Westcon Power & Automation AS · N-5582 Ølensvåg AS, Norway
Tel: +47 474 68 000, faks: +47 53 76 61 51 · E-mail: westcon.pa@westcon.no
www.westcon.no

ATLANTIC OFFSHORE

DP FMEA PROVING TRIAL

M/V OCEAN KING

WPA Document No 71312-Rev. 6

6	21.05.14	Updated regarding test 2014	AU	HES	HES
5	11.11.05	Updated after test dated 12.10.05	HES	EZ	EZ
4	05.07.05	Updated after test 04.07.05	HES	EZ	EZ
3	29.06.05	Updated after new control system for main propellers have been installed.	HES	EZ	EZ
2	21.09.04	Updated after sea trial	HES	EZ	EZ
1	15.06.04	Updated after comments from class	EZ	HES	HES
0	20.04.04	For approval	MB	HES	HES
Rev.	**Date**	**Document issue and status**	**Made by**	**Checked by**	**Approved by**

"Specification for Redundancy in Position Keeping Ability"

12 Instruction

12.1.1 Westcon Power and Automation Stord AS (WPA) was instructed by Atlantic Offshore to witness the DP FMEA Proving Trial which is based on the test program in section 8.

12.1.2 The scope includes preparation/participation in:

- DP FMEA Proving Trial program
- Participation during trial
- Final report with any findings

12.1 General

The following test programme is mainly made to confirm if the ship will fulfil the requirements stated in "Specification for Redundancy in Position Keeping Ability". This implies that after any single failure the vessel is to be able to produce sufficient transverse thrust, longitudinal thrust and yawing moment to keep its position and to safely terminate the operation.

Secondly, the test to prove that loss of signals to thrusters/propellers should not have any severe influence on manoeuvrability of the ship.

The test is divided in 4 parts:

12.2 Electrical

The configuration of generators, bustie breakers and thrusters normally is as follows when operating the vessel (see also dwg. no. 352-01 rev.D) This configuration has been changed since the first sea-trial where no aux generator was running.

- 1-one aux.generator running
- 1-one shaft generators running feeding 1-one bow thruster and respective cooling -& steering gear pumps
- 1-one shaft generators running feeding 1-one bow thruster and respective cooling -& steering gear pumps
- All relevant starter cabinets to be in "auto" or "remote" modus.

12.3 Thrusters etc.

Mainly the "order" and "feedback" signals will be disconnected (broken wire simulation) to see the effect of the thrusters/propellers.
Generally, RPM should freeze or go to zero, be de-selected from DP and alarm/warning should be activated.

12.4 DP control

UPS capacity is tested in addition to some "electronic card" (power failure).
A "Box test" was performed for checking the reference system. Sensors was disconnected/ changing between sensors during the test.

12.6 Added comments

Since FMEA-test performed 04.09.04 a new control system for the main propellers has been installed. Therefore this new test program will include all the tests related to the control system in addition to the tests that have to be retested due to the results from 04.09.04.

12.7 Template history

Revisjon	Date	Comments
0	20.04.04	For approval
1	15.06.04	Updated after comments from class
2	21.09.04	Updated after sea trial
3	29.06.05	Updated after new control system for main propellers have been installed.
4	05.07.05	Updated after test 04.07.05
5	11.11.05	Updated after test dated 12.10.05
6	21.05.14	Updated regarding test 2014

12.10 TEST PROGRAM MAIN PROPULSION/ELECTRICAL

12.10.01. Total failure of main gear port

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **Note: Run test for 30 min for side effects.**	10min in DP mode 10min in joystick mode 10min on levers	SG1 and SG2 running SG2 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG1	Breakers for G1,G2,G3 open Breaker for SG1 closed Breaker for SG2 closed Busbreaker SG1 to MSB open Busbreaker SG2 to MSB closed

Fault condition	Method	Expected results	Actual test results
Autostop of main engine 3 & 4	Emergency stop of main engine 3 & 4 to be activated	-Port propeller will stop -One bow thr. will stop -Blackout 440/220V main swbd -several alarms	-As expected

Comments:

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.10 TEST PROGRAM SUB-SYSTEM ELECTRICAL

12.10.02. Total failure of main gear starboard

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **Note: Run each test for 30 min.**	10min in DP mode 10min in joystick mode 10min on levers	SG1 and SG2 running One aux generator running feeding the main switchboard, the others in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	One aux gen breaker closed, the others open Breaker for SG1 closed Breaker for SG2 closed Busbreaker SG1 to MSB open Busbreaker SG2 to MSB open

Fault condition	Method	Expected results	Actual test results
Autostop of main engine 1 & 2	Emergency stop of main engine 1 & 2 to be activated.	-Starb. propeller will stop -One bow thr. will stop -Stern thr. will stop -several alarms	As expected.

