screen capture printer	F7 Gyro 2										
F4 APC 10 & HiPAP display											
<b>RESULTS :</b> <table style="width: 100%; border: none;"> <tr> <td style="width: 20%;"></td> <td style="width: 80%; text-align: center;"><u>DP UPS No.2</u></td> </tr> <tr> <td>1.</td> <td>As Expected</td> </tr> <tr> <td>2.</td> <td>Start 2130: 98.4V, Stop 2200: 97.0V Current 12.2A</td> </tr> <tr> <td>3.</td> <td>As Expected.</td> </tr> </table>					<u>DP UPS No.2</u>	1.	As Expected	2.	Start 2130: 98.4V, Stop 2200: 97.0V Current 12.2A	3.	As Expected.
	<u>DP UPS No.2</u>										
1.	As Expected										
2.	Start 2130: 98.4V, Stop 2200: 97.0V Current 12.2A										
3.	As Expected.										
<b>COMMENTS :</b> <b>F8 TW, now on F7 UPS 1.</b>											
<b>WITNESSED BY :</b>		A.J. Cumming	<b>DATE :</b>								
			19-February 2006								

**EQUIPMENT SYSTEM : POWER MANAGEMENT SYSTEM**

<b>TEST NO.</b>	<b>19</b>	<b>SUBSYSTEM:</b> Power Supplies
<b>PURPOSE :</b> Simulate loss of power supply to PMS and alarm system.		
<b>METHOD :</b> 1) Fail 24VDC supply to PMS from ER distribution panel no. 1. Restore. 2) Fail power supply to alarm computer from ER distribution panel no. 2. Restore. 3) Fail power supply to alarm system monitor from dedicated UPS system. Restore		
<b>EXPECTED RESULTS :</b> 1) No immediate effects. Not possible to remotely operate the switchboard, or start thrusters from the bridge. 2) Loss of alarm and monitoring system. No effect. 3) Loss of monitor. No effects.  No effect on DP		
<b>RESULTS :</b>  1. As Expected 2. UPS now fitted. 3. As Expected.		
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM :** POWER MANAGEMENT SYSTEM

<b>TEST NO.</b>	<b>20</b>	<b>SUBSYSTEM:</b> PMS functions
<b>PURPOSE :</b> Test blackout recovery, autostart of standby auxiliary generator. Test load dependent autostart of standby auxiliary generator. Test heavy load consumers start inhibit.		
<b>METHOD :</b> Setup with only one diesel generator running on port switchboard section selected other generator as standby. 1) Trip running generator (i.e. simulate LO low pressure). 2) Increase the load on busbar, i.e. input move on DP, or operate in manual joystick. 3) Attempt start of a thruster.		
<b>EXPECTED RESULTS :</b> 1) Blackout, standby generator starts and connects. 2) Standby generator starts and connects. 3) Starting blocked. Standby generator starts and connects.  No effect on vessel position.		
<b>RESULTS :</b>  1. Lost T1 & T3, Stand-By Generator starts and connects.  2. As Expected.  3. As Expected.		
<b>COMMENTS :</b> <i>Second Generator to be running before starting second thruster.</i>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : POWER MANAGEMENT SYSTEM**

<b>TEST NO.</b> <b>21</b>	<b>SUBSYSTEM:</b> Kilowatt Signal Loss / Bus Tie Info
<b>PURPOSE :</b> Test system to loss of kW signals. Test system for loss of bus tie status data	
<b>METHOD :</b> With all thrusters and generators on line. 1) Disconnect kW signal cable from DP system. Terminal Board 25A1 tag 8C / 9C. 2) Disconnect bus tie status signal, Terminals DPJC 441 and DP11 439.	
<b>EXPECTED RESULTS :</b> 1) DP shows loss of generator on mimic, spinning reserve unaffected. No change in thruster or generator status. 2) DP alarm, “Power out of Range” 3) No change in thruster or generator status  No effect on DP.	
<b>RESULTS :</b>  1. As Expected. 2. As Expected. 3. As Expected.	
<b>COMMENTS :</b>	
<b>WITNESSED BY :</b> A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM :** POWER MANAGEMENT SYSTEM

