



Western Norway  
University of  
Applied Sciences

# Commissioning procedure changes to DAB cooling system

---

## Document control

<i>Report title:</i> Functional description and design changes to DAB cooling system	<i>Dato/Version</i> 28. May. 2021/1.0
	<i>Report#:</i> N/A
<i>Authors:</i> Even Sælen Uthaug Kjell Martin Dagsvik Patrick Desmond Mccann Sindre Eide Steffensen	<i>Course:</i> AUT18
	<i>Page count:</i> 39
<i>HVL supervisor:</i> Svein Haustveit	<i>Grading:</i> Open

<i>Customer:</i> Odfjell Drilling	<i>Customer Project No.</i> N/A
<i>Main point of contact:</i> Thomas Borsholm	

Revision	Dato	Status	Utført av
1.0	12.02.21	Draft Issued to Odfjell Drilling	HVL students

# 1 Contents

Document control .....	2
1 Introduction.....	4
1.1 Commisioning package.....	4
1.2 Abbreviations .....	5
1.3 System description .....	6
1.3.1 PORT AFT Fresh water cooling system .....	6
1.3.2 STBD AFT Fresh water cooling system.....	6
1.3.3 Port Forward Fresh water cooling system.....	7
1.3.4 STBD Forward Fresh water cooling system .....	7
1.4 IAS Control and monitoring .....	7
1.4.1 Freshwater Cooling pumps.....	7
1.4.2 Sea Water cooling pumps.....	8
1.4.3 Valves.....	<b>Error! Bookmark not defined.</b>
1.5 Blackout recovery .....	9
2 Objective.....	9
3 General .....	10
3.1 Special tools and equipment .....	10
3.2 Commission preparatory Check .....	10
4 Pre-Commissioning.....	10
4.1 Electrical .....	10
4.1.1 FW PUMP.....	10
5 Freshwater cooling system (PORT AFT).....	12
5.1 Function test.....	12
5.2 Flow verification .....	36

# 1 Introduction

## 1.1 Commissioning package

This Procedure covers the commissioning procedure for the following changes to the Central cooling system:

- VFD implementation on SW cooling pump.
- VFD implementation on FW cooling pump.
- Automated control of HP Mud pump FW cooling valves.
- Automated control of anchor winch FW cooling valves.
- Automated control of break resistor FW cooling valves.
- Automated control of cement package FW cooling valves.
- Establish routines for closing Chiller unit valves when inactive.

## 1.2 Abbreviations

FW	Freshwater
FWD	Forward
IAS	Integrated Automation System
MCC	Motor control Center
MODU	Mobile offshore drilling unit
PT	Pressure transmitter
STBD	Starboard
SW	Seawater
TBC	To Be Clarified
TT	Temperature Transmitter
TV	Temperature control valve
VFD	Variable frequency drive
VSP	Variable speed pump

### 1.3 System description

The central cooling system is arranged to remove excess heat from diesel engines, generators, compressors, drilling equipment, transformers, chiller units etc. via heat exchangers to fresh water coolant. This coolant is in turn cooled by seawater in the same heat exchangers, the sea water there after being discharges back into the sea.

#### 1.3.1 PORT AFT Fresh water cooling system\

The PORT AFT freshwater cooling system is arranged for the following consumers:

- Drilling switchboard
- Drilling Transformer
- Service air Compressors (3 units)
- HP Mud Pumps (2 units)
- Engine room – WCCU for FCU cooling coil
- Fan room – WCCU for FCU Cooling coil
- Starting air compressor
- Guide line Winch
- Driller Cabin-HVAC Condensor
- Lir – HVAC Condensor
- Cement Package
- Breaking resistor cooler
- Breaking resistor for AHU Winch
- WROV
- Anchor Winch

#### 1.3.2 STBD AFT Fresh water cooling system

The STBD AFT freshwater cooling system is arranged for the following consumers:

- Drilling switchboard
- Drilling Transformer
- Service air Compressor
- HP Mud Pumps (2 units)
- Engine room – WCCU for FCU cooling coil
- Subsea workshop
- Starting air compressor
- Guide line Winch Breaking resistor
- HP Hydraulic Ring Line
- HP Air Compressor
- Main AHDD Drawworks
- Breaking resistor
- Anchor Winch

### 1.3.3 Port Forward Fresh water cooling system

The Port Forward freshwater cooling system is arranged for the following consumers:

- Chiller Unit
- A/C Refrigeration Unit
- Drilling SwitchBoard
- Utility Room- WCCU for FCU & cooling coil
- Cooling unit for dynamic breake
- Aux AHD Drawworks

### 1.3.4 STBD Forward Fresh water cooling system

The STBD Forward freshwater cooling system is arranged for the following consumers:

- Chiller Unit
- Drilling Switchboard
- Drilling Transformer
- FW Treatment Room-WCCU for FCU & cooling coil
- Vent house – WCCU for FCU & Cooling Coil
- Breaking resistor
- MAIN AHDD Drawworks
- Breaking resistor for VFD

## 1.4 IAS Control and monitoring

### 1.4.1 Freshwater Cooling pumps

There are 8 Freshwater cooling pump listed in the table below. All the freshwater pumps have been upgraded to run by VFD. The freshwater cooling pump is operated in Duty / Stand-by (each 100%). The Duty pump is normally running in (Auto mode). The Switch over is activated in the case of electrical fault

Pump Tag	Description	Disch. Press
722-PA-001-A	FRESH WATER COOLING PUMP (FWD PORT)	722-PT-103
722-PA-001-B	FRESH WATER COOLING PUMP (FWD PORT)	722-PT-106
722-PA-002-A	FRESH WATER COOLING PUMP (FWD STBD)	722-PT-203
722-PA-002-B	FRESH WATER COOLING PUMP (FWD STBD)	722-PT-206
722-PA-003-A	FRESH WATER COOLING PUMP (AFT PORT)	722-PT-303
722-PA-003-B	RESH WATER COOLING PUMP (AFT PORT)	722-PT-306
722-PA-004-A	RESH WATER COOLING PUMP (AFT STBD)	722-PT-403
722-PA-004-B	RESH WATER COOLING PUMP (AFT STBD)	722-PT-406

### 1.4.2 Sea Water cooling pumps

There are eight main sea water cooling pumps. Two in each pump room for cooling the FW cooling system via the central water coolers/heat exchangers. One pump in each quadrant will be fitted with a VFD will be implemented on the SW system to actively regulate the flow of the SW in order to regulate temperature of the FW cooling system.