Comments: Chang-over switch for stern thruster to be checked in this fail mode.

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.10 TEST PROGRAM MAIN PROPULSION/ELECTRICAL

12.10.03. Total failure of 440V main switchboard

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **Note: Run test for 30 min for side effects.**	10min in DP mode 10min in joystick mode 10min on levers	SG1 and SG2 running One aux generator running feeding the 440V msb.	All thrusters/propellers running Aft. thr. connected to SG1	Breakers for G1closed, G2,G3 open Breaker for SG1 closed Breaker for SG2 closed Busbreaker SG1 to MSB open Busbreaker SG2 to MSB open

Fault condition	Method	Expected results	Actual test results
Autostop of running aux generator	Running aux generator to be disconnected	-Blackout 440/220V main swbd -several alarms	As expected

Comments:

Voltage to be measured on batteries for B1A/B1B, B2 and batteries thrusters immediately after disconnection/before reconnection of batteries during this test.

	Voltage when disconnected	Voltage when connected
Battery for B1A and B1B		
Battery for B2	25,1 V	23,0V
Battery for thrusters aft.	26,8V	26,2V
Battery for fwd thrusters no.1	26,1V	25,1V
Battery for fwd thrusters no.2	26,1V	25,1V

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.10 TEST PROGRAM SUB-SYSTEM ELECTRICAL

12.10.04. 24VDC B1A & B1B failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **Note: Run each test for 30 min for side effects.**	10min in DP mode 10min in joystick mode 10min on levers	SG1 and SG2 running One aux generator running feeding the 440V msb.	All thrusters/propellers running Aft. thr. connected to SG2	

Fault condition	Method	Expected results	Actual test results
1. No power on B1A or B1B 2. No power on div. batteries for thrusters	1 Disconnect supply to B1A/B1-B from fusebox 2 Disconnect supply to respective consumers	1. B1A: One bow tunnel - and stern thrusters will stop 2. Stop of respective thruster	1. As expected. 2. As expected

Comments:

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.10 TEST PROGRAM SUB-SYSTEM ELECTRICAL

12.10.05. 24VDC B2 failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **Note: Run each test for 30 min for side effects.**	10min in DP mode 10min in joystick mode 10min on levers	SG1 and SG2 running One aux generator running feeding the 440V msb.	All thrusters/propellers running Aft. thr. connected to SG2	

Fault condition	Method	Expected results	Actual test results
1. No power on B2	1.Disconnection supply to B2	1.No influence on running machinery.	As expected
	2.Disconnect supply to respective consumers	2.No influence on running machinery.	As expected

Comments:

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.10 TEST PROGRAM SUB-SYSTEM ELECTRICAL

