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MENAS

OFFSHORE SUPPORT VESSEL

“RELUME”

DP FMEA PROVING TRIALS 2004 RESULTS

Report No: GM-44514-0904-48010, Rev.0

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SUMMARY

Global Maritime have attended the “RELUME” and witnessed the commissioning and DP trials for the vessel.

The trials were carried out at West Pit, approximately 10 miles NW of Vlissingen, Netherlands, between the 3rd and 5th September and concluded on the 14th September.

The completed trials sheets together with the status report of the DP related equipment is appended to this report.

The list of items from the first trial were all closed out on the second trial, so this report has no A or B recommendations.

Following the conclusion of the trials Lloyds Register confirmed that the vessel would be given their AA DP notation (DP Class 2).

This document should be read with the FMEA report GM 44514-0404-47837.

KEYWORDS

| | | | |
|---------------|-----------|---------------------|--------|
| ANNUAL TRIALS | CPP | DYNAMIC POSITIONING | IMCA |
| MENAS | THRUSTERS | RELUME | CANMAN |

1. INTRODUCTION

1.1 Instructions

1.1.1 Global Maritime was requested by MENAS to prepare an FMEA and trials program for their new build vessel “Relume”.

1.2 Scope Of Work

1.2.1 The scope of work includes:

1. Prepare draft DP FMEA,
2. Prepare a programme of trials to validate the assumptions of the FMEA,
3. Attend the vessel, co-ordinate and record results of trials,
4. Issue final FMEA following the conclusion of the trials.

1.2.2 This report covers Item 3 of the above.

1.3 Background

1.3.1 The Offshore Support Vessel “Relume”, was built at Schelde Naval Shipbuilding, The Netherlands. During the construction Global Maritime were instructed to review the vessel systems and prepare a DP FMEA.

1.3.2 This trials document is based the DP FMEA and is designed to verify the assumptions made.

- 1.6.2 All tests were co-ordinated with the Master of the vessel with full regard to the vessels safety. All tests were carried out on full DP with some varying load on the systems, induced by movements of the vessel, due to the very calm weather conditions.
- 1.6.3 During the trials the vessel's staff 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.
- 1.6.4 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.
- 1.6.5 The results from testing by Class was included in this document and the tests not repeated where applies and when documented.
- 1.6.6 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.
- 1.6.7 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.
- 1.6.8 Any the items that needed to be closed out are listed in section 3.

2. TRIALS CONCLUSIONS AND FINDINGS

2.1 Conclusions

2.1.1 Global Maritime witnessed the 2004 FMEA proving trials on the “Relume”. From the results of the trials and 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 DP operations within normal operational limits of the vessel with no exceptions.

2.2 Category A

2.2.1 There were no Category A items found.

2.3 Category B

2.3.1 There were no Category B items found.

2.4 Trials Conduct and Findings

2.4.1 Power Generation

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

2.4.2 Power Distribution

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

2.4.3 Power Management

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

2.4.4 Thrusters And Propulsion

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

2.4.5 DP Control Systems

All tests were completed satisfactorily as per the trials programme with the exception of those items already tested as part of the Customer Acceptance trials, which were conducted by the Yard, The Owner and Lloyds Register.

2.4.6 Communications

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

2.4.7 Maintenance

As the vessel is currently being delivered from the Yard, all equipment is new and insufficient running hours accumulated to require maintenance.

2.4.8 Personnel

The ship’s staff and yard personnel rendered every assistance during the trials and enabled the vessel to produce excellent results achieved.

3. ACTION LIST**3.1 For Immediate Attention**

3.1.1 There are no items requiring immediate attention.

3.2 For Action When Reasonably Convenient

3.2.1 The output frequency of Bridge UPS No. 2 is currently 50Hz, while the consumers are 60Hz. This is to be rectified by Kongsberg Simrad.

3.3 For Future Attention/Consideration

3.3.1 None.

PART 1 – EQUIPMENT STATUS

EQUIPMENT STATUS**1. Thrusters and Propulsion**

| | <i>T 1</i> | <i>T 2</i> | <i>T 3t</i> | <i>T 4</i> |
|---|------------|------------|-------------|------------|
| MAINTENANCE RECORDS CHECKED | New | New | New | New |
| OUTSTANDING MAINTENANCE | None | None | None | None |
| LAST OIL ANALYSIS (DATE) | New | New | New | New |
| LAST OIL ANALYSIS OK | N/A | N/A | N/A | N/A |
| Remarks: | | | | |
| 1. All the equipment is new with running hours accumulated prior to the trials of less than 200hours. | | | | |

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 | New | New | New | New | New |
| OUTSTANDING MAINTENANCE | All equipment new | | | | |
| LAST OIL ANALYSIS (DATE) | N/A | N/A | N/A | N/A | N/A |
| LAST OIL ANALYSIS OK | N/A | N/A | N/A | N/A | N/A |
| RUNNING HOURS: AT PRESENT | New | New | New | New | New |
| LAST MAJOR OVERHAUL | N/A | N/A | N/A | N/A | N/A |
| Remarks: | | | | | |
| 1. All the equipment is new with running hours accumulated prior to the trials of less than 200hours. | | | | | |

3. Electrical Protection

| Circuit Breakers | Date | Company |
|--|-------------|----------------|
| Switchboard Bus Ties | New | |
| Generator Breakers | New | |
| Thruster Breakers | New | |
| Remarks: Yard delivered vessel to Owners on 15 th September 2004. | | |

4. DP Sensors

| Sensor | Records Checked | Remarks |
|--|------------------------|----------------|
| Gyro 1 | New | |
| Gyro 2 | New | |
| Gyro 3 | New | |
| Wind Sensor 1 | New | |
| Wind Sensor 2 | New | |
| MRU 1 | New | |
| MRU 2 | New | |
| DGPS 1 | New | |
| DGPS 2 | New | |
| DGPS 3 | New | |
| Sonardyne HPR | New | |
| Taut Wire | New | |
| Fan Beam | New | |
| Remarks: All equipment newly fitted. | | |

5. DP Computers

| | |
|--|-------------------------------|
| Maintenance checked? | New installation |
| Last software revision? | 1.9 Update 9 (Build 13810) |
| Dates of last DP Control system software upgrade | SdpOS exe generated 2004/9/04 |
| Remarks: None | |

6. UPS

| Unit | Battery check | Remarks |
|-------------------------|---------------|---------|
| UPS 1 | New | |
| UPS 2 | New | |
| | | |
| Remarks: None | | |

7. Hardware Modification

| | |
|---|------------|
| Have there been any modifications since last annual trials? | New vessel |
| Have modifications been thoroughly tested? | N/A |
| Have trials procedures (Part 2) been updated? | N/A |