Pump Tag	Description	Disch. Press
722-PA-001-A	FRESH WATER COOLING PUMP (FWD PORT) (VFD)	722-PT-103
722-PA-001-B	FRESH WATER COOLING PUMP (FWD PORT)	722-PT-106
722-PA-002-A	FRESH WATER COOLING PUMP (FWD STBD) (VFD)	722-PT-203
722-PA-002-B	FRESH WATER COOLING PUMP (FWD STBD)	722-PT-206
722-PA-003-A	FRESH WATER COOLING PUMP (AFT PORT) (VFD)	722-PT-303
722-PA-003-B	RESH WATER COOLING PUMP (AFT PORT)	722-PT-306
722-PA-004-A	RESH WATER COOLING PUMP (AFT STBD) (VFD)	722-PT-403
722-PA-004-B	RESH WATER COOLING PUMP (AFT STBD)	722-PT-406

### 1.4.3 Temperature control and monitoring

The VFDs for the SW pumps will be controlled by the IAS via Profibus-DP communication. The motor speed will be determined by a temperature controller integrated in the VFDs software. The Temperature setpoint will be given to the VFD by IAS. This temperature function in the VFD will be set to a default temperature of 36 °C. The VFD will be connected to the relevant TT sensor in series with IAS, giving both the VFD and IAS access to the same TT.

### 1.4.4 Break resistor

There are four break resistor coolers, each connected to a separate freshwater cooling circuit. Temperature sensors are located within each of the coolers. Each cooler has two butterfly valves located at the suction and discharge side. The butterfly valves have gear boxes, which effectively makes them multi-turn valves. The existing gearboxes will be removed on discharge side.

Tag	Description	TT tag.	Valve tag.
866-EY-010	BREAK RESISTOR COOLER PORT FWD	TBC	TBC
866-EY-020	BREAK RESISTOR COOLER STBD FWD	TBC	TBC
866-EY-030	BREAK RESISTOR COOLER PORT AFT	TBC	TBC
866-EY-040	BREAK RESISTOR COOLER STBD AFT	TBC	TBC

### 1.4.5 Anchor winch

There are four different anchor winches, each one consists of an individual cooling circuit with a heat exchanger. We will be adding a Temperature transmitter on each of the systems, to determine if there is a need for external cooling. We will also be adding a pneumatic actuator controlled by a digital signal from the IAS.

## Functional description and design changes to DAB cooling system

Tag	Description	Freshwater TT
431-OJ-001-A	DYNAMIC BREAK ANCHOR WINCH A	TBC
431-OJ-001-B	DYNAMIC BREAK ANCHOR WINCH B	TBC
431-OJ-001-C	DYNAMIC BREAK ANCHOR WINCH C	TBC
431-OJ-001-D	DYNAMIC BREAK ANCHOR WINCH D	TBC

### 1.4.6 MUD pump

There are four high pressure drill fluid pumps. The FW cooling system consists of two valves one for pump A and B, and one for C plus D. The IAS uses a running signal from the mud pump drives to indicate when the valves need to be opened. The sy

Tag	Description	Cooling Circuit Valve
325-BK-101-A	HIGH PREASSURE MUD PUMP A	Valve-1 TBC
325-BK-101-B	HIGH PREASSURE MUD PUMP B	Valve-1 TBC
325-BK-101-C	HIGH PREASSURE MUD PUMP C	Valve-2 TBC
325-BK-101-D	HIGH PREASSURE MUD PUMP D	Valve-2 TBC

### 1.5 Blackout recovery

The automatic sequential start up after restoring of power required for the central cooling system pumps. The remote operated valves are fail safe-type to remain as is, or fail safe open.

## 2 Objective

The objective of the procedure is to give clear instructions for the activities to be carried out to complete the necessary commissioning activities to the upgrades features to the central cooling system.

### 3 General

#### 3.1 Special tools and equipment

1. Ultrasonic flow meter (portable type)

#### 3.2 Commission preparatory Check

The following check shall be done before testing:

1. Grease the required points correctly and sufficiently to the new motors if required. Never grease excessively.
2. Confirm the smooth rotation of the pump and motor by hand.
3. All required utilities such as electric power supply and instrument air supply have been ready to use.
4. Ensure all manual valves to auxiliary equipment are in the appropriate position.

### 4 Pre-Commissioning

#### 4.1 Electrical

##### 4.1.1 FW PUMP

1. Check control/indication function of the VFD starters in Local/remote and verify motor space heater is active:

Motor Tag.	VFD tag.	Control & indication				Motor space heater	Date	Signature
		LCS		IAS				
		Start	Stop	Start	Stop			
722-PA-001-A	TBC	Y N	Y N	Y N	Y N			
722-PA-001-B	TBC	Y N	Y N	Y N	Y N			
722-PA-002-A	TBC	Y N	Y N	Y N	Y N			
722-PA-002-B	TBC	Y N	Y N	Y N	Y N			
722-PA-003-A	TBC	Y N	Y N	Y N	Y N			
722-PA-003-B	TBC	Y N	Y N	Y N	Y N			
722-PA-004-A	TBC	Y N	Y N	Y N	Y N			
722-PA-004-B	TBC	Y N	Y N	Y N	Y N			

## Functional description and design changes to DAB cooling system

### 2. Confirm correct rotating direction of pumps by manually controlling VFD

Motor Tag.	VFD tag.	Design Value	Results	Date	Signature
722-PA-001-A	TBC	Rotating direction marked on pump	CW CCW		
722-PA-001-B	TBC	Rotating direction marked on pump	CW CCW		
722-PA-002-A	TBC	Rotating direction marked on pump	CW CCW		
722-PA-002-B	TBC	Rotating direction marked on pump	CW CCW		
722-PA-003-A	TBC	Rotating direction marked on pump	CW CCW		
722-PA-003-B	TBC	Rotating direction marked on pump	CW CCW		
722-PA-004-A	TBC	Rotating direction marked on pump	CW CCW		
722-PA-004-B	TBC	Rotating direction marked on pump	CW CCW		

### 3. Confirm no abnormal vibrations in pump, by running VFD manually and increasing speed in 25 RPM increments.

Motor Tag.	VFD tag.	Results	Vibration range (RPM)	Date	Signature
722-PA-001-A	TBC	Y N			
722-PA-001-B	TBC	Y N			
722-PA-002-A	TBC	Y N			
722-PA-002-B	TBC	Y N			
722-PA-003-A	TBC	Y N			
722-PA-003-B	TBC	Y N			
722-PA-004-A	TBC	Y N			
722-PA-004-B	TBC	Y N			

In the case of vibration, isolate the RPM range in the VFD.