12.10.06. 24VDC Earth failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup →	On Dynpos	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
1. Earth failure on B1A 2. Earth failure on B1B 3. Earth failure on B2	Simulate Earth failure on the 24VDC distribution boards.	No reduction of manoeuvrability for all tests local alarm for each test alarm in alarmplant	Tested for B2 and As expected
Comments:	Resistance to be used		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.01. Port side Main propeller – Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On lever	SG1 and SG2 running One aux generator running, the others in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signal failure	1. Disconnect **command pitch signal** to step-motor from PCU. (X40-220-221.)	1. No change in pitch thrust Only possible to operate the pitch from the local station on gearbox	1. As expected
	2. Disconnect **remote control feedback signal** from propeller PCU (X40-123)	2. No change in thrust. Still able to operate. Several alarms.	2. As expected.
	3. Disconnect **indication feedback signal** from prop. to PCU (X40-128)	3. No change in thrust. Still able to operate. Several alarms.	3. As expected
Comments:	(see drawing LT7000A drawings 4340D0001-1/4340D0001-3)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.02. Port side Main propeller – Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On joystick	SG1 and SG2 running One aux generator running, the others in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signal failure	4. Disconnect **command pitch order signal** from joystick to joystick interf. module (disconnect X55.20) 5. Disconnect **call signal** from joystick to electronic cabinet in ecr (X55.26)	4. Pitch to zero. 5. Change from joystick to lever control on ACS (main station)	4. As expected. 5. As expected.
Comments:	(see drawing LT7000A drawings 4355D0002-1)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.03. Port side Main propeller – Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Dynpos	SG1 and SG2 running One aux generator running, the others in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signal failure	7. Disconnect **command pitch order signal** from DP system to PCU (Disconnect X40.350)	7. Pitch to zero. - No Alarm	7. As expected
	8. Disconnect **ready signal** from DP system to PCU. (Disconnect X40.352)	8. Change from DP to lever control	8. Alarm in DP cabinet. Alarm"port propeller not ready."
	9. Disconnect **feedback signal** from PCU to DP (Disconnect X40.356)	9. Lost in DP, failure in DP signal, to be controlled by levers.	9. Warning signal in DP cabinet. Still operated by DP.
Comments:	(see drawing LT7000A drawings 4340D0001-4)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.05. Port side Main propeller – Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Dynpos. ME4 used only for generator. (Main clutch 4 disengaged.)	SG1 and SG2 running One aux generator running, the others in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signal failure ** To be disconnected in ecr.	10. Disconnect **RPM command signal** from LT7KA to Heinzmann governor (Disconnect X46.126)	10. RPM to idle. Generator will tripp due to under – voltage.	10. As expected.
	11. Disconnect **power supply** to Heinzmann governor (Disconnect LHP 1&2)	11. Engine will stop, several alarms	11. As expected.
	12. Disconnect **power supply** to shaft generator protection ps (circ.breaker in cabinet aft between ME)	12. Ps shaft generator will trip, consumers connected to ps will fail	12. As expected
Comments:	(see drawing LT7000A RCDJ-HNZ/4346D0001-1)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.06. Port side Main propeller – Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Dynpos	SG1 and SG2 running One aux generator running, the others in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signal failure	12. Disconnect **fuel rack feedback signal** from inductive sensor to LT7KA (Disconnect X40.132-Eng.3 & 137 Eng.4)	12. Alarm fuel rack sensor 1 & 2. Loadsystem out of order. Ready for DP and feedback to DP not affected	12. As expected
	13 Disconnect **fuel rack feedback signal** from inductive sensor to LT7KA (Disconnect X40.404-Eng.1 & 406 Eng.2)	13. Alarm fuel rack sensor 1 & 2. Loadsystem out of order. Ready for DP and feedback to DP not affected	13. As expected
	14.Disconnect **230V main power supply** from MSB to LT7KA (Disconnect in MSB)	14.Alarm "Failure 230V"	14. As expected Alarm in ecr "battery-charger remote control failure"
Comments:	(see drawing LT7000A 4340D0001-2 / 4340D0001-4)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.07. Starboard side Main propeller – Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On lever	SG1 and SG2 running One aux generator running, the others in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signal failure	1. Disconnect **command pitch signal** to step-motor from PCU. (Remove change-over relay Main/ Back-up K7 in PCU cab.)	1. No change in pitch thrust Only possible to operate the pitch from the local station on gearbox	1. Not tested. Ref test of port side.
	2. Disconnect **remote control feedback signal** from propeller PCU (remove sensor supply W4)	2. No change in thrust. Still able to operate. Several alarms.	2. As expected.
	3. Disconnect **indication feedback signal** from prop. to PCU (X40-128)	3. No change in thrust. Still able to operate. Several alarms.	3. As expected.
Comments:	(see drawing LT7000A drawings 4340D0001-1/4340D0001-3)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje Endre Strand	Oddvar Ulvestad	Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.08. Starboard side Main propeller – Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On joystick	SG1 and SG2 running One aux generator running, the others in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signal failure	4. Disconnect **command pitch order signal** from joystick to joystick interf. module (disconnect X55.20) 5. Disconnect **call signal** from joystick to electronic cabinet in ecr L12-427**	4. Pitch to zero. 5. Change from joystick to lever control on ACS (main station)	4. As expected. 5. As expected. 6.
Comments:	(see drawing LT7000A drawings 4355D0002-1)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje Endre Strand	Oddvar Ulvestad	Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.09. Starboard side Main propeller – Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Dynpos	SG1 and SG2 running One aux generator running, the others in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signal failure	7. Disconnect **command pitch order signal** from DP system to PCU (Disconnect X40.350)	7. Pitch to zero. - Alarm	7. As expected.