8. Capability Plots

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

PART 2 – 2004 DP TRIALS SHEETS

| Test | System | Subsystem | Component | Comment |
|------|---------------------|--------------------------|-------------------------------|----------------|
| 1 | Power Generation | Fuel Oil System | Q/C V/Vs | Done |
| 2 | Power Generation | Fuel Oil System | Boost P/ps | Done |
| 3 | Power Generation | Fuel Oil System | Fuel meter system | Done |
| 4 | Power Generation | Fuel Oil System | Tk. level and filter alarms | Done |
| 5 | Power Generation | Lub. Oil System | Pre lub test | Done |
| 6 | Power Generation | SW Cooling | Venting | Done |
| 7 | Power Generation | SW Cooling | P/P auto start A101 & A102 | Done |
| 8 | Power Generation | SW Cooling | Loss and temp rise | Done |
| 9 | Power Generation | FW Cooling | FW P/p speed change | Done |
| 10 | Power Generation | FW Cooling | FW Hdr. Tk. level alarms | Done |
| 11 | Power Generation | FW Cooling | Loss of FW cooling | Done |
| 12 | Power Generation | Control Air | Loss of | Done |
| 13 | Power Generation | Ventilation | Loss of | Done |
| 14 | Power Generation | Fuel Control System | Loss of | Done |
| 15 | Power Generation | Excitation | Loss of | Done |
| 16 | Power Distribution | Main Switchboard | Loss of Port Section | Done |
| 17 | Power Distribution | Main Switchboard | Loss of Stbd. Section | Done |
| 18 | Power Distribution | 440V switchboard | Loss of Port & Stbd. Sections | Done |
| 19 | Power Distribution | 220V switchboard | Loss of T1 and T2 | Done |
| 20 | Power Distribution | Emerg. Switchboard | Loss of switchboard | Done |
| 21 | Power Distribution | 24V dc | Loss of supply | Done |
| 22 | Power Distribution | UPS 1 | Loss of UPS | Done |
| 23 | Power Distribution | UPS 2 | Loss of UPS | Done – comment |
| 24 | Power Management | Power Supply | Loss of supply | Done |
| 25 | Power Management | Function | Blackout recovery | Done |
| 26 | Power Management | kW signal | Loss of kW & bus tie signals | Done |
| 27 | Power Management | CAN Bus | Loss of | Done |
| 28 | Power Management | DPU | Loss of | Done |
| 29 | Thrusters | Thrusters No. 1 & 2 | Pitch signals (KS) | Done |
| 30 | Thrusters | Thrusters No. 1 & 2 | Pitch signals (Imtech) | Done |
| 31 | Thrusters | Thruster No. 3 & 4 (Azi) | Speed signal | Done |
| 32 | Thrusters | Thruster No. 4 (Azi) | Azimuth signal | Done |
| 33 | Thrusters | Control Panel | Loss of panel | CAT |
| 34 | Thrusters | Hydraulics | Loss of hydraulics | Done |
| 35 | Thrusters & Engines | Emerg. Stops | Function test | Done |
| 36 | Thruster | Ventilation | Shut down test | Done |
| 37 | DP Control | Networks | Loss of network | Done |
| 38 | DP Control | DP Consoles | Loss of consoles | Done |
| 39 | DP Control | Gyros | Loss of gyros | CAT |
| 40 | DP Control | Anemometers | Loss of anemometers | Done |
| 41 | DP Control | VRU | Loss of VRU | CAT |
| 42 | DP Control | DGPS System | Redundancy | CAT |
| 43 | DP Control | DGPS Capability | Loss of DGPS | CAT |
| 44 | DP Control | HiPAP | Loss of | CAT |
| 45 | DP Control | Fan Beam | Loss of | CAT |
| 46 | DP Control | Model Control | Test | CAT |
| 47 | DP Control | Pos. Ref. Weighting | Test | CAT |
| 48 | DP Control | Consequence Analysis | Test | Done |
| 49 | DP Control | Operational modes | Test | CAT |
| 50 | DP Control | Control Modes | Test | Done |
| 51 | DP Control | DP Main / Backup | Test transfer | CAT |
| 52 | DP Control | Communications | Test | Done |
| 53 | Thrusters | Frequency Drives | Test | Done |
| 54 | Sensors | Taut Wire | Test | CAT |
| 55 | Fire Suppression | CO2 | Test switches | Done |
| 56 | Blank | Blank | Blank | |

EQUIPMENT SYSTEM : POWER GENERATION

| | |
|--|-----------------------------------|
| TEST NO. 1 | SUBSYSTEM: FUEL OIL SYSTEM |
| PURPOSE : 1. Check operation of Quick Closing Valves. | |
| METHOD : 1) Operate controls for quick-closing valves located at the Emergency Headquarters. 2) Monitor the action of each valve and record result | |
| EXPECTED RESULTS : 1) Valves closes and fuel supply shut off. 2) Quick closing valves close as per test schedule. | |
| RESULTS: 1) Port side forward No. 3 Generator, tested - OK 2) Stbd. Side forward No. 2 Generator, tested - OK All other valves previously tested and witnessed by LR | |
| COMMENTS : | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 3/9/04 |

EQUIPMENT SYSTEM : POWER GENERATION

| | |
|--|-------------------------------|
| TEST NO. 2 | SUBSYSTEM: Fuel Oil |
| PURPOSE : Check operation of ME FO Boost Pumps stand-by start. | |
| METHOD : 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 | |
| EXPECTED RESULTS : 1) Alarm, low fuel supply pressure. 2) Alarm, low fuel supply pressure 3) Alarm, low fuel supply pressure 4) Alarm, low fuel supply pressure. | |
| RESULTS : 1) 2) 3) 4) | |
| COMMENTS : Pumps not used in normal operation, test combined with test overleaf. | |
| WITNESSED BY : | DATE : |

EQUIPMENT SYSTEM : POWER GENERATION

| | | |
|--|-------------------|-------------------------------|
| TEST NO. | 3 | SUBSYSTEM: Fuel Oil |
| PURPOSE : 1) Simulate failure of fuel metering system. | | |
| METHOD: With generators on no load, 1) Restrict fuel output from metering system supply boost pump A12 starts, reinstate. 2) Restrict fuel output from metering system supply boost pump A10, reinstate 3) Restrict fuel output from metering system supply boost pump A11, reinstate 4) Restrict fuel output from metering system supply boost pump A13, reinstate. | | |
| EXPECTED RESULTS : 1) Alarm, low fuel supply pressure, boost pump starts, alarm boost pump started. 2) Alarm, low fuel supply pressure, boost pump starts, alarm boost pump started. 3) Alarm, low fuel supply pressure, boost pump starts, alarm boost pump started. 4) Alarm, low fuel supply pressure, boost pump starts, alarm boost pump started. | | |
| RESULTS : 1) As expected. 2) As expected. 3) As expected. 4) As expected. | | |
| COMMENTS : Coarse filter fitted before boost pump, no differential pressure alarm fitted across this filter. Fine filter fitted on each engine and fitted with differential pressure alarm. | | |
| WITNESSED BY : | J. Farrell-Dillon | DATE : 3/9/04 |

EQUIPMENT SYSTEM : POWER GENERATION

| | | |
|---|-------------------------------|--|
| TEST NO. 4 | SUBSYSTEM: Fuel Oil | |
| PURPOSE : Check operation of Daily Service Tank port and starboard low-level alarms. Check operation of high differential pressure across fuel filters | | |
| METHOD : 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 | | |
| EXPECTED RESULTS : 1) Alarm. 2) Alarm. 3) Alarm 4) Alarm | | |
| RESULTS : 1) Tested – OK Alarm level 15% 2) Tested – OK Alarm level 15% 3) Previously tested by Engine manufacturer and LR 4) Previously tested by Engine manufacturer and LR | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 3/9/04 | |