## 5

## 5.2 Freshwater cooling system

(CP no.722-C01, P&amp;ID no. 3033DA722R001&amp;5)

## 5.2.1 Function test port aft.

SN	Description	Tag No.	Design Value	Results	Date/sign	
1.	Confirm crossover valve is closed	722-XV-305	NA	Y N		
		722-XV-305	NA	Y N		
		722-XV-406	NA	Y N		
		722-XV-407	NA	Y N		
<b>Fresh water cooling pump (722-PA-002-A)</b>						
2.	Start / Stop of FW cooling pump manually in AIS			Y N		
3.	Select FW cooling pump "A" as the duty pump	722-PA-002-A	NA	Y N		
	Select FW cooling pump "B" as the duty pump	722-PA-002-B	NA	Y N		
4.	Select FW cooling pump "A" in auto mode in the AIS	722-PA-002-A	NA	Y N		
5.	Verify that discharge pressure is the same as setpoint in IAS	722-PI-303	>7.0 bar	Y N		
6.	Disconnect Profibus of pump "A" from VFD, Check pump is still running and that fault has been detected	TBC		Y N		
	Confirm automatic switch over to standby pump "B" while duty pump "A" stops after 3 minutes disconnect period.					
7.	Connect profibus for pump "A"	TBC		Y N		
8.	Disconnect pressure transmitter from drive, confirm low pressure is detected in drive and in AIS	722-PT-303		Y N		
	Confirm automatic switch over to standby pump "B" while duty pump "A" stops.	722-PA-002-B 722-PA-002-A		Y N		

Functional description and design changes to DAB cooling system

9.	Reconnect pressure transmitter to VFD.	722-PT-303		Y	N		
	Stop pump "B" in IAS						
	Start main Pump "A" in auto mode in AIS						
10.	Stop pump "B" in IAS			Y	N		
	Start main Pump "A" in auto mode in AIS			Y	N		
11.	Check auto start pump "B" due to electrical failure in duty pump "A" by manually opening feeder in MCC	722-PA-002-B		Y	N		
	Check pump "A" fail alarm in IAS	722-PA-002-A		Y	N		
	Change setpoint pressure in IAS and verify VFD adjust to new setpoint			Y	N		
	Manually close valves in the system and verify that the VFD follows the setpoint pressure			Y	N		
	Simulate high motor temp and verify fault detection and the shut down of duty pump "A" while backup pump B starts up.			Y	N		
<b>Fresh water cooling pump (722-PA-002-B)</b>							
	Start / Stop of FW cooling pump manually in AIS			Y	N		
	Select FW cooling pump "B" as the duty pump	722-PA-002-B		Y	N		
	Select FW cooling pump "A" as the duty pump	722-PA-002-A		Y	N		
	Select FW cooling pump "B" in auto mode in the AIS	722-PA-002-B		Y	N		
	Verify that discharge pressure is the same as setpoint in IAS	722-PI-303	>7.0 bar	Y	N		
	Disconnect Profibus of pump "A" from VFD, Check pump is still running and that fault has been detected	TBC		Y	N		

Functional description and design changes to DAB cooling system

	Confirm automatic switch over to standby pump "A" while duty pump "B" stops after 3 minute disconnect period.					
	Connect profibus for pump "A"	TBC		Y	N	
	Disconnect pressure transmitter from drive, Confirm low pressure is detected in drive and in AIS	722-PT-303		Y	N	
	Confirm automatic switch over to standby pump "A" while duty pump "B" stops.	722-PA-002-A		Y	N	
		722-PA-002-B				
	Reconnect pressure transmitter to VFD.	722-PT-303		Y	N	
	Stop pump "A" in IAS			Y	N	
	Start main Pump "B" in auto mode in AIS			Y	N	
	Stop pump "A" in IAS			Y	N	
	Start main Pump "B" in auto mode in AIS			Y	N	
	Check auto start pump "A" due to electrical failure in duty pump "A" by manually opening feeder in MCC	722-PA-002-A		Y	N	
	Check pump "B" fail alarm in IAS	722-PA-002-A		Y	N	
	Change setpoint pressure in IAS and verify VFD adjust to new setpoint			Y	N	
	Manually close valves in the system and verify that the VFD follows the setpoint pressure			Y	N	
	Simulate high motor temp and verify fault detection and the shut down of duty pump "B" while backup pump "A" starts up.			Y	N	
<b>Sea water cooling pump (721-PA-002-A)</b>						

Functional description and design changes to DAB cooling system

	Start / Stop of FW cooling pump manually in AIS			Y	N		
	Select SW cooling pump "A" as the duty pump	721-PA-002-A		Y	N		
	Select FW cooling pump "B" as the duty pump	721-PA-002-B		Y	N		
	Select FW cooling pump "A" in auto mode in the AIS	721-PA-002-A		Y	N		
	Verify that VFD temperature input is the same as setpoint in IAS	TBC		Y	N		
	Disconnect Profibus of pump "A" from VFD, Check pump is still running and that fault has been detected	TBC		Y	N		
	Confirm automatic switch over to standby pump "B" when duty pump "A" is stopped locally on VFD			Y	N		
	Connect profibus for pump "A"	TBC		Y	N		
	Disconnect temperature transmitter from drive, verify sensor failure alarm is detected in drive and in AIS	721-PT-306		Y	N		
	Confirm automatic switch over to standby pump "B" while duty pump "A" stops.	721-PA-002-B		Y	N		
	Reconnect temperature transmitter to VFD.	TBC		Y	N		
	Stop pump "B" in IAS	721-PT-306		Y	N		
	Start main Pump "A" in auto mode in AIS			Y	N		
	Check auto start pump "B" due to electrical failure in duty pump "A" by manually opening feeder in MCC			Y	N		

