KONGSBERG

Functional Design Specification (FDS)

ESD and F&G system

KM - Drill8

Project:	12345678
Product:	K-Safe
Location:	
Synopsis:	This document describes the design and functionality of the KM Emergency ShutDown System (ESD) and Fire & Gas System (F&G) for the SHI2018 Maersk project.

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Document history

Revision	Description of Change
A	*First issue*
B	*Updated according to comments from SHI*
C	*Added section for fire pump logic*
D	*Updated to as-built, project specific info;12.1* *Special logic, list of net signals.12.1338* *Gas detector settings (ICR-315) 4.2* *Removed PB for start of fire pump from WM/Inergen room.5.1* *Updated symbols section.7.7* *Updated alarm priority table with manual activation & activation conflict.7.5.3* *Updated scan task 7.8.1*

References

Ref: Document title:	Document number:
• *K-Safe Product Description*	*163875*
• *K-Safe Configuration Manual*	*1032539*
• *Safety Systems Design Philosophy*	
• *Project Topology Drawing*	*1179338*
• *Bill of Materials*	

Ref: Document title:	**Document number:**
• *Safety Analysis Report (SAR)*	
• *C&E diagrams for ESD System*	
• *C&E diagrams for F&G System*	
• *I/O list for the ESD System*	
• *I/O list for the F&G System*	
• *Layout of ESD and F&G CAAP's*	*1180156 (W/H)* *1180157 (ECR)* *1180158 (Fire Control Station)* *1180159 (WM & Inergen Room)* *1180160 (DWS)*
• *P&ID's*	
• *Fire & Gas Detector Layouts*	
• *Hardware Loop Typicals*	
• *F&G Cabinet Drawings*	*353482/B*
• *ESD Cabinet Drawings*	*353478/B*
• *Fire Central Loop Arrangement*	
• *Fire Central Installation Handbook*	
• *FAT Procedure for the ESD System*	*1205073*
• *FAT Procedure for the F&G System*	*1205073*
• *AIM User Guide*	*Online Help on every OS*
• *Project Design Manual*	
• *Datasheets for detectors and devices*	
• *Software Logic