EQUIPMENT SYSTEM : POWER GENERATION

| | | |
|---|--------------------------------------|--|
| TEST NO. 5 | SUBSYSTEM: Lubricating Oil | |
| PURPOSE : 1) Simulate failure of diesel generator gear driven LO pump, check stand-by pump auto start. 2) Test operation of low-low lub oil sensor 3) Check operation of diesel generator pre-lube oil pump. 4) Check operation of generator start following loss of pre lub pump 5) Test start under simulated blackout conditions | | |
| METHOD : 1) Isolate low LO pressure alarm pressure switch and drain. 2) Isolate low-low lub oil sensor and drain 3) Check pre-lube pump start/stop at engine stop/start. 4) Isolate pre lub pump and try to start generator engine. 5) Simulate loss of mains supply and attempt engine start | | |
| EXPECTED RESULTS : 1) Alarm, stand-by pump auto starts. 2) Alarm, generator sheds load, trips and shuts down 3) Pre-lube pump starts when DG stops, and stops when DG starts. 4) Generator will not start if pre lub pump has not run in the previous 4 minutes. 5) Timer lockout bypassed and engine starts without pre-lub pump | | |
| RESULTS : 1) Not applicable 2) Tested previously by LR 3) Result as expected 4) Tested Port side Fwd - OK 5) No timer lockout fitted. Both 1300kW engine priming pumps supplied from Emergency switchboard | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 3/9/04 | |

EQUIPMENT SYSTEM : POWER GENERATION

| | |
|---|---|
| TEST NO. 6 | SUBSYSTEM: Cooling venting arrangements |
| PURPOSE : Check operation of SW cooling sea suction vents. | |
| METHOD : With one seawater pump running and the other on auto start. 1) Open weed-clearing line to port sea suction and monitor seawater pressure. | |
| EXPECTED RESULTS : 1) No loss of pressure, air is discharged through vent system. | |
| RESULTS : 1) Venting system inspected and found to be adequate. | |
| COMMENTS : Test not carried out | |
| WITNESSED BY : | DATE : |

EQUIPMENT SYSTEM : POWER GENERATION

| | |
|--|---------------------------------|
| TEST NO. 7 | SUBSYSTEM: SW Cooling |
| PURPOSE : Simulate low SW pressure Check for SW stand-by pump auto start. | |
| METHOD : 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. | |
| EXPECTED RESULTS : 1) Alarm SW low pressure. 2) Pump auto starts. Standby pump start alarm | |
| RESULTS : Sea water pump A101 1) Result as expected. 2) Result as expected. Sea water pump A102 1) Result as expected. 2) Result as expected. | |
| COMMENTS : | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 3/9/04 |

EQUIPMENT SYSTEM : POWER GENERATION

| | | |
|--|-------------------|---------------------------------|
| TEST NO. | 8 | SUBSYSTEM: SW Cooling |
| PURPOSE : Simulate loss of SW pressure Measure subsequent temperature rise. | | |
| METHOD : Stop each seawater pump. Monitor temperature rise | | |
| EXPECTED RESULTS : 1) Alarm SW low pressure. 2) Temperature rises. | | |
| RESULTS : 1) Alarm 2) Alarm of High temperature, FW Low Temperature circuit, after five minutes, engines running at 75% load. Test commenced 17.02hrs, concluded 17.07hrs. Temperature readings: Start 39 degrees. Stop: 45 degrees. | | |
| COMMENTS : | | |
| WITNESSED BY : | J. Farrell-Dillon | DATE : 5/9/04 |

EQUIPMENT SYSTEM : POWER GENERATION

| | | |
|--|---|--|
| TEST NO. 9 | SUBSYSTEM: FW Cooling Generator engines | |
| PURPOSE : With each diesel generator running, simulate failure of one FW circulation pump. Check for FW cooling alarm and auto start of standby pump. | | |
| METHOD : For each circulation pump in turn 1) Stop FW pump No. 1. Restore. 2) Stop FW pump No. 2. Restore. | | |
| EXPECTED RESULTS : 1) Alarm FW low pressure. Auto start of standby pump. 2) Alarm FW low pressure. Auto start of standby pump. | | |
| RESULTS : FW P/P No. 1 1) Result as expected 2) Result as expected FW P/P No. 2 1) Result as expected 2) Result as expected | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 14/9/04 | |

EQUIPMENT SYSTEM : POWER GENERATION

| | | |
|--|--|--|
| TEST NO. 10 | SUBSYSTEM: FW Cooling System | |
| PURPOSE : Test operation of level sensors in FW header and Buffer Tanks No. 1 and No. 2. | | |
| METHOD : For each tank in turn 1) Simulate operation of low level sensor. Restore. 2) Simulate operation of low level sensor. Restore. | | |
| EXPECTED RESULTS : 1) Alarm. 2) Alarm. 3) Alarm. | | |
| RESULTS : Header Tk. 1) Alarm as expected Buffer Tk No. 1 2) Alarm as expected Buffer tank No. 2 3) Alarm as expected. | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 4/9/04 | |

EQUIPMENT SYSTEM : POWER GENERATION

| | | |
|--|--|--|
| TEST NO. 11 | SUBSYSTEM: FW Cooling System | |
| PURPOSE : Simulate loss of FW circulation pumps. Check for temperature rise over five minutes. | | |
| METHOD : 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 | | |
| EXPECTED RESULTS : 1) Alarm FW low pressure. Gradual increase in temperature on engines and thrusters | | |
| RESULTS : 1) Loss of cooling water to frequency converters result in immediate shut of converter and loss of associated azimuth thruster | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 4/9/04 | |

EQUIPMENT SYSTEM : POWER GENERATION

| | | |
|--|----------------------------------|--|
| TEST NO. 12 | SUBSYSTEM: Control Air | |
| PURPOSE : Simulate loss of control air. | | |
| METHOD : 1) Isolate control air system and drain. | | |
| EXPECTED RESULTS : 1) No effect on cooling water system, no pneumatic valves fitted. 2) Low pressure alarm on Thruster header tank. | | |
| RESULTS : 1) As expected. 2) As expected. | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 4/9/04 | |

EQUIPMENT SYSTEM : POWER GENERATION

| | | |
|---|----------------------------------|--|
| TEST NO. 13 | SUBSYSTEM: Ventilation | |
| PURPOSE : Simulate loss of ventilation. | | |
| METHOD : In each engine room stop one supply fan. 1) Port engine room stop one fan, reinstate 2) Starboard engine room, stop one fan, reinstate | | |
| EXPECTED RESULTS : 1) Remaining supply fans sufficient for both diesel generators in port engine room 2) Remaining supply fans sufficient for both diesel generators in starboard engine room. | | |
| RESULTS : 1) Both engines loaded to 50%. Fan stopped, other fan increased to high speed – OK. 2) Both engines loaded to 50%. One fan stopped, no effect on engine performance. | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 4/9/04 | |