Functional description and design changes to DAB cooling system

	Check pump "A" fail alarm in IAS			Y	N		
	Change setpoint Temperature in IAS and verify VFD adjust to new setpoint			Y	N		
	Simulate high motor temp and verify fault detection and the shut down of duty pump "A" while backup pump B starts up.	721-PA-002-B		Y	N		
<b>Anchor winch cooling system</b>							
	Open / Close the valve manually IAS			Y	N		
	Set valve to auto mode			Y	N		
	Simulate temperature increase to 36°C and 50°C and verify that the valve adjusts accordingly.			Y	N		
	Disconnect the air supply to actuator			Y	N		
	Verify that valve failsafe opens.						
	Reconnect temperature transmitter						
	Disconnect temperature transmitter and verify alarm in IAS			Y	N		
	Verify that valve failsafe opens.						
	Reconnect temperature transmitter						
	Disconnect power supply			Y	N		
	Verify that valve failsafe opens.						
	Reconnect temperature transmitter						
				Y	N		
<b>Break resistor cooler</b>							
	Open / Close the valve manually IAS			Y	N		
	Set valve to auto mode			Y	N		
	Simulate temperature			Y	N		

Functional description and design changes to DAB cooling system

	increase to 38°C, 43°C, 46°C and verify that the valve automatically opens.					
	Disconnect the air supply to actuator and verify that the valve is failsafe open.			Y	N	
	Disconnect temperature transmitter and verify alarm in IAS			Y	N	
	Verify that valve opens fully.			Y	N	
	Disconnect temperature transmitter and verify alarm in IAS			Y	N	
	Verify that valve failsafe opens.			Y	N	
	Reconnect temperature transmitter			Y	N	
	Disconnect power supply			Y	N	
	Verify that valve failsafe opens.			Y	N	
	Reconnect temperature transmitter			Y	N	
<b>MUD Pump</b>						
	Open / Close the valve manually IAS			Y	N	
	Set valve to auto mode			Y	N	
	Simulate that the MUD pump is active by connecting the drive Signal cable to ground			Y	N	
	Simulate that the MUD pump is active by connecting the drive Signal cable to 24V pin on drive			Y	N	

**5.2.2 Function test stbd aft.**

SN	Description	Tag No.	Design Value	Results	Date/sign	
1.	Confirm crossover valve is closed	722-XV-305	NA	Y N		
		722-XV-305	NA	Y N		
		722-XV-406	NA	Y N		
		722-XV-407	NA	Y N		
<b>Fresh water cooling pump (722-PA-002-C)</b>						
2.	Start / Stop of FW cooling pump manually in AIS			Y N		
3.	Select FW cooling pump "C" as the duty pump	722-PA-002-C	NA	Y N		
	Select FW cooling pump "D" as the duty pump	722-PA-002-D	NA	Y N		
4.	Select FW cooling pump "C" in auto mode in the AIS	722-PA-002-C	NA	Y N		
5.	Verify that discharge pressure is the same as setpoint in IAS	722-PI-303	>7.0 bar	Y N		
6.	Disconnect Profibus of pump "C" from VFD, Check pump is still running and that fault has been detected	TBC		Y N		
	Confirm automatic switch over to standby pump "D" while duty pump "C" stops after 3 minute disconnect period.					
7.	Connect profibus for pump "C"	TBC		Y N		
8.	Disconnect pressure transmitter from drive, Confirm low pressure is detected in drive and in AIS	722-PT-303		Y N		
	Confirm automatic switch over to standby pump "D" while duty pump "C" stops.	722-PA-002-D		Y N		
		722-PA-002-C				
9.	Reconnect pressure transmitter to VFD.	722-PT-303		Y N		
	Stop pump "D" in IAS					
	Start main Pump "C" in auto mode in AIS					

Functional description and design changes to DAB cooling system

10.	Stop pump "D" in IAS			Y	N		
	Start main Pump "C" in auto mode in AIS			Y	N		
11.	Check auto start pump "D" due to electrical failure in duty pump "C" by manually opening feeder in MCC	722-PA-002-D		Y	N		
	Check pump "C" fail alarm in IAS	722-PA-002-C		Y	N		
	Change setpoint pressure in IAS and verify VFD adjust to new setpoint			Y	N		
	Manually close valves in the system and verify that the VFD follows the setpoint pressure			Y	N		
	Simulate high motor temp and verify fault detection and the shut down of duty pump "C" while backup pump D starts up.			Y	N		
<b>Fresh water cooling pump (722-PA-002-D)</b>							
	Start / Stop of FW cooling pump manually in AIS			Y	N		
	Select FW cooling pump "D" as the duty pump	722-PA-002-D		Y	N		
	Select FW cooling pump "C" as the duty pump	722-PA-002-C		Y	N		
	Select FW cooling pump "D" in auto mode in the AIS	722-PA-002-D		Y	N		
	Verify that discharge pressure is the same as setpoint in IAS	722-PI-303	>7.0 bar	Y	N		
	Disconnect Profibus of pump "C" from VFD, Check pump is still running and that fault has been detected	TBC		Y	N		
	Confirm automatic switch over to standby pump "C" while duty pump "D" stops after 3 minute disconnect period.						