<b>TEST NO.</b> <b>22</b>	<b>SUBSYSTEM:</b> Loss of CAN Bus		
<b>PURPOSE :</b> Test system to loss of CAN Bus.			
<b>METHOD :</b> With all thrusters and generators on line. 1) Test for loss of one of the dual CAN Bus to the individual PMS module. 2) Fail second CAN Bus feed			
<b>EXPECTED RESULTS :</b> 1) Alarm, Board not present. 2) Generator operates in droop mode.			
<b>RESULTS :</b>  1. As Expected.  2. As Expected, in addition, loss of mimic.			
<b>COMMENTS :</b>			
<b>WITNESSED BY :</b> A.J. Cumming		<b>DATE :</b> 19-February 2006	

**EQUIPMENT SYSTEM : POWER MANAGEMENT SYSTEM**

<b>TEST NO.</b> <b>23</b>	<b>SUBSYSTEM:</b> DPU Failure	
<b>PURPOSE :</b> Test system to loss of DPU.		
<b>METHOD :</b> With all thrusters and generators on line. 1) Simulate failure of DPU 1 2) Simulate failure of DPU 2 3) Simulate failure of DPU 3 4) Simulate failure of DPU 4 5) Simulate failure of DPU 5.		
<b>EXPECTED RESULTS :</b> 1. On E/R mimic, Loss of “indication only” on Fwd BT. 2. On E/R mimic, Loss of “indication only” on Aft BT. 3. On E/R mimic, Loss of “indication only” on Port Azimuth. 4. On E/R mimic, Loss of “indication only” on Stbd. Azimuth. 5. Alarm, loss of consumers.  No effect on DP.		
<b>RESULTS :</b>  1. As Expected.  2. As Expected.  3. As Expected.  4. As Expected.  5. As Expected.		
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : THRUSTERS**

<b>TEST NO.</b>	<b>24</b>	<b>SUBSYSTEM:</b> T 1 & T2 (Tunnel Thrusters), Pitch Signals (KS)	
<b>PURPOSE :</b> Simulate failure of signals to each tunnel thruster in turn.			
<b>METHOD :</b> To each tunnel thruster in turn: 1) Fail pitch reference (command) signal from DP to control unit, before isolation amplifier. 2 2) Fail pitch feedback signal from control unit to DP, before isolation amplifier. 3) Fail pitch reference (command) signal after isolation amplifier from control unit to thruster. 4) Fail pitch feedback signal from thruster to control unit.			
<b>EXPECTED RESULTS :</b> 1) Pitch fails to zero, “Thruster Prediction error” alarm on DP. 2) Thruster still controlling pitch, feedback indication on DP to zero, No alarm on DP. 3) Pitch freeze, thruster “Ready Signal” lost, and “Thruster Not Ready alarm on DP). 4) Thruster’s pitch to zero immediately.			
<b>RESULTS :</b>			
	<u>Thruster T 1</u>	<u>Thruster T2</u>	
1.	As Expected	As Expected	
2.	T 1 input error, no feedback. Pitch to zero.	T 2 input error, no feedback. Pitch to zero.	
3.	As Expected.	As Expected.	
4.	Pitch fails as set.	Pitch fails as set.	
<b>COMMENTS :</b>  <b>Pitch fails as Set on loss of feedback signal from thruster to ECU.</b>			
<b>WITNESSED BY :</b>		<b>DATE :</b>	
A.J. Cumming		19-February 2006	

**EQUIPMENT SYSTEM : THRUSTERS**

<b>TEST NO.</b>	<b>25</b>	<b>SUBSYSTEM:</b> T 1 & T2 (Tunnel Thrusters), Pitch Signals (Rolls Royce)	
<b>PURPOSE :</b> Simulate failure of signals to each tunnel thruster in turn.			
<b>METHOD :</b> To each tunnel thruster in turn: 1) Fail pitch command signal. 2) Fail pitch feedback signal.			
<b>EXPECTED RESULTS :</b> 1) Pitch fails to zero, Alarm “Thruster not ready” alarm. DP indicates zero pitch, gives indication that thruster stopped, but is actually running, ready and enabled. 2) Thruster still controlling pitch, feedback indication on DP to zero, Alarm “Thruster input error”. Thruster remains running ready and enabled.			
<b>RESULTS :</b>			
	<u>Thruster T 1</u>	<u>Thruster T2</u>	
1.	As Expected	As Expected	
2.	As Expected, Feedback to -30°	As Expected, Feedback to -30°	
<b>COMMENTS :</b>			
<b>WITNESSED BY :</b>		A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : THRUSTERS**