EQUIPMENT SYSTEM : POWER GENERATION

| | | |
|--|--|----------------------|
| TEST NO. 14 | SUBSYSTEM: Diesel Engines, Fuel Actuator | |
| PURPOSE : Simulate failure of Fuel Actuator. | | |
| METHOD : 1) To each auxiliary generator in turn switch off the power supply to the fuel actuator. <ul style="list-style-type: none"> • Restore supply and restart engine before continuing to the next. 2) To each engine in turn fail one speed sensor. Restore before continuing. | | |
| EXPECTED RESULTS : 1) Auxiliary generator shuts down. 2) Alarm only, no effect on engine. | | |
| RESULTS : | | |
| | 1) | 2) |
| 1) DG 1 | As expected | As expected |
| 2) DG2 | As expected | As expected |
| 3) DG 3 | As expected | As expected |
| 4) DG 4 | As expected | As expected |
| COMMENTS : | | |
| WITNESSED BY : | J. Farrell-Dillon | DATE : 4/9/04 |

EQUIPMENT SYSTEM : POWER GENERATION

| | | |
|---|---|-----------------------|
| TEST NO. 15 | SUBSYSTEM: Diesel Engines, Excitation | |
| PURPOSE : Simulate failure of generator excitation. | | |
| METHOD : 1) To each engine in turn simulate failure of excitation circuit. Restore before continuing. | | |
| EXPECTED RESULTS : 1) Alarm auxiliary generator trips. 2) Repeat for other engines | | |
| RESULTS : 1) DG 1 Alarm and trips 2) DG2 Alarm and trips 3) DG 3 Alarm and trips 4) DG 4 Alarms and trips | | |
| COMMENTS : Generators tested in Manual and Auto Modes. | | |
| WITNESSED BY : | J. Farrell-Dillon | DATE : 14/9/04 |

EQUIPMENT SYSTEM : POWER DISTRIBUTION

| | | |
|--|---|--|
| TEST NO. 16 | SUBSYSTEM: Main Switchboard, Port Section | |
| PURPOSE : Simulate loss of port section of the main switchboard. | | |
| METHOD : 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. | | |
| EXPECTED RESULTS : Partial Blackout 1) Loss of connected consumers 2) Pumps supplied from port switchboard stop, alarms and change over to pumps powered from starboard section (pumps nos. 2) 3) Momentary loss of 220V main switchboard until supply changeover to transformer T2. 4) Alarm for DP UPS, transfer to internal power. Vessel maintains position with remaining thrusters. | | |
| RESULTS : 1) Loss of BT Fwd when DG3 breaker opened 2) Switchboard section blacked out. Loss of port Azimuth. Automatic change over of cooling pumps 3) Transfer to alternative supply 4) As expected. | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 4/9/04 | |

EQUIPMENT SYSTEM : POWER DISTRIBUTION

| | | |
|--|--|--|
| TEST NO. 17 | SUBSYSTEM: Main Switchboard, Stbd. Section | |
| PURPOSE : Simulate loss of Stbd. section of the main switchboard. | | |
| METHOD : Set up with the bustie breaker open, normal DP configuration. | | |
| EXPECTED RESULTS : Loss of BT Aft when No. 4 DG shut down Partial Blackout when switchboard section s/d. Emergency generation starts 1) Loss of Stbd. Azimuth. 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. Vessel maintains position with remaining thrusters. | | |
| RESULTS : 1) As expected. 2) As expected. 3) As expected. | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 14/9/04 | |

EQUIPMENT SYSTEM : POWER DISTRIBUTION

| | | | |
|---|---------------------|--|------------------------|
| TEST NO. | 18 | SUBSYSTEM: 440V Main Switchboard | |
| PURPOSE : Simulate loss of 440V Switchboard Port. Simulate loss of 440V Switchboard Stbd. | | | |
| METHOD : Set up with 440V switchboard bus tie open 1) Trip supply to Port Section, restore 2) Trip supply to Stbd. Section, restore. | | | |
| EXPECTED RESULTS : 1) Loss of consumers from Port Section, no loss of DP. 2) Loss of consumers from Starboard Section, no loss of DP. No effects to DP. | | | |
| RESULTS : | | | |
| | Port | | Stbd. |
| 1) | Port Azi stops | | Stbd. Azi stops |
| | Fwd BT stops | | Aft BT stops |
| | Loss of ECR monitor | | Emergency genr. starts |
| COMMENTS : | | | |
| WITNESSED BY : | | J. Farrell-Dillon | DATE : 14/9/04 |

EQUIPMENT SYSTEM : POWER DISTRIBUTION

| TEST NO. 19 | SUBSYSTEM: 220V Main Switchboard | | | | | | | | | | | |
|--|--|--|------|-------|------------------------|--|---|--|---|--|---|--|
| PURPOSE : Simulate loss of 440V/220V transformers T1 and T2 | | | | | | | | | | | | |
| METHOD : 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 | | | | | | | | | | | | |
| EXPECTED RESULTS : 1) Momentary loss of 220V main distribution until manual changeover to other transformer. 2) Alarms for engine room 24VDC battery systems Nos. 1 and 2. (on batteries). 3) Loss of supply to forward bridge distribution panel (no effects, change over to 220V emergency). No effects to DP. | | | | | | | | | | | | |
| RESULTS : <table style="width: 100%; border: none;"> <thead> <tr> <th style="text-align: left; width: 50%;">Port</th> <th style="text-align: left; width: 50%;">Stbd.</th> </tr> </thead> <tbody> <tr> <td>1) Loss of ECR monitor</td> <td>1) Client No. 12 Comm ethernet Main fail</td> </tr> <tr> <td>2) BT Aft electrical cabinet system failure</td> <td>2) Client No. 12 Comm ethernet Backup fail</td> </tr> <tr> <td>3) BT Fwd electrical cabinet system failure</td> <td></td> </tr> <tr> <td>4) Az PS & SS ATU converter No. 1 gear fail</td> <td></td> </tr> </tbody> </table> | | | Port | Stbd. | 1) Loss of ECR monitor | 1) Client No. 12 Comm ethernet Main fail | 2) BT Aft electrical cabinet system failure | 2) Client No. 12 Comm ethernet Backup fail | 3) BT Fwd electrical cabinet system failure | | 4) Az PS & SS ATU converter No. 1 gear fail | |
| Port | Stbd. | | | | | | | | | | | |
| 1) Loss of ECR monitor | 1) Client No. 12 Comm ethernet Main fail | | | | | | | | | | | |
| 2) BT Aft electrical cabinet system failure | 2) Client No. 12 Comm ethernet Backup fail | | | | | | | | | | | |
| 3) BT Fwd electrical cabinet system failure | | | | | | | | | | | | |
| 4) Az PS & SS ATU converter No. 1 gear fail | | | | | | | | | | | | |
| COMMENTS : All thrusters remain available on DP | | | | | | | | | | | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 4/9/04 | | | | | | | | | | | |