Functional description and design changes to DAB cooling system

	Connect profibus for pump "C"	TBC		Y	N		
	Disconnect pressure transmitter from drive, Confirm low pressure is detected in drive and in AIS	722-PT-303		Y	N		
	Confirm automatic switch over to standby pump "C" while duty pump "D" stops.	722-PA-002-C		Y	N		
		722-PA-002-D					
	Reconnect pressure transmitter to VFD.	722-PT-303		Y	N		
	Stop pump "C" in IAS			Y	N		
	Start main Pump "D" in auto mode in AIS			Y	N		
	Stop pump "C" in IAS			Y	N		
	Start main Pump "D" in auto mode in AIS			Y	N		
	Check auto start pump "C" due to electrical failure in duty pump "C" by manually opening feeder in MCC	722-PA-002-C		Y	N		
	Check pump "D" fail alarm in IAS	722-PA-002-D		Y	N		
	Change setpoint pressure in IAS and verify VFD adjust to new setpoint			Y	N		
	Manually close valves in the system and verify that the VFD follows the setpoint pressure			Y	N		
	Simulate high motor temp and verify fault detection and the shut down of duty pump "D" while backup pump "C" starts up.			Y	N		
<b>Sea water cooling pump (721-PA-002-A)</b>							
	Start / Stop of FW cooling pump manually in AIS			Y	N		
	Select SW cooling pump "C" as the duty pump	721-PA-002-C		Y	N		
	Select FW cooling pump "D" as the duty pump	721-PA-002-D		Y	N		

Functional description and design changes to DAB cooling system

	Select FW cooling pump "C" in auto mode in the AIS	721-PA-002-C		Y	N		
	Verify that VFD temperature input is the same as setpoint in IAS	TBC		Y	N		
	Disconnect Porfibus of pump "C" from VFD, Check pump is still running and that fault has been detected	TBC		Y	N		
	Confirm automatic switch over to standby pump "D" when duty pump "C" is stopped locally on VFD			Y	N		
	Connect profibus for pump "C"	TBC		Y	N		
	Disconnect temperature transmitter from drive, verify sensor failure alarm is detected in drive and in AIS	721-PT-306		Y	N		
	Confirm automatic switch over to standby pump "D" while duty pump "C" stops.	721-PA-002-D		Y	N		
	Reconnect temperature transmitter to VFD.	TBC		Y	N		
	Stop pump "D" in IAS	721-PT-306		Y	N		
	Start main Pump "C" in auto mode in AIS			Y	N		
	Check auto start pump "D" due to electrical failure in duty pump "C" by manually opening feeder in MCC			Y	N		
	Check pump "C" fail alarm in IAS			Y	N		
	Change setpoint Temperature in IAS and verify VFD adjust to new setpoint			Y	N		
	Simulate high motor temp and verify fault detection and the	721-PA-002-D		Y	N		

Functional description and design changes to DAB cooling system

	shut down of duty pump "C" while backup pump D starts up.					
<b>Anchor winch cooling system</b>						
	Open / Close the valve manually IAS			Y	N	
	Set valve to auto mode			Y	N	
	Simulate temperature increase to 36°C and 50°C and verify that the valve adjusts accordingly.			Y	N	
	Disconnect the air supply to actuator			Y	N	
	Verify that valve failsafe opens.					
	Reconnect temperature transmitter					
	Disconnect temperature transmitter and verify alarm in IAS			Y	N	
	Verify that valve failsafe opens.					
	Reconnect temperature transmitter					
	Disconnect power supply			Y	N	
	Verify that valve failsafe opens.					
	Reconnect temperature transmitter					
				Y	N	
<b>Break resistor cooler</b>						
	Open / Close the valve manually IAS			Y	N	
	Set valve to auto mode			Y	N	
	Simulate temperature increase to 38°C, 43°C, 46°C and verify that the valve automatically opens.			Y	N	
	Disconnect the air supply to actuator and verify that the valve is failsafe open.			Y	N	

Functional description and design changes to DAB cooling system

	Disconnect temperature transmitter and verify alarm in IAS			Y	N		
	Verify that valve opens fully.			Y	N		
	Disconnect temperature transmitter and verify alarm in IAS			Y	N		
	Verify that valve failsafe opens.			Y	N		
	Reconnect temperature transmitter			Y	N		
	Disconnect power supply			Y	N		
	Verify that valve failsafe opens.			Y	N		
	Reconnect temperature transmitter			Y	N		
<b>MUD Pump</b>							
	Open / Close the valve manually IAS			Y	N		
	Set valve to auto mode			Y	N		
	Simulate that the MUD pump is active by connecting the drive Signal cable to ground			Y	N		
	Simulate that the MUD pump is active by connecting the drive Signal cable to 24V pin on drive			Y	N		

**5.2.3 Function test port fwd.**

SN	Description	Tag No.	Design Value	Results	Date/sign	
1.	Confirm crossover valve is closed	722-XV-305	NA	Y N		
		722-XV-305	NA	Y N		
		722-XV-406	NA	Y N		
		722-XV-407	NA	Y N		
<b>Fresh water cooling pump (722-PA-001-A)</b>						
2.	Start / Stop of FW cooling pump manually in AIS			Y N		
3.	Select FW cooling pump "A" as the duty pump	722-PA-001-A	NA	Y N		
	Select FW cooling pump "B" as the duty pump	722-PA-001-B	NA	Y N		
4.	Select FW cooling pump "A" in auto mode in the AIS	722-PA-001-A	NA	Y N		
5.	Verify that discharge pressure is the same as setpoint in IAS	722-PI-303	>7.0 bar	Y N		
6.	Disconnect Profibus of pump "A" from VFD, Check pump is still running and that fault has been detected	TBC		Y N		
	Confirm automatic switch over to standby pump "B" while duty pump "A" stops after 3 minute disconnect period.					
7.	Connect profibus for pump "A"	TBC		Y N		
8.	Disconnect pressure transmitter from drive, Confirm low pressure is detected in drive and in AIS	722-PT-303		Y N		
	Confirm automatic switch over to standby pump "B" while duty pump "A" stops.	722-PA-001-B		Y N		
		722-PA-001-A				
9.	Reconnect pressure transmitter to VFD.	722-PT-303		Y N		
	Stop pump "B" in IAS					
	Start main Pump "A" in auto mode in AIS					