<b>TEST NO.</b>	<b>26</b>	<b>SUBSYSTEM:</b> T 3 & T4, Speed Signals	
<b>PURPOSE :</b> Simulate failure of speed signals to azimuth thruster.			
<b>METHOD :</b> 1) Fail speed reference (command) signal from DP to thruster converter before isolation amplifier. 2) Fail speed feedback signal from thruster to DP. 3) Fail speed reference (command) signal after isolation amplifier. 4) Fail speed feedback signal from thruster to Aquamaster control unit.			
<b>EXPECTED RESULTS :</b> 1) Speed fails to zero, alarm “Thruster deselected” alarm on DP. 2) Thruster still controlling speed, alarm “input error” on DP. Thruster lost from Aquamaster RR Control desk. 3) Thruster stops, no alarm, indicating running, ready and enabled. 4) No effect.			
<b>RESULTS :</b>			
<b>T 3</b>		<b>T 4</b>	
1. Zero speed, alarm “Thruster prediction error”, Thruster remains in DP.		Zero speed, alarm “Thruster prediction error”, Thruster remains in DP.	
2. As Expected, Thruster available on RR desk.		As Expected, Thruster available on RR desk.	
3. Alarm, “Thruster Prediction error”, Pitch to zero, indicating running, ready and enabled.		Alarm, “Thruster Prediction error”, Pitch to zero, indicating running, ready and enabled.	
4. As Expected.		As Expected.	
<b>COMMENTS :</b>			
<b>WITNESSED BY :</b>		<b>DATE :</b>	
A.J. Cumming		19-February 2006	

**EQUIPMENT SYSTEM : THRUSTERS**

<b>TEST NO.</b> <b>27</b>	<b>SUBSYSTEM:</b> T 3 & T4 Azimuth Signals	
<b>PURPOSE :</b> Simulate failure of azimuth signals to azimuth thruster.		
<b>METHOD :</b> 1) Fail azimuth reference (command) signal from DP to control unit. 2) Fail azimuth feedback signal from control unit to DP. 3) Fail azimuth feedback signal from thruster to control unit.		
<b>EXPECTED RESULTS :</b> 1) Azimuth fails to zero position, speed still controlling. Alarm “Thruster prediction error”. No control, thruster running, ready and enabled, fails to fore & aft position. 2) No effect. 3) Thruster deselected. Thruster fails as set, Alarm “Thruster Steering Prediction error” on DP. Thruster stays in desk, indicated as running, ready and enabled.		
<b>RESULTS :</b>		
	<b>T 3</b>	<b>T 4</b>
1.	As Expected.	As Expected.
2.	As Expected.	As Expected.
3.	Alarm, “Thruster prediction error”. Thruster freely rotating with pitch on. Vessel position destabilised.	Alarm, “Thruster prediction error”. Thruster freely rotating with pitch on. Vessel position destabilised.
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : THRUSTERS**

<b>TEST NO.</b>	<b>28</b>	<b>SUBSYSTEM:</b> Hydraulic Systems
<b>PURPOSE :</b> Simulate failure of hydraulic system for each thruster in turn. Test hydraulic level alarms		
<b>METHOD :</b> 1) Bow thrusters; locally stop running hydraulic pump. Restore and repeat for other tunnel thruster. 2) Simulate hydraulic level alarms		
<b>EXPECTED RESULTS :</b> 1) Alarm automatic start of standby pump. Tunnel thruster remaining in operation. 2) Alarm, low level. Thruster stays running.		
<b>RESULTS :</b>  1. As Expected.  2. As Expected.		
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM : THRUSTERS**