EQUIPMENT SYSTEM : POWER DISTRIBUTION

| | | |
|---|---|--|
| TEST NO. 20 | SUBSYSTEM: Emergency Distribution | |
| PURPOSE : Simulate loss of supply to emergency switchboard. | | |
| METHOD : Switch emergency generator to manual. Trip the supply breaker on the main switchboard. | | |
| EXPECTED RESULTS : Loss of 440V and 220V emergency distribution. 1) Loss of 220V backup supply to forward bridge distribution panel (no effects, main 220V still available, no alarm). 2) Loss of backup supply to engine room 24VDC battery systems nos. 1 and 2 (no effects, main 220V still available, no alarm). 3) Activate emergency generator. Above consumers restored. No effects to DP. | | |
| RESULTS : 1) Loss of Stbd Azi due to loss of lub oil pressure (supplied from emergency switchboard) 2) Port and stbd. side backup 220V supplies lost, alarm 3) Port and stbd side main supplies off – alarms. | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 14/9/04 | |

EQUIPMENT SYSTEM : POWER DISTRIBUTION

| | | | |
|--|---|---|--|
| TEST NO. | 21 | SUBSYSTEM: Engine Room 24VDC Distribution | |
| PURPOSE : Simulate failures to the engine room 24VDC systems. Test batteries. | | | |
| METHOD : To each engine room 24VDC distribution system in turn: 1) 24VDC UPS, fail supply from 220V main switchboard; 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. | | | |
| EXPECTED RESULTS : 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. | | | |
| RESULTS : | | | |
| | <u>ER system No. 1</u> | <u>ER system No. 2 (in wheelhouse)</u> | |
| 1. | As expected | As expected | |
| 2. | As expected | As expected. | |
| 3. | As expected | As expected. | |
| 4. | Start 25.68V, finish 25.4V Current 10A | Start 25.6V, finish 24.6V Current 20A | |
| COMMENTS : Complete list of consumers detailed overleaf. | | | |
| WITNESSED BY : | | DATE : | |
| J. Farrell-Dillon | | 14/9/04 | |

POWER DISTRIBUTION 24V DC CONSUMERS WHEELHOUSE ECR SUPPLY MSB1

| Breaker | Consumer |
|----------------|---|
| 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 |

MSB 2 24V DC – UPS Consumers

| | |
|-----|---|
| 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

| Breaker | Consumer |
|----------------|---|
| 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 Warning s for: Stbd Azi ACU unit Port Azi 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 | Juntion box for addis lamp - alarm “Addis 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

| | | |
|---|---|--|
| TEST NO. 22 | SUBSYSTEM: UPS Systems No. 1 for DP | |
| PURPOSE : Simulate failure of the UPS No. 1 for DP. Test batteries. | | |
| METHOD : 1) Fail 440V main supply to UPS 1. 2) Test batteries for 30 minutes. 3) Turn off power supply to DP consumers. | | |
| EXPECTED RESULTS : 1. Output to consumers changes over to battery supply. 2. 30 minutes OK. 3. Loss of: <u>UPS 1</u> Consumers: F1 DPC 21 (Controller A) F2 OS1 (identified on OS3 as OS3) F3 Fan beam supply (not currently fitted) F4 Fan beam power (not currently fitted) F5 DP alarm printer F6 Gyro 1 – (alarm given but no loss of gyro as it is provided with alternative supply) | | |
| RESULTS : <u>DP UPS no. 1</u> 1. As expected 2. As expected 3. As expected | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 4/9/04 | |

EQUIPMENT SYSTEM : POWER MANAGEMENT SYSTEM

| | | |
|--|-------------------------------------|--|
| TEST NO. 24 | SUBSYSTEM: Power Supplies | |
| PURPOSE : Simulate loss of power supply to PMS and alarm system. | | |
| METHOD : 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 | | |
| EXPECTED RESULTS : 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. | | |
| RESULTS : 1) Result as expected 2) Result as expected 3) Result as expected | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 4/9/04 | |

EQUIPMENT SYSTEM : POWER MANAGEMENT SYSTEM

| | | |
|--|-------------------|------------------------------------|
| TEST NO. | 25 | SUBSYSTEM: PMS functions |
| PURPOSE : Test blackout recovery, autostart of standby auxiliary generator. Test load dependent autostart of standby auxiliary generator. Test heavy load consumers start inhibit. | | |
| METHOD : 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. | | |
| EXPECTED RESULTS : 1) Blackout, standby generator starts and connects. 2) Standby generator starts and connects. 3) Starting prevented. Standby generator starts and connects. | | |
| RESULTS : 1) Done as part of previous test 2) Not applicable. 3) As expected. | | |
| COMMENTS : (In normal DP Class 2 operations both diesel generators in each engine room are normally running) | | |
| WITNESSED BY : | J. Farrell-Dillon | DATE : 4/9/04 |

EQUIPMENT SYSTEM : POWER MANAGEMENT SYSTEM

| | |
|--|--|
| TEST NO. 26 | SUBSYSTEM: Kilowatt Signal Loss / Bus Tie Info |
| PURPOSE : Test system to loss of kW signals. Test system for loss of bus tie status data | |
| METHOD : 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. | |
| EXPECTED RESULTS : 1) No change in thruster or generator status. 2) No change in thruster or generator status | |
| RESULTS : 1) Mimic shows loss of generator, spinning reserve unaffected. 2) As expected. | |
| COMMENTS : Dual cable from each generator transducer supply DP with power signal, loss of one has no effect on spinning reserve or DP operation | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 4/9/04 |

EQUIPMENT SYSTEM : POWER MANAGEMENT SYSTEM

| | | | |
|--|--------------------------------------|----------------------|--|
| TEST NO. 27 | SUBSYSTEM: Loss of CAN Bus | | |
| PURPOSE : Test system to loss of CAN Bus. | | | |
| METHOD : With all thrusters and generators on line. 1) Test for loss of one of the dual CAN Bus to the individual PMS module. Processor XC301 T6, backup T17 2) Fail second CAN Bus feed | | | |
| EXPECTED RESULTS : 1) Alarm, Board not present. 2) Generator operates in droop mode. | | | |
| RESULTS : 1) As expected. 2) As expected. | | | |
| COMMENTS : | | | |
| WITNESSED BY : J. Farrell-Dillon | | DATE : 4/9/04 | |

EQUIPMENT SYSTEM : POWER MANAGEMENT SYSTEM

| | | |
|--|----------------------------------|--|
| TEST NO. 28 | SUBSYSTEM: DPU Failure | |
| PURPOSE : Test system to loss of DPU. | | |
| METHOD : 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. | | |
| EXPECTED RESULTS : Alarm, loss of consumers. | | |
| RESULTS : 1) No effect on DP, indication only loss of BT Fwd. 2) No effect on DP, indication only loss of BT Aft. 3) No effect on DP, indication only loss of Port Azimuth. 4) No effect on DP, indication only loss of Stbd. Azimuth. 5) No effect on DP. | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 14/9/04 | |