Functional description and design changes to DAB cooling system

10.	Stop pump "B" in IAS			Y	N		
	Start main Pump "A" in auto mode in AIS			Y	N		
11.	Check auto start pump "B" due to electrical failure in duty pump "A" by manually opening feeder in MCC	722-PA-001-B		Y	N		
	Check pump "A" fail alarm in IAS	722-PA-001-A		Y	N		
	Change setpoint pressure in IAS and verify VFD adjust to new setpoint			Y	N		
	Manually close valves in the system and verify that the VFD follows the setpoint pressure			Y	N		
	Simulate high motor temp and verify fault detection and the shut down of duty pump "A" while backup pump B starts up.			Y	N		
<b>Fresh water cooling pump (722-PA-001-B)</b>							
	Start / Stop of FW cooling pump manually in AIS			Y	N		
	Select FW cooling pump "B" as the duty pump	722-PA-001-B		Y	N		
	Select FW cooling pump "A" as the duty pump	722-PA-001-A		Y	N		
	Select FW cooling pump "B" in auto mode in the AIS	722-PA-001-B		Y	N		
	Verify that discharge pressure is the same as setpoint in IAS	722-PI-303	>7.0 bar	Y	N		
	Disconnect Profibus of pump "A" from VFD, Check pump is still running and that fault has been detected	TBC		Y	N		
	Confirm automatic switch over to standby pump "A" while duty pump "B" stops after 3 minute disconnect period.						

Functional description and design changes to DAB cooling system

	Connect profibus for pump "A"	TBC		Y	N		
	Disconnect pressure transmitter from drive, Confirm low pressure is detected in drive and in AIS	722-PT-303		Y	N		
	Confirm automatic switch over to standby pump "A" while duty pump "B" stops.	722-PA-001-A		Y	N		
		722-PA-001-B					
	Reconnect pressure transmitter to VFD.	722-PT-303		Y	N		
	Stop pump "A" in IAS			Y	N		
	Start main Pump "B" in auto mode in AIS			Y	N		
	Stop pump "A" in IAS			Y	N		
	Start main Pump "B" in auto mode in AIS			Y	N		
	Check auto start pump "A" due to electrical failure in duty pump "A" by manually opening feeder in MCC	722-PA-001-A		Y	N		
	Check pump "B" fail alarm in IAS	722-PA-001-A		Y	N		
	Change setpoint pressure in IAS and verify VFD adjust to new setpoint			Y	N		
	Manually close valves in the system and verify that the VFD follows the setpoint pressure			Y	N		
	Simulate high motor temp and verify fault detection and the shut down of duty pump "B" while backup pump "A" starts up.			Y	N		
<b>Sea water cooling pump (721-PA-001-A)</b>							
	Start / Stop of FW cooling pump manually in AIS			Y	N		
	Select SW cooling pump "A" as the duty pump	721-PA-001-A		Y	N		

Functional description and design changes to DAB cooling system

	Select FW cooling pump "B" as the duty pump	721-PA-001-B		Y	N		
	Select FW cooling pump "A" in auto mode in the AIS	721-PA-001-A		Y	N		
	Verify that VFD temperature input is the same as setpoint in IAS	TBC		Y	N		
	Disconnect Profibus of pump "A" from VFD, Check pump is still running and that fault has been detected	TBC		Y	N		
	Confirm automatic switch over to standby pump "B" when duty pump "A" is stopped locally on VFD			Y	N		
	Connect profibus for pump "A"	TBC		Y	N		
	Disconnect temperature transmitter from drive, verify sensor failure alarm is detected in drive and in AIS	721-PT-306		Y	N		
	Confirm automatic switch over to standby pump "B" while duty pump "A" stops.	721-PA-001-B		Y	N		
	Reconnect temperature transmitter to VFD.	TBC		Y	N		
	Stop pump "B" in IAS	721-PT-306		Y	N		
	Start main Pump "A" in auto mode in AIS			Y	N		
	Check auto start pump "B" due to electrical failure in duty pump "A" by manually opening feeder in MCC			Y	N		
	Check pump "A" fail alarm in IAS			Y	N		
	Change setpoint Temperature in IAS and verify VFD adjust to new setpoint			Y	N		

Functional description and design changes to DAB cooling system

	Simulate high motor temp and verify fault detection and the shut down of duty pump "A" while backup pump B starts up.	721-PA-001-B		Y	N		
<b>Anchor winch cooling system</b>							
	Open / Close the valve manually IAS			Y	N		
	Set valve to auto mode			Y	N		
	Simulate temperature increase to 36°C and 50°C and verify that the valve adjusts accordingly.			Y	N		
	Disconnect the air supply to actuator			Y	N		
	Verify that valve failsafe opens.						
	Reconnect temperature transmitter						
	Disconnect temperature transmitter and verify alarm in IAS			Y	N		
	Verify that valve failsafe opens.						
	Reconnect temperature transmitter						
	Disconnect power supply			Y	N		
	Verify that valve failsafe opens.						
	Reconnect temperature transmitter						
				Y	N		
<b>Break resistor cooler</b>							
	Open / Close the valve manually IAS			Y	N		
	Set valve to auto mode			Y	N		
	Simulate temperature increase to 38°C, 43°C, 46°C and verify that the valve automatically opens.			Y	N		
	Disconnect the air supply to actuator and verify that the			Y	N		

Functional description and design changes to DAB cooling system

	valve is failsafe open.					
	Disconnect temperature transmitter and verify alarm in IAS			Y	N	
	Verify that valve opens fully.			Y	N	
	Disconnect temperature transmitter and verify alarm in IAS			Y	N	
	Verify that valve failsafe opens.			Y	N	
	Reconnect temperature transmitter			Y	N	
	Disconnect power supply			Y	N	
	Verify that valve failsafe opens.			Y	N	
	Reconnect temperature transmitter			Y	N	