<b>TEST NO.</b>	<b>29</b>	<b>SUBSYSTEM:</b> Emergency Stops			
<b>PURPOSE :</b> Test thruster emergency stops.					
<b>METHOD :</b> Activate thruster emergency stops from all locations. Restore and reselect to DP before tripping the next					
<b>EXPECTED RESULTS :</b> 1) Thruster T1 stop. Deselect from DP, “Unavailable” alarm. 2) Thruster T2 stop. Deselect from DP, “Unavailable” alarm. 3) Thruster T3 stop. Deselect from DP, “Unavailable” alarm. 4) Thruster T4 stop. Deselect from DP, “Unavailable” alarm.					
<b>RESULTS :</b>					
	Local	Bridge Fwd	Bridge Port	Bridge Stbd.	ECR
1.			T 3		N/A
2.		T 2		T 1	N/A
3.	T 3				
4.					T 4
<b>COMMENTS :</b> <i>Five emergency stops tested. All emergency stops are tested monthly, as per AMOS PMS.</i>					
<b>WITNESSED BY :</b>			<b>DATE :</b>		
A.J. Cumming			19-February 2006		

**EQUIPMENT SYSTEM : THRUSTERS**

<b>TEST NO.</b>	<b>30</b>	<b>SUBSYSTEM:</b> Frequency Drives	
<b>PURPOSE :</b> 1. Verify Alarms on T3 and T4			
<b>METHOD :</b> 1) Simulate water temperature alarm 2) Simulate water leakage alarm in converter panel 3) Simulate motor temperature alarm 4) Simulate current control system fault. 5) Fail PLC on frequency drive converter			
<b>EXPECTED RESULTS :</b> 1) Alarm, HH alarm results in thruster shut down. 2) Alarm, water leakage, thruster shuts down 3) Alarm, HH alarm results in thruster shut down. 4) Alarm, no effect on DP 5) Alarm, loss of thruster 6) Power to thrusters chopped back			
<b>RESULTS :</b>		<b>T3</b>	<b>T4</b>
1.	As Expected		As Expected
2.	As Expected, but no alarm in E/Room on shut down of thruster.		As Expected, but no alarm in E/Room on shut down of thruster.
3.	Alarm, and motor stop.		Alarm, and motor stop.
4.	Not Tested		Not Tested
5.	As Expected		As Expected
6.	Not Tested		Not Tested
<b>COMMENTS :</b> <b>Alarm to be incorporated in Engine room monitoring software.</b>			
<b>WITNESSED BY :</b>		A.J. Cumming	<b>DATE :</b> 19-February 2006

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b>	<b>31</b>	<b>SUBSYSTEM:</b> Networks
<b>PURPOSE :</b> Simulate failure of Ethernet networks.		
<b>METHOD :</b> 1) One at a time, disconnect the Ethernet cables from each Ethernet hub. Restore before disconnecting the next. 2) One at a time, fail the power supply to Ethernet hub. Restore before failing the other. 3) Test Ethernet LAN for O/C, S/C and ground		
<b>EXPECTED RESULTS :</b> 1) Alarm, communications between consoles continue on other Ethernet network. 2) Alarm, communications between consoles interrupt. No effects to online console and DP. 3) Alarm, communications continue on other network. Earth indication.		
<b>RESULTS :</b>  1.  2.  3.		
<b>COMMENTS :</b> <b>Test not carried out due to the ETO being unable to fail either net.</b> <b>This test to be carried out a.s.a.p. to confirm redundancy.</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 20-February 2006

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b> 32	<b>SUBSYSTEM:</b> DP Consoles		
<b>PURPOSE :</b> Simulate power failure to OS Display.			
<b>METHOD :</b> 1) Turn off power supply to master DP Display. Restore. 2) Turn off power supply to stand-by DP Display. Restore			
<b>EXPECTED RESULTS :</b> 1) Alarm but no loss of position. Requires manual change over to stand by console. 2) Same for other console.  No effects to positioning.			
<b>RESULTS :</b>  1. As Expected  2. As Expected			
<b>COMMENTS :</b> <i>Incorporate in UPS tests.</i>			
<b>WITNESSED BY :</b> A.J. Cumming		<b>DATE :</b> 20-February 2006	

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b> 33	<b>SUBSYSTEM:</b> Computer Failure	
<b>PURPOSE :</b> To check that a bumpless transfer takes place to the offline desk		
<b>METHOD :</b> On DP, DPC 21-1 on line 1. Trip power supply to DPC21-1 2. Observe position accuracy. Restore DPC 21-2 On line 1. Trip power supply to DPC21-2 2. Observe position accuracy. Restore 3. Fail supply to OS1 when OS1 in use. Restore 4. Fail supply to OS2 when OS2 in use. Restore		
<b>EXPECTED RESULTS :</b> 1 Loss of DPC21-1, auto changeover to DPC21-2 2 No change in position. 3 Loss of DPC21-2, auto changeover to DPC21-1. 4 No change in position. 5 Alarm 6 Alarm		
<b>RESULTS :</b> 1. 2. 3. 4. 5. 6.		
<b>COMMENTS :</b> <i>Test carried out when failing UPS 1 and 2.</i>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 20-February 2006