EQUIPMENT SYSTEM : THRUSTERS

| | | | |
|---|---------------------|--|----------------------|
| TEST NO. | 29 | SUBSYSTEM: T 1 & T2 (Tunnel Thrusters), Pitch Signals (KS) | |
| PURPOSE : Simulate failure of signals to each tunnel thruster in turn. | | | |
| METHOD : To each tunnel thruster in turn: 1) Fail pitch reference (command) signal from DP to control unit, before isolation amplifier. Terminals 1 & 2 2) Fail pitch feedback signal from control unit to DP, before isolation amplifier. Terminals 1& 2 on 1A. 3) Fail pitch reference (command) signal after isolation amplifier from control unit to thruster. Terminals T8, 9 on 1A. 4) Fail pitch feedback signal from thruster to control unit, Terminals 1&2. | | | |
| EXPECTED RESULTS : 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 indicated not running (“Unavailable” alarm on DP). 4) Thruster pitch to zero immediately. Remains on DP. | | | |
| RESULTS : | | | |
| | <u>Thruster T 1</u> | <u>Thruster T2</u> | |
| 1) | As expected | As expected. | |
| 2) | As expected | As expected | |
| 3) | As expected | As expected. | |
| 4) | As expected | As expected. | |
| COMMENTS : | | | |
| WITNESSED BY : | | J. Farrell-Dillon | DATE : 5/9/04 |

EQUIPMENT SYSTEM : THRUSTERS

| | | |
|--|--|----------------------|
| TEST NO. 30 | SUBSYSTEM: T 1 & T2 (Tunnel Thrusters), Pitch Signals (Imtech) | |
| PURPOSE : Simulate failure of signals to each tunnel thruster in turn. | | |
| METHOD : To each tunnel thruster in turn: 1) Fail pitch reference (command) signal Terminals U4 X1C 39, 40 2) Fail pitch feedback signal Terminals U4 X41C 57, 58. | | |
| EXPECTED RESULTS : 1) Pitch fails to zero, Alarm “Thruster not ready” alarm on 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. | | |
| RESULTS : | | |
| | <u>Thruster T 1</u> | <u>Thruster T2</u> |
| 1) | As expected | As expected. |
| 2) | As expected | As expected |
| COMMENTS : | | |
| WITNESSED BY : | J. Farrell-Dillon | DATE : 5/9/04 |

EQUIPMENT SYSTEM : THRUSTERS

| | | |
|---|-------------------|--|
| TEST NO. | 31 | SUBSYSTEM: T 3 & T4, Speed Signals |
| PURPOSE : Simulate failure of speed signals to azimuth thruster. | | |
| METHOD : <ol style="list-style-type: none"> 1) Fail speed reference (command) signal from DP to thruster converter before isolation amplifier Terminals 1, 2 2) Fail speed feedback signal from thruster to DP, Terminals X4 55, 56. 3) Fail speed reference (command) signal after isolation amplifier Terminals T7, 9. 4) Fail speed feedback signal from thruster to Aquamaster control unit. Terminals T60, 61. | | |
| EXPECTED RESULTS : <ol style="list-style-type: none"> 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 (“Unavailable” alarm on DP). 4) No effect. | | |
| RESULTS : <ol style="list-style-type: none"> 1) As expected. 2) As expected. 3) Thruster stops – no alarm – remains in desk – indicating running ready and enabled. 4) As expected. | | |
| COMMENTS : | | |
| WITNESSED BY : | J. Farrell-Dillon | DATE : 5/9/04 |

EQUIPMENT SYSTEM : THRUSTERS

| | | |
|--|---|--|
| TEST NO. 32 | SUBSYSTEM: T 3 & T4 Azimuth Signals | |
| PURPOSE : Simulate failure of azimuth signals to azimuth thruster. | | |
| METHOD : 1) Fail azimuth reference (command) signal from DP to control unit. Terminals X18 500/501 2) Fail azimuth feedback signal from control unit to DP. Terminal 10096 / 10097 3) Fail azimuth reference (command) signal from control unit to thruster. Terminal X1 E05/ E07 4) Fail azimuth feedback signal from thruster to control unit. Terminal X330, 331. | | |
| EXPECTED RESULTS : 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) Azimuth freezes, “Prediction error” alarm on DP, loss of control of thruster. 4) Thruster deselected. Thruster fails as set, Alarm “Thruster Steering Prediction error” on DP. Thruster stays in desk, indicated as running, ready and enabled. | | |
| RESULTS : 1) As expected. 2) As expected. 3) As expected. 4) As expected. | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 5/9/04 | |

EQUIPMENT SYSTEM : THRUSTERS

| | |
|---|---|
| TEST NO. 33 | SUBSYSTEM: Thruster Available Signals |
| PURPOSE : Simulate loss of available signal for each thruster in turn. | |
| METHOD : Disconnect available signals within each outstation in turn. | |
| EXPECTED RESULTS : 1) Tunnel thrusters T1, T2 deselect from DP control in turn; “Unavailable” alarm on DP, pitch to zero. 2) Azimuth thruster T3, T4 : deselects from DP control in turn, “Unavailable” alarm on DP, speed to zero, azimuth angle fails to zero position | |
| RESULTS : 1) 2) | |
| COMMENTS : Tested as part of CAT | |
| WITNESSED BY : | DATE : |

EQUIPMENT SYSTEM : THRUSTERS

| | | | |
|--|--|---------------|---------|
| TEST NO. 34 | SUBSYSTEM: Hydraulic Systems | | |
| PURPOSE : Simulate failure of hydraulic system for each thruster in turn. Test hydraulic level alarms | | | |
| METHOD : 1) Bow thrusters; locally stop running hydraulic pump. Restore and repeat for other tunnel thruster. 2) Simulate hydraulic level alarms | | | |
| EXPECTED RESULTS : 1) Alarm automatic start of standby pump. Tunnel thruster remaining in operation. 2) Alarm, low level. Thruster stays running. | | | |
| RESULTS : 1) Alarm standby pump autostart. Thruster continues running. 2) As expected. | | | |
| COMMENTS : | | | |
| WITNESSED BY : | J. Farrell-Dillon | DATE : | 14/9/04 |

EQUIPMENT SYSTEM : THRUSTERS

| | | | | | |
|--|-----------------------|--------------------------------------|-------------------|---------------|-------------|
| TEST NO. | 35 | SUBSYSTEM: Emergency Stops | | | |
| PURPOSE : Test thruster and generator emergency stops. | | | | | |
| METHOD : Activate thruster emergency stops from all locations. Restore and reselect to DP before tripping the next For diesel generators, test one engine at a time. Restore before tripping the other. | | | | | |
| EXPECTED RESULTS : 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. 5) Diesel generator , shut down | | | | | |
| RESULTS : | | | | | |
| | Local | Bridge Fwd | Bridge Port | Bridge Stbd. | ECR |
| 1) | OK | OK | OK | OK | None fitted |
| 2) | OK | OK | OK | OK | None fitted |
| 3) | OK | OK | OK | OK | OK |
| 4) | OK | OK | OK | OK | OK |
| 5) | Tested as part of CAT | | | | |
| COMMENTS : | | | | | |
| WITNESSED BY : | | | J. Farrell-Dillon | DATE : | |
| | | | | 14/9/04 | |