**5.2.4 Function test stbd fwd.**

SN	Description	Tag No.	Design Value	Results	Date/sign	
1.	Confirm crossover valve is closed	722-XV-305	NA	Y N		
		722-XV-305	NA	Y N		
		722-XV-406	NA	Y N		
		722-XV-407	NA	Y N		
<b>Fresh water cooling pump (722-PA-002-C)</b>						
2.	Start / Stop of FW cooling pump manually in AIS			Y N		
3.	Select FW cooling pump "C" as the duty pump	722-PA-002-C	NA	Y N		
	Select FW cooling pump "D" as the duty pump	722-PA-002-D	NA	Y N		
4.	Select FW cooling pump "C" in auto mode in the AIS	722-PA-002-C	NA	Y N		
5.	Verify that discharge pressure is the same as setpoint in IAS	722-PI-303	>7.0 bar	Y N		
6.	Disconnect Profibus of pump "C" from VFD, Check pump is still running and that fault has been detected	TBC		Y N		
	Confirm automatic switch over to standby pump "D" while duty pump "C" stops after 3 minute disconnect period.					
7.	Connect profibus for pump "C"	TBC		Y N		
8.	Disconnect pressure transmitter from drive, Confirm low pressure is detected in drive and in AIS	722-PT-303		Y N		
	Confirm automatic switch over to standby pump "D" while duty pump "C" stops.	722-PA-002-D		Y N		
		722-PA-002-C				
9.	Reconnect pressure transmitter to VFD.	722-PT-303		Y N		
	Stop pump "D" in IAS					
	Start main Pump "C" in auto mode in AIS					

Functional description and design changes to DAB cooling system

10.	Stop pump "D" in IAS			Y	N		
	Start main Pump "C" in auto mode in AIS			Y	N		
11.	Check auto start pump "D" due to electrical failure in duty pump "C" by manually opening feeder in MCC	722-PA-002-D		Y	N		
	Check pump "C" fail alarm in IAS	722-PA-002-C		Y	N		
	Change setpoint pressure in IAS and verify VFD adjust to new setpoint			Y	N		
	Manually close valves in the system and verify that the VFD follows the setpoint pressure			Y	N		
	Simulate high motor temp and verify fault detection and the shut down of duty pump "C" while backup pump D starts up.			Y	N		
<b>Fresh water cooling pump (722-PA-002-D)</b>							
	Start / Stop of FW cooling pump manually in AIS			Y	N		
	Select FW cooling pump "D" as the duty pump	722-PA-002-D		Y	N		
	Select FW cooling pump "C" as the duty pump	722-PA-002-C		Y	N		
	Select FW cooling pump "D" in auto mode in the AIS	722-PA-002-D		Y	N		
	Verify that discharge pressure is the same as setpoint in IAS	722-PI-303	>7.0 bar	Y	N		
	Disconnect Profibus of pump "C" from VFD, Check pump is still running and that fault has been detected	TBC		Y	N		
	Confirm automatic switch over to standby pump "C" while duty pump "D" stops after 3 minute disconnect period.						

Functional description and design changes to DAB cooling system

	Connect profibus for pump "C"	TBC		Y	N		
	Disconnect pressure transmitter from drive, Confirm low pressure is detected in drive and in AIS	722-PT-303		Y	N		
	Confirm automatic switch over to standby pump "C" while duty pump "D" stops.	722-PA-002-C		Y	N		
		722-PA-002-D					
	Reconnect pressure transmitter to VFD.	722-PT-303		Y	N		
	Stop pump "C" in IAS			Y	N		
	Start main Pump "D" in auto mode in AIS			Y	N		
	Stop pump "C" in IAS			Y	N		
	Start main Pump "D" in auto mode in AIS			Y	N		
	Check auto start pump "C" due to electrical failure in duty pump "C" by manually opening feeder in MCC	722-PA-002-C		Y	N		
	Check pump "D" fail alarm in IAS	722-PA-002-D		Y	N		
	Change setpoint pressure in IAS and verify VFD adjust to new setpoint			Y	N		
	Manually close valves in the system and verify that the VFD follows the setpoint pressure			Y	N		
	Simulate high motor temp and verify fault detection and the shut down of duty pump "D" while backup pump "C" starts up.			Y	N		
<b>Sea water cooling pump (721-PA-002-A)</b>							
	Start / Stop of FW cooling pump manually in AIS			Y	N		
	Select SW cooling pump "C" as the duty pump	721-PA-002-C		Y	N		
	Select FW cooling pump "D" as the duty pump	721-PA-002-D		Y	N		

Functional description and design changes to DAB cooling system

	Select FW cooling pump "C" in auto mode in the AIS	721-PA-002-C		Y	N		
	Verify that VFD temperature input is the same as setpoint in IAS	TBC		Y	N		
	Disconnect Porfibus of pump "C" from VFD, Check pump is still running and that fault has been detected	TBC		Y	N		
	Confirm automatic switch over to standby pump "D" when duty pump "C" is stopped locally on VFD			Y	N		
	Connect profibus for pump "C"	TBC		Y	N		
	Disconnect temperature transmitter from drive, verify sensor failure alarm is detected in drive and in AIS	721-PT-306		Y	N		
	Confirm automatic switch over to standby pump "D" while duty pump "C" stops.	721-PA-002-D		Y	N		
	Reconnect temperature transmitter to VFD.	TBC		Y	N		
	Stop pump "D" in IAS	721-PT-306		Y	N		
	Start main Pump "C" in auto mode in AIS			Y	N		
	Check auto start pump "D" due to electrical failure in duty pump "C" by manually opening feeder in MCC			Y	N		
	Check pump "C" fail alarm in IAS			Y	N		
	Change setpoint Temperature in IAS and verify VFD adjust to new setpoint			Y	N		
	Simulate high motor temp and verify fault detection and the	721-PA-002-D		Y	N		

Functional description and design changes to DAB cooling system

	shut down of duty pump "C" while backup pump D starts up.					
<b>Anchor winch cooling system</b>						
	Open / Close the valve manually IAS			Y	N	
	Set valve to auto mode			Y	N	
	Simulate temperature increase to 36°C and 50°C and verify that the valve adjusts accordingly.			Y	N	
	Disconnect the air supply to actuator			Y	N	
	Verify that valve failsafe opens.					
	Reconnect temperature transmitter					
	Disconnect temperature transmitter and verify alarm in IAS			Y	N	
	Verify that valve failsafe opens.					
	Reconnect temperature transmitter					
	Disconnect power supply			Y	N	
	Verify that valve failsafe opens.					
	Reconnect temperature transmitter					
				Y	N	
<b>Break resistor cooler</b>						
	Open / Close the valve manually IAS			Y	N	
	Set valve to auto mode			Y	N	
	Simulate temperature increase to 38°C, 43°C, 46°C and verify that the valve automatically opens.			Y	N	
	Disconnect the air supply to actuator and verify that the valve is failsafe open.			Y	N	