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b>	<b>34</b>	<b>SUBSYSTEM:</b> Gyro Compasses	
<b>PURPOSE :</b> Simulate failure of gyro compasses. Prove gyro redundancy.			
<b>METHOD :</b> To one gyro compass at a time: 1) Fail gyro compass power supply. 2) Fail gyro compass interface to DP console. 3) Test gyro difference alarms			
<b>EXPECTED RESULTS :</b> 1) Alarm, Gyro switches to back up supply 2) Gyro 2: alarm “Gyro Failure”, rejected from median. Loss of HPR. 3) Alarm			
<b>RESULTS :</b>			
	Gyro 1	Gyro 2	Gyro 3
1.	No alarm on Bridge	No alarm on Bridge	No alarm on Bridge
2.	Alarm, compass (x) not ready, Gyro (x) communication error. Lost Gyro to DP.		
3.	Unable to simulate the 2° difference.		
<b>COMMENTS :</b> <b>There is no alarm on the Bridge for the loss of the main power supply to the Gyros. On loss of Gyro 1 or 2 back –up supply, there is an alarm on the ford bridge. There is no alarm for the back-up supply of Gyro 3.</b>			
<b>WITNESSED BY :</b>		<b>DATE :</b>	
A.J. Cumming		20-February 2006	

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b>	<b>35</b>	<b>SUBSYSTEM:</b> Anemometers
<b>PURPOSE :</b> Simulate failure of anemometers. Prove anemometers redundancy.		
<b>METHOD :</b> 1 Lead wind direction at a 45 degrees angle (partly shielding and leading by small board), release after 20 seconds. 2 Fail power supply to wind sensor 3 Fail serial input wind sensor to DPC 4 Stop preferred wind sensor by hand (bucket test) 5 Change to other wind sensor 6 Measure excursion of position 7 Release sensor		
<b>EXPECTED RESULTS :</b> 1. Wind direction difference alarm, small increase in thruster activity. 2. Alarm, wind not ready. 3. Alarm, wind not ready. 4. Wind speed difference alarm. 5. Increase in thruster activity. 6. Unstable position. 7. Position restored.		
<b>RESULTS :</b>  1. Not carried out due to no safe access on the mast to the wind sensors. 2. Alarm, communication error. 3. Wind (x), communication error. 4. Not tested 5. Not tested 6. Not tested 7. Not tested		
<b>COMMENTS :</b> <b>Power supplies at present are taken from EMSB; this should be changed to a separate UPS supply, or taken from the DP consoles.</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 20-February 2006

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b> <b>36</b>	<b>SUBSYSTEM:</b> Motion Reference Unit (MRU)		
<b>PURPOSE :</b> Simulate failure of MRU.			
<b>METHOD :</b> 1) Fail MRU 1 power supply. Restore. 2) Fail MRU 2 power supply. Restore. 3) Fail MRU 1 input signal, roll, pitch & heave to DP. Restore 4) Fail MRU 2 input signal roll, pitch & heave to DP. Restore			
<b>EXPECTED RESULTS :</b> 1) Alarm to DP. Loss of HPR. Possible effects to both DGPS positioning. 2) Alarm. Possible effects to both DGPS positioning. 3) As Expected. 4) As Expected.			
<b>RESULTS :</b>  1. No loss of HPR. (The pitch and roll indication on HPR screen goes to zero)  2. Alarm, no effects on positioning to calm weather conditions.  3. Alarm, HPR1 not ok.  4. As expected, loss of Roll, Pitch and Heave.			
<b>COMMENTS :</b> <b>MRU 1 – Powered from DP</b> <b>MRU 2 – UPS</b> <b>MRU 2 signal to HPR.</b>			
<b>WITNESSED BY :</b> A.J. Cumming		<b>DATE :</b> 20-February 2006	