EQUIPMENT SYSTEM : THRUSTERS

| | | | |
|--|----------------------------------|----------------------|--|
| TEST NO. 36 | SUBSYSTEM: Ventilation | | |
| PURPOSE : Test thruster's ventilation stops. | | | |
| METHOD : Close off ventilation to thruster room. Attempt to start thruster. | | | |
| EXPECTED RESULTS : 1) Thruster T1 fail to start. 2) Thruster T2 fail to start. | | | |
| RESULTS : 1) With thruster running loss of ventilation has no effect. 2) BT start request declined when no fans running BT start request declined when only one fan running BT start request accepted when both fans running 3) Azimuth start request accepted with one fan off. | | | |
| COMMENTS : | | | |
| WITNESSED BY : J. Farrell-Dillon | | DATE : 5/9/04 | |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

| | | |
|---|-------------------------------|--|
| TEST NO. 37 | SUBSYSTEM: Networks | |
| PURPOSE : Simulate failures of Ethernet and CANman networks. | | |
| METHOD : 1) One at a time disconnect Ethernet cables from each Ethernet hub. Restore before disconnecting the next. 2) One at a time fail power supply to Ethernet hub. Restore before failing the other. 3) One a time disconnect one CANman network from Praxis console stations. Restore before failing the next. Terminal 16 Backup (316) 4) Test Ethernet LAN for O/C, S/C and ground | | |
| EXPECTED RESULTS : 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 CANman network. 4) Alarm, communications continue on other CANman network. | | |
| RESULTS : 1) As expected. 2) As expected. 3) Alarm, no effect. 4) Earth indication and alarm | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 14/9/04 | |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

| | | |
|--|----------------------------------|--|
| TEST NO. 38 | SUBSYSTEM: DP Consoles | |
| PURPOSE : Simulate failure of DP consoles. | | |
| METHOD : 1) Turn off power supply to master DP console. Restore. 2) Turn off power supply to stand-by DP console. | | |
| EXPECTED RESULTS : 1) Alarm, manual changeover to stand-by console. 2) Alarm. No effects to positioning. | | |
| RESULTS : 1) Result as expected. 2) Result as expected. | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 5/9/04 | |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

| TEST NO. 39 | SUBSYSTEM: Gyro Compasses | | | | | | | | | | | | | |
|---|-------------------------------------|--------|--------|--------|--------|----|--|--|----|--|--|----|--|--|
| PURPOSE : Simulate failure of gyro compasses. Prove gyro redundancy. | | | | | | | | | | | | | | |
| METHOD : 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 | | | | | | | | | | | | | | |
| EXPECTED RESULTS : 1) Gyro 1: alarm “Gyro Failure”, rejected from median. 2) Gyro 2: alarm “Gyro Failure”, rejected from median. Loss of HPR. 3) Alarm | | | | | | | | | | | | | | |
| RESULTS : <table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%; text-align: center;">Gyro 1</th> <th style="width: 33%; text-align: center;">Gyro 2</th> <th style="width: 33%; text-align: center;">Gyro 3</th> </tr> </thead> <tbody> <tr> <td>1)</td> <td></td> <td></td> </tr> <tr> <td>2)</td> <td></td> <td></td> </tr> <tr> <td>3)</td> <td></td> <td></td> </tr> </tbody> </table> | | | Gyro 1 | Gyro 2 | Gyro 3 | 1) | | | 2) | | | 3) | | |
| Gyro 1 | Gyro 2 | Gyro 3 | | | | | | | | | | | | |
| 1) | | | | | | | | | | | | | | |
| 2) | | | | | | | | | | | | | | |
| 3) | | | | | | | | | | | | | | |
| COMMENTS : Completed as part of CAT | | | | | | | | | | | | | | |
| WITNESSED BY : | DATE : | | | | | | | | | | | | | |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

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| TEST NO. 40 | SUBSYSTEM: Anemometers | |
| PURPOSE : Simulate failure of anemometers. Prove anemometers redundancy. | | |
| METHOD : To one anemometer at a time: 1) Fail power supply. 2) Fail input to DP. 3) By software input change direction of one sensor. | | |
| EXPECTED RESULTS : 1) Alarm, anemometer rejected from median. 2) Anemometer failure reported by other console, rejected by median (if online). 3) Alarm, rejected from median. | | |
| RESULTS : 1) As expected. 2) Alarm 3) Wind prediction error alarm, wind difference. DPO chooses manually which sensor to accept. (Test carried out by software limit modification, then restored to original setting) | | |
| COMMENTS : | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 5/9/04 | |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

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| TEST NO. 41 | SUBSYSTEM: Vertical Reference Unit (VRU) |
| PURPOSE : Simulate failure of VRU. | |
| METHOD : 1) Fail VRU power supply 2) Fail input to DP. | |
| EXPECTED RESULTS : 1) Alarm to DP. Loss of HPR. Possible effects to both DGPS positioning. 2) Alarm. Possible effects to both DGPS positioning. | |
| RESULTS : 1) 2) | |
| COMMENTS : Tested as part of CAT | |
| WITNESSED BY : | DATE : |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

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|--|-----------------------------------|
| TEST NO. 42 | SUBSYSTEM: DGPS Systems |
| PURPOSE : Test performance of DGPS systems. Simulate failures. | |
| METHOD : 1) Select both DGPS systems to DP, check performance and weighting. On one DGPS system at a time: 2) Fail differential signal. 3) Fail GPS signal. | |
| EXPECTED RESULTS : 1) Weighting equally divided between systems. 2) Alarm, system rejected. 3) Alarm, system rejected. | |
| RESULTS : 1) 2) 3) | |
| COMMENTS : Tested as part of CAT. | |
| WITNESSED BY : | DATE : |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

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|---|--|
| TEST NO. 43 | SUBSYSTEM: Position Reference DGPS 360° Capability |
| PURPOSE : Check 360° capability. | |
| METHOD : 1) DGPS 1, set up with 6 satellites, rotate through 360° check for blind sectors. 2) Repeat for DGPS 2. | |
| EXPECTED RESULTS : 1) No sectors where position data is lost. 2) No sectors where position data is lost. | |
| RESULTS : 1) 2) | |
| COMMENTS : Tested as part of CAT. | |
| WITNESSED BY : | DATE : |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

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|--|-----------------------------------|
| TEST NO. 44 | SUBSYSTEM: HiPAP System |
| PURPOSE : Test performance of acoustic system. Simulate failures. | |
| METHOD : 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 input. 4) Fail VRU input. | |
| EXPECTED RESULTS : 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. | |
| RESULTS : 1) 2) 3) 4) | |
| COMMENTS : Tested as part of CAT. | |
| WITNESSED BY : | DATE : |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

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|---|-------------------------------|
| TEST NO. 45 | SUBSYSTEM: Fan Beam |
| PURPOSE : Test position reference stability and overshoot. | |
| METHOD : Establish vessel in stable position relative to the target. each leg, 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. | |
| EXPECTED RESULTS : 1) No significant difference. 2) No significant difference. | |
| RESULTS : 1) 2) | |
| COMMENTS : Tested as part of CAT. | |
| WITNESSED BY : | DATE : |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