Functional description and design changes to DAB cooling system

	Disconnect temperature transmitter and verify alarm in IAS			Y	N		
	Verify that valve opens fully.			Y	N		
	Disconnect temperature transmitter and verify alarm in IAS			Y	N		
	Verify that valve failsafe opens.			Y	N		
	Reconnect temperature transmitter			Y	N		
	Disconnect power supply			Y	N		
	Verify that valve failsafe opens.			Y	N		
	Reconnect temperature transmitter			Y	N		

## 5.3 Flow verification

### 5.3.1 Port AFT

SN	Description	Tag No.	Design Value	Recorded value	Results	Date/sign	
1.	Cooler for MDF	722-HE-002-C	20.0		Y N		
	Generator E	861-EG-001-E	28.4		Y N		
	Generator F	861-EG-001-F	28.4		Y N		
	Anchor winch	431-OJ-001-C	75		Y N		
	Transformer	865-ET-003-C	12.2		Y N		
	Drilling Switchboard	571-HE-S03	21.5		Y N		
	Service air compressor	733-KC-001-A	14.2		Y N		
	HP MUD Pump – Electric motor	325-BK-101-A	22.7		Y N		
	HP MUD PUMP – Electric motor		22.7		Y N		
	HP MUD PUMP – Line Spray		27.3		Y N		
	HP MUD PUMP – Lube Oil		3.5		Y N		
	WCCU – Engine room(M147B)	576-HE-001	57.0		Y N		
	WCCU – Fan room(M316)	576-HE-006	4.5		Y N		
	HVAC Condenser - Driller cabin	311-GX454	7.3		Y N		
	Guideline winch	314-MK-101	0.7		Y N		
	Cement package	371-B1001	52.7		Y N		
	AHU Winch	314H1-MK001	0.7		Y N		
	Breaking resistor for AHU winch	314H1-EZ001	5.5		Y N		
	Centrifuge		1.4		Y N		
	WROV – Winch Reel Cont. cabinet		4.5		Y N		
	WROV – Winch breaking resistor		12.3		Y N		
					Y N		

If flow isn't sufficient to individual consumers adjust setpoint pressure in IAS.

Functional description and design changes to DAB cooling system

**5.3.2 STBD AFT**

SN	Description	Tag No.	Design Value	Recorded value	Results	Date/sign	
1.	Cooler for MDF	722-HE-002-C	20.0		Y N		
	Generator G	861-EG-001-G	28.4		Y N		
	Generator H	861-EG-001-H	28.4		Y N		
	Transformer	865-ET-003-D	12.2		Y N		
	Drilling Switchboard	571-HE-S04	21.5		Y N		
	Service air compressor	733-KC-001-D	14.2		Y N		
	HP MUD Pump – Electric motor	325-BK-101-C	22.7		Y N		
	HP MUD PUMP – Electric motor		22.7		Y N		
	HP MUD PUMP – Line Spray		27.3		Y N		
	HP MUD PUMP – Lube Oil		3.5		Y N		
	WCCU – Engine room(M147B)	576-HE-002	57.0		Y N		
	FCU – Subsea Workshop	576-GB-262E	17.6		Y N		
	Starting air compressor B	731-KB-001-B	4.8		Y N		
	Anchor Winch	431-OJ-110-D	75.0		Y N		
	HVAC Condenser - Driller cabin	311-GX454	7.3		Y N		
	Guideline winch break resistor	314-EZ-100A	0.7		Y N		
	HP hydraulic oil ring	343-CT-100	82		Y N		
	HP air compressor	315A1-YD001	4.8		Y N		
	Breaking Resistor	866-EY-040	63		Y N		

If flow isn't sufficient to individual consumers adjust setpoint pressure in IAS.

Functional description and design changes to DAB cooling system

**5.3.3 Port FWD**

SN	Description	Tag No.	Design Value	Recorded value	Results	Date/sign	
1.	Cooler for MDF	722-HE-002-A	20.0		Y N		
2.	Generator A	861-EG-001-A	28.4		Y N		
3.	Generator B	861-EG-001-B	28.4		Y N		
4.	Anchor winch	431-OJ-001-B	75.0		Y N		
5.	Transformer	865-ET-003-B	12.2		Y N		
6	Drilling Switchboard	571-HE-S01	21.5		Y N		
7.	Chiller Unit A	571-HE-001-A	248.5		Y N		
8.	AC refrigeration unit A	572-HE-001-A	8.0		Y N		
9.	WCCU – Utility room	576-HE-004	57.0		Y N		
11.	Break resistor cooler	866-EY-010	117.0		Y N		
12	AUX AHD Drawwork	312-BG-001	4.5		Y N		

If flow isn't sufficient to individual consumers adjust setpoint pressure in IAS.

Functional description and design changes to DAB cooling system

**5.3.4 STBD FWD**

SN	Description	Tag No.	Design Value	Recorded value	Results	Date/sign	
1.	Cooler for MDF	722-HE-002-B	20.0		Y N		
2.	Generator C	861-EG-001-C	28.4		Y N		
3.	Generator D	861-EG-001-D	28.4		Y N		
4.	Anchor winch	431-OJ-001-C	75.0		Y N		
5.	Transformer	865-ET-003-A	12.2		Y N		
6	Drilling Switchboard	571-HE-S02	21.5		Y N		
7.	Chiller Unit B	571-HE-001-B	248.5		Y N		
8.	A/C refrigeration unit A	572-HE-001-A	8.0		Y N		
9.	WCCU – Freshwater treatment room	576-HE-003	57.0		Y N		
11.	Break resistor cooler	866-EY-010	117.0		Y N		
12	Main AHDD Drawwork A - FWD	312-BG-001	4.5		Y N		

If flow isn't sufficient to individual consumers adjust setpoint pressure in IAS.