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b>	<b>37</b>	<b>SUBSYSTEM:</b> DGPS Systems
<b>PURPOSE :</b> Test performance of DGPS systems. Simulate failures.		
<b>METHOD :</b> 1. Rotate vessel through 360° and check for blind sectors. 2. Simulate communication failure by failing input telegram from in turn, DGPS 1, 2 & 3 to DP 3. Simulate DGPS rejection by reducing the number of satellites from 6 downwards and wait to see when rejection takes place. 4. Fail IALA diff. Signal 5. Fail diff signal from Inmarsat- DGPS 1 6. Fail Spotbeam diff signal, DGPS 3		
<b>EXPECTED RESULTS :</b> 1. No sectors where position data is lost 2. Time out alarm and zero weight 3. Use of altitude aiding, rejection when five satellites 4. Alarm, loss of diff. signal to DGPS, other corrections still available 5. Alarm, loss of diff signal to DGPS, other corrections still available 6. Alarm, loss of last diff signal to DGPS, GPS mode available		
<b>RESULTS :</b>  1. Blind sector to be verified on DGPS 1. 2. DGPS communication error. 3. As Expected. 4. Loss of DGPS 2 5. Loss of DGPS 1 after 5 minutes. 6. Loss of DGPS 3.		
<b>COMMENTS :</b> <i>DGPS 1- Veripos- Diff Spot or Inmarsat- UPS 1</i> <i>DGPS 2- Lecia- Diff IALA- 24V GMDSS Supply</i> <i>DGPS 3- Trimble- Diff Spot Beam – 24V MSB 1</i>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 20-February 2006

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b>	<b>38</b>	<b>SUBSYSTEM:</b> HiPAP System
<b>PURPOSE :</b> Test performance of acoustic system. Simulate failures.		
<b>METHOD :</b> Setup with acoustic system online with other reference systems. 1) Compare performance with other systems. 2) Fail power supply to position reference console. 3) Fail gyro 1 input. 4) Fail MRU 1 input.		
<b>EXPECTED RESULTS :</b> 1) Weighting equally divided with other reference systems. 2) Loss of acoustics and rejected from DP. 3) Acoustics rejected from DP. 4) Acoustics rejected from DP.		
<b>RESULTS :</b>  1. As Expected.  2. As Expected.  3. Heading freezes on HPR screen, HPR “Not ok”, then rejected.  4. As Expected.		
<b>COMMENTS :</b>     		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 20-February 2006

**EQUIPMENT SYSTEM : SENSORS**

<b>TEST NO.</b>	<b>39</b>	<b>SUBSYSTEM:</b> Taut Wire
<b>PURPOSE :</b> Verify operation of Taut Wire Alarm Limits		
<b>METHOD :</b> Move vessel to exceed taut wire warning and alarm limits. 1) To port 2) To starboard 3) To aft 4) To forward		
<b>EXPECTED RESULTS :</b>  1) Alarm, taut wire exceeding limits, Taut wire deselected. 2) Alarm, taut wire exceeding limits, Taut wire deselected. 3) Alarm, taut wire exceeding limits, Taut wire deselected. 4) Alarm, taut wire exceeding limits, Taut wire deselected.		
<b>RESULTS :</b>  1. As Expected. 2. As Expected. 3. As Expected. 4. As Expected.		
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 20-February 2006

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b> <b>40</b>	<b>SUBSYSTEM:</b> Fan Beam
<b>PURPOSE :</b> Test position reference stability and overshoot.	
<b>METHOD :</b> Establish vessel in stable position relative to the target. Compare with another reference system. 1) Move vessel 20m towards target and compare with other reference systems. 2) Move vessel aft 20m from target and compare with other reference systems.	
<b>EXPECTED RESULTS :</b> 1) No significant difference. 2) No significant difference.	
<b>RESULTS :</b>  1.  2.	
<b>COMMENTS :</b> <i>Test not carried out due to Fan Beam not being fitted.</i>	
<b>WITNESSED BY :</b>	<b>DATE :</b>