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|---|------------------------------------|
| TEST NO. 46 | SUBSYSTEM: Model Control |
| PURPOSE : Test model control upon loss of all position references. | |
| METHOD : Select all available position references. 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. | |
| EXPECTED RESULTS : Position loss <10 metres, rapidly deteriorating with time. | |
| RESULTS : 1) 2) 3) | |
| COMMENTS : Tested as part of CAT. | |
| WITNESSED BY : | DATE : |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

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|---|---|
| TEST NO. 47 | SUBSYSTEM: Position References, Weighting |
| PURPOSE : Check software weighting routines. | |
| METHOD : 1) Select DGPS 1 2) Select DGPS 2. 3) Select HiPAP 4) Select Fan Beam 5) Select Taut Wire Degrade each one by one and restore. Note point of rejection Observe weighting changes and performance | |
| EXPECTED RESULTS : Weighting matches performance. | |
| RESULTS : 1) 2) 3) 4) | |
| COMMENTS : Tested as part of CAT. | |
| WITNESSED BY : | DATE : |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

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|---|---|
| TEST NO. 48 | SUBSYSTEM: Consequence Analysis |
| PURPOSE : Test consequence analysis. | |
| METHOD : With all generators on line and all thrusters 1) Reduce number of generators, restore 2) Reduce number of thrusters, restore. | |
| EXPECTED RESULTS : 1) Consequence analysis warning 2) Consequence analysis warning. | |
| RESULTS : 1) Loss of any generator results in the loss of DP Class AA capability 2) T2 stopped. Alarm “T2 not ready”. “Power limits reached on Bus B”, Consequence analysis drift off warning after 3 minutes. | |
| COMMENTS : | |
| WITNESSED BY : | DATE : |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

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|---|--|
| TEST NO. 49 | SUBSYSTEM: Operational Modes |
| PURPOSE : Test all operational modes while on DP. | |
| METHOD : While on DP, test operation of all operational modes, 1) High precision Mode. 2) Relaxed Mode. 3) Green Control | |
| EXPECTED RESULTS : 1) Improved position keeping 2) Reduced fuel consumption 3) Reduced fuel consumption. | |
| RESULTS : 1) 2) 3) | |
| COMMENTS : Tested as part of CAT. | |
| WITNESSED BY : | DATE : |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

| | |
|---|------------------------------------|
| TEST NO. 50 | SUBSYSTEM: Control Modes |
| PURPOSE : Test all other control modes while on DP. | |
| METHOD : While on DP, test operation of all other control modes, 1) Manual control, levers, transit etc. | |
| EXPECTED RESULTS : 1) DP system in control, others ineffective. | |
| RESULTS : 1) Result as expected. | |
| COMMENTS : | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 5/9/04 |

EQUIPMENT SYSTEM : DP CONTROL SYSTEM

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|--|---|
| TEST NO. 51 | SUBSYSTEM: Change over, DP Main / DP Joystick Control |
| PURPOSE : Test the change over between DP main system and DP back-up system | |
| METHOD : 1) Check operation of command transfer from SDP-21 to joystick control SDP 11 2) Simulate fault in transfer line. With all sensors and reference systems on line: 3) Test operation from SDP-11 console 4) Test joystick. | |
| EXPECTED RESULTS : 1) Smooth change-over. 2) Alarm, no transfer possible. 3) Normal operation 4) Joystick manoeuvre smoothly. | |
| RESULTS : 1) 2) 3) 4) | |
| COMMENTS : Tested as part of CAT. | |
| WITNESSED BY : | DATE : |

EQUIPMENT SYSTEM : Communications

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|---|--|-----------------------|--|
| TEST NO. 52 | SUBSYSTEM: Communication Systems and DP Alerts | | |
| PURPOSE : Check functionality of communication systems and DP alerts. | | | |
| METHOD : 1) Test all communications system (telephones, intercoms, etc.). 2) Test DP alerts. | | | |
| EXPECTED RESULTS : All systems operational. | | | |
| RESULTS : 1) All systems operational. 2) All systems operational. | | | |
| COMMENTS : No alarm horn fitted to portable alarm panel of Buoy Workshop. | | | |
| WITNESSED BY : J. Farrell-Dillon | | DATE : 14/9/04 | |

EQUIPMENT SYSTEM : FREQUENCY DRIVES

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|---|-------------------|---------------------------------------|
| TEST NO. | 53 | SUBSYSTEM: FREQUENCY DRIVES |
| PURPOSE : Verify alarms | | |
| METHOD : <ol style="list-style-type: none"> 1) Simulate water temperature alarm 2) Simulate water leakage alarm 3) Simulate motor temperature alarm 4) Simulate current control system fault. 5) Fail hardwire signal from switchboard to frequency drive converter PLC 6) Trip running generator to cause undervoltage and generate power chop | | |
| EXPECTED RESULTS : <ol style="list-style-type: none"> 1) Alarm, no effect on DP 2) Alarm, no effect on DP 3) Alarm, no effect on DP 4) Alarm, no effect on DP 5) Alarm 6) Power to thrusters chopped back | | |
| RESULTS : <ol style="list-style-type: none"> 1) 45deg alarm “port side high 45 deg. HH alarm thruster stop – DP alarm thruster deselected. (Same result on Stbd. Side.) 2) Alarm, no effect on DP. 3) Alarm, HH alarm results in thruster shut down. 4) Result as expected. 5) Result as expected. | | |
| COMMENTS : HH alarm not in Imtech’s shut down suite of alarms | | |
| WITNESSED BY : | J. Farrell-Dillon | DATE : 5/9/04 |

EQUIPMENT SYSTEM : SENSORS

| | | |
|---|--------------------------------|--|
| TEST NO. 54 | SUBSYSTEM: Taut Wire | |
| PURPOSE : Verify operation of Taut Wire Alarm Limits | | |
| METHOD : Move vessel to exceed taut wire warning and alarm limits. 1) To port 2) To starboard 3) To aft 4) To forward | | |
| EXPECTED RESULTS : 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. | | |
| RESULTS : 1) Result as expected. 2) Result as expected. 3) Result as expected. 4) Result as expected. | | |
| COMMENTS : Tested as part of CAT. | | |
| WITNESSED BY : J. Farrell-Dillon | DATE : 3/9/04 | |

EQUIPMENT SYSTEM : FIRE SUPPRESSION

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|---|---------------------------------|----------------------|--|
| TEST NO. 55 | SUBSYSTEM: CO2 System | | |
| PURPOSE : Verify redundancy of supplies and switches of CO2 activation system | | | |
| METHOD : 1) Trip each supply to relay box in turn, restore. 2) Fail individual switch on release box | | | |
| EXPECTED RESULTS : 1) Alarm, no effect on DP 2) Alarm, no effect on DP | | | |
| RESULTS : 1) As expected. 2) As expected. | | | |
| COMMENTS : | | | |
| WITNESSED BY : J. Farrell-Dillon | | DATE : 5/9/04 | |

EQUIPMENT SYSTEM :

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|---------------------------|-------------------|
| TEST NO. 56 | SUBSYSTEM: |
| PURPOSE : | |
| METHOD : | |
| EXPECTED RESULTS : | |
| RESULTS : | |
| COMMENTS : | |
| WITNESSED BY : | DATE : |