	8. Disconnect **call signal** from DP system to PCU. (Disconnect X40.352)	8. Change from DP to lever control	8. Alarm in DP cabinet. Alarm "starb. propeller not ready".
	9. Disconnect **feedback signal** from PCU to DP (Disconnect X40.356)	9. Lost in DP, failure in DP signal, to be controlled by levers.	9. Warning signal in DP cabinet. Still operated by DP.
Comments:	(see drawing LT7000A drawings 4340D0001-4)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje Endre Strand	Oddvar Ulvestad	Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.10. Starboard side Main propeller – Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Dynpos. ME4 used only for generator. (Main clutch 4 disengaged.)	SG1 and SG2 running One aux generator running, the others in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signal failure ** To be disconnected in ecr.	10. Disconnect **RPM command signal** from LT7KA to Heinzmann governor (Disconnect X46.126)	10. RPM to idle. Generator will tripp due to under – voltage.	10. As expected.
	11. Disconnect **power supply** to Heinzmann governor (Disconnect LHP 1&2)	11. Engine will stop, several alarms.	11. As expected.
	12. Disconnect **power supply** to shaft generator protection sb (circ. breaker in cabinet aft between ME)	12. Sb shaft generator will trip, consumers connected to sb will fail	12. As expected
Comments:	(see drawing LT7000A RCDJ-HNZ/4346D0001-1)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.11. Starboard side Main propeller – Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Dynpos	SG1 and SG2 running One aux generator running, the others in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signal failure	12. Disconnect **fuel rack feedback signal** from inductive sensor to LT7KA (Disconnect X40.132-Eng.3 & 137 Eng.4)	12. Alarm fuel rack sensor 1 & 2. Loadsystem out of order. Ready for DP and feedback to DP not affected	12. As expected
	13 Disconnect **fuel rack feedback signal** from inductive sensor to LT7KA (Disconnect X40.404-Eng.1 & 406 Eng.2)	13. Alarm fuel rack sensor 1 & 2. Loadsystem out of order. Ready for DP and feedback to DP not affected	13. As expected
	14.Disconnect **230V main power supply** from MSB to LT7KA (Disconnect in MSB)	14.Alarm "Failure 230V"	14. As expected Alarm in ecr "battery-charger remote control failure"
Comments:	(see drawing LT7000A 4340D0001-2 / 4340D0001-4)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.12. Tunnel thruster (bow thruster no.1) Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On lever	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure Signals to be disconnected in instrument room	1. Disconnect **command pitch signal** from electronic unit UN41 to thruster (X41-30,32 & 33) 2. Disconnect **feedback pitch signal** from thruster to electronic unit UN41 (X41-F1, F2 & 26)	1. Pitch freez, alarm prediction error.(Thruster should be stopped) 2. Alarm (remote syst.fail.); auto stop of servopump & drive motor (Thruster stop)	1. As expected 2. As expected
Comments:	(see drwg. no. H500 321c and H311 275b from Liaaen/Helitron)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.13. Tunnel thruster (bow thruster no.1) Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Joystick	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure	3. Disconnect **command signal** from joystick computer to main bridge panel UN63 (X63-44 & 45) 4.Disconnect **ready signal** from joystick computer to main bridge panel UN63 (X63-42 & 43)	3. Pitch to zero 4. Change from joystick to lever control. - Alarm on bridge	3. As expected 4. As expected
Comments:	(see drwg. no. H500 321c and H311 275b from Liaaen/Helitron)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.14. Tunnel thruster (bow thruster no.1) Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Dynpos	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure Signals to be disconnected in instrument room	5. Disconnect **command signal** from DP computer to main bridge panel UN63 (X63-115 & 116)	5. Prop.contr. will interpretend this as 0-order	5. As expected, prediction error
	6. Disconnect **feedback signal** from electr. unit to DP computer (X63-117 & 118)	6. No surveillance of propeller control signal, continue to read orders from DP; "ready to DP" not affected	6. As expected
	7. Disconnect **power supply** 24 V DC to electr.unit (circ.breaker in B2)	7. Alarm (remote syst.fail.); auto stop of servopump & drive motor	7. See test for B2
	8. Disconnect **power supply** 230 V to electr.unit (circ.breakers in L8,L9)	8. Alarm (remote syst.fail.); auto stop of servopump & drive motor	8. Test deleted
Comments:	(see drwg. no. H500 321c and H311 275b from Liaaen/Helitron)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.15. Tunnel thruster (bow thruster no.2) Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On lever	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure Signals to be disconnected in instrument room	1. Disconnect **command pitch signal** from electronic unit UN41 to thruster (X41-30,32 & 33) 2. Disconnect **feedback pitch signal** from thruster to electronic unit UN41 (X41-F1, F2 & 26)	1. Pitch freez,alarm prediction error.(Thruster should be stopped) 2. Alarm (remote syst.fail.); auto stop of servopump & drive motor	1. 2. As expected (tested 04.09.04)
Comments:	(see drwg. no. H500 321c and H311 275b from Liaaen/Helitron)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.16. Tunnel thruster (bow thruster no.2) Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Joystick	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure	3. Disconnect **command signal** from joystick computer to main bridge panel UN63 (X63-44 & 45) 4.Disconnect **ready signal** from joystick computer to main bridge panel UN63 (X63-42 & 43)	3. Pitch to zero 4. Change from joystick to lever control.	3. As expected 4. As expected.
Comments:	(see drwg. no. H500 321c and H311 275b from Liaaen/Helitron)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.17. Tunnel thruster (bow thruster no.2) Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Dynpos	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure Signals to be disconnected in instrument room	5. Disconnect **command signal** from DP computer to main bridge panel UN63 (X63-115 & 116)	5. Prop.contr. will interpretend this as 0-order, "ready	5. As expected, prediction error
	6. Disconnect **feedback signal** from electr. unit to DP computer (X63-117 & 118)	6. No surveillance of propeller control signal, continue to read orders from DP; "ready to DP" not affected	6. As expected
	7. Disconnect **power supply** 24 V DC to electr.unit (circ.breaker in B2)	7. Alarm (remote syst.fail.); auto stop of servopump & drive motor	7. As expected

Comments: (see drwg. no. H500 321c and H311 275b from Liaaen/Helitron)

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.18. Tunnel thruster (stern thruster) Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On lever	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure Signals to be disconnected in instrument room	1. Disconnect **command pitch signal** from electronic unit UN41 to thruster (X41-30,32 & 33) 2. Disconnect **feedback pitch signal** from thruster to electronic unit UN41 (X41-F1, F2 & 26)	1. Pitch freez, alarm prediction error.(Thruster should be stopped) 2. Alarm (remote syst.fail.); auto stop of servopump & drive motor (Thruster stop)	1. As expected 2. As expected
Comments:	(see drwg. no. H500 321c and H311 275b from Liaaen/Helitron)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.19. Tunnel thruster (stern thruster) Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Joystick	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure	3. Disconnect **command signal** from joystick computer to main bridge panel UN63 (X63-44 & 45) 4.Disconnect **ready signal** from joystick computer to main bridge panel UN63 (X63-42 & 43)	3. Pitch to zero 4. No changes in thr system.	3. As expected 4. As expected.
Comments:	(see drwg. no. H500 321c and H311 275b from Liaaen/Helitron)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.20. Tunnel thruster (stern thruster) Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Dynpos	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure Signals to be disconnected in instrument room	5. Disconnect **command signal** from DP computer to main bridge panel UN63 (X63-115 & 116)	5. Prop.contr. will interpretend this as 0-order, "ready	5. As expected, prediction error
	6. Disconnect **feedback signal** from electr. unit to DP computer (X63-117 & 118)	6. No surveillance of propeller control signal, continue to read orders from DP; "ready to DP" not affected	6. As expected
	7. Disconnect **power supply** 24 V DC to electr.unit (circ.breaker in B2)	7. Alarm (remote syst.fail.); auto stop of servopump & drive motor	7. As expected

Comments: (see drwg. no. H500 321c and H311 275b from Liaaen/Helitron)

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.21. Steering gear port side Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On lever	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure	1. Disconnect **command signal** from electronic cabinet to steering gear (term. 30-31 in electronic cabinet instr.room) 2. Disconnect **feedback signal** from rudder to electronic cabinet steering gear (term. R1-R2 in electronic cabinet instr.room)	1. Rudder freezes. 2. Rudder freezes as long as no command is given. If any command is given, rudder will go to full angle. -No alarm	1. As expected. 2. As expected
Comments:	(see Frydenbø drwg. no. 50511)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.22. Steering gear port side Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Dynpos	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure	3. Disconnect **command signal** from DP computer to electronic cabine. (U41-TB3-10,11)	3. Rudder goes to center position, no alarm prediction)	3. As expected
	4. Disconnect **feedback signal** from electronic cabinet to DP computer (U41-TB1-7,8)	4. Rudder works as normal.	4. As expected
	5. Disconnect **ready** signal from electronic cabinet to DP computer (U31-TB1-9,10)	5. Change from DP to lever control, alarm in DP panel (Out of DP)	5. As expected
Comments:	(see drwg. 19 & 20 of 23 from Kongsberg Simrad)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.23. Steering gear starboard side Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On lever	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure	1. Disconnect **command signal** from electronic cabinet to steering gear (term. 30-31 in electronic cabinet instr.room) 2. Disconnect **feedback signal** from rudder to electronic cabinet steering gear (term. R1-R2 in electronic cabinet instr.room)	1. Rudder goes to centre position. 2. Rudder freezes as long as no command is given. If any command is given, rudder will go to full angle.	1. Rudder freez. 2. As expected, no alarm
Comments:	(see Frydenbø drwg. no. 50511)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.24. Steering gear starboard side Signal failure

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Dynpos	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure	3. Disconnect **command signal** from DP computer to electronic cabine. (U41-TB3-7,8)	3. Rudder goes to center position, no alarm prediction)	3. As expected
	4. Disconnect **feedback signal** from electronic cabinet to DP computer (U41-TB1-5,6)	4. Rudder works as normal.	4. As expected
	5. Disconnect **ready** signal from electronic cabinet to DP computer (U31-TB1-7,8)	5. Change from DP to lever control, alarm in DP panel (Out of DP)	5. As expected
Comments:	(see drwg. 19 & 20 of 23 from Kongsberg Simrad)		

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.11 TEST PROGRAM SUB-SYSTEM THRUSTERS

12.11.25. Auto-heading failure/alarm

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On joystick	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various signals failure	Set position for joystick Disconnect fwd thruster Increase load on thruster trying to move the heading position	Alarm in joystick panel	As expected

Comments:

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.12 TEST PROGRAM SUB-SYSTEM DP CONTROL

12.12.01. Failure on UPS in instrument room.

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed. Run method 2 for 30 min.**	On Dynpos	SG1 and SG2 running One aux generator running, the others in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Various failure conditions	1. Simulate fuse failure (one by one) 2. Simulate mains failure	1. Alarm on DP, connected equipment fails one by one. 2. UPS alarms - No loss of output - No loss of equipment	1. As expected 2. Lost supply from batteries after about 11 min. **To be checked**

Comments:

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.12 TEST PROGRAM SUB-SYSTEM DP CONTROL

12.12.02. Failure on computer electronic cards

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Dynpos	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
Failure on electronic cards in DPC-11	-Disconnect power on card U41 -Disconnect power on card U51	Alarms, At least 1-one thruster fwd and 1-one thruster aft to operate normally	As expected

Comments:

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim

12.12 TEST PROGRAM SUB-SYSTEM DP CONTROL

12.12.03. Reference sensors - Position accuracy

	Operation mode	Gensets	Thrusters/propellers	misc.
Setup → **NOTE: reconnect after each method listed**	On Dynpos	SG1 and SG2 running SG1 feeding the net No aux generator in standby mode	All thrusters/propellers running Aft. thr. connected to SG2	440V and 220V busbar energized All normal auxiliaries running

Fault condition	Method	Expected results	Actual test results
	Execute a 20 m box maneuver by keeping on heading, observe DGPS coordinates to check orientation. Change between DGPS 1 and 2, Gyros	Satisfactory position keeping. Maximum overshoot at each new position shall be less than 3 m. Heading stability +/- 3 degrees.	As expected Max overshot was 0,3 – 0,5 m With changing between DGS 1 and 2 max overshot was 2,9 m.

Comments:

	Yard	Owner	Class	WPA
Test verification **Date: 21.05.14**		Aage Misje		Arne Urheim