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b>	<b>41</b>	<b>SUBSYSTEM:</b> Model Control
<b>PURPOSE :</b> Test model control upon loss of all position references.		
<b>METHOD :</b> On DP 1) Leave system to build the model for at least 20 minutes (do not input moves/heading changes or change thruster configuration) 2) Deselect all position references from DP. 3) Utilise independent reference to measure position loss, measure after 5 minutes.		
<b>EXPECTED RESULTS :</b> 1. Position drop out alarm 2. Vessel moves of position slowly.		
<b>RESULTS :</b>  1. As Expected. 2. Vessel moves 14m after 5 minutes.		
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b>	A.J. Cumming	<b>DATE :</b> 20-February 2006

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b> 42	<b>SUBSYSTEM:</b> BLANK
<b>PURPOSE :</b>	
<b>METHOD :</b>	
<b>EXPECTED RESULTS :</b>	
<b>RESULTS :</b>	
<b>COMMENTS :</b>	
<b>WITNESSED BY :</b>	<b>DATE :</b>

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b> <b>43</b>	<b>SUBSYSTEM:</b> Consequence Analysis		
<b>PURPOSE :</b> Test consequence analysis alarms.			
<b>METHOD :</b> With all generators on line and all thrusters 1) Reduce number of generators, restore 2) Reduce number of thrusters, restore.			
<b>EXPECTED RESULTS :</b> 1) Consequence analysis warning 2) Consequence analysis warning.			
<b>RESULTS :</b>  1. Consequence analysis tested several times throughout the trials  2. Consequence analysis tested several times throughout the trials			
<b>COMMENTS :</b>			
<b>WITNESSED BY :</b> A.J. Cumming		<b>DATE :</b> 20-February 2006	

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b> 44	<b>SUBSYSTEM:</b> Operational Modes		
<b>PURPOSE :</b> Test all operational modes while on DP.			
<b>METHOD :</b> While on DP, test operation of all operational modes, 1) High precision Mode. 2) Relaxed Mode. 3) Green Control			
<b>EXPECTED RESULTS :</b> 1) Improved position keeping 2) Reduced fuel consumption 3) Reduced fuel consumption.			
<b>RESULTS :</b>  1. As Expected.  2. As Expected.  3. As Expected.			
<b>COMMENTS :</b>			
<b>WITNESSED BY :</b> A.J. Cumming		<b>DATE :</b> 20-February 2006	

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b> 45	<b>SUBSYSTEM:</b> Control Modes		
<b>PURPOSE :</b> Test all other control modes while on DP.			
<b>METHOD :</b> While on DP, test operation of all other control modes, 1) Manual control, levers, transit etc.			
<b>EXPECTED RESULTS :</b> 1) DP system in control, others ineffective.			
<b>RESULTS :</b>  1. As Expected			
<b>COMMENTS :</b> <i>Expand test to include all consoles.</i>			
<b>WITNESSED BY :</b> A.J. Cumming		<b>DATE :</b> 20-February 2006	

**EQUIPMENT SYSTEM :** DP CONTROL SYSTEM

<b>TEST NO.</b> <b>46</b>	<b>SUBSYSTEM:</b> Change over, DP Main / DP Joystick Control
<b>PURPOSE :</b> Test the change over between DPC (Aft) and DPC (Fwd)	
<b>METHOD :</b> 1) Check operation of command transfer from SDP-21 to joystick control. 2) Simulate fault in transfer line.  With all sensors and reference systems on line: 3) Test operation from OS 1 console. (Bridge Fwd) 4) Test joystick.	
<b>EXPECTED RESULTS :</b> 1) Smooth change-over. 2) Alarm, no transfer possible. 3) Normal operation 4) Joystick manoeuvre smoothly.	
<b>RESULTS :</b>  1.  2.  3.  4.	
<b>COMMENTS :</b> <i>Test not carried out due to the vessel not being fitted with an independent joystick.</i>	
<b>WITNESSED BY :</b>	<b>DATE :</b>

**EQUIPMENT SYSTEM :** Communications

<b>TEST NO.</b> 47	<b>SUBSYSTEM:</b> Communication Systems and DP Alerts	
<b>PURPOSE :</b> Check functionality of communication systems and DP alerts.		
<b>METHOD :</b> 1) Test all communications system (telephones, intercoms, etc.). 2) Test DP alerts.		
<b>EXPECTED RESULTS :</b> All systems operational.		
<b>RESULTS :</b>  1. As Expected.  2. As expected.		
<b>COMMENTS :</b>		
<b>WITNESSED BY :</b> A.J. Cumming	<b>DATE :</b> 20-February 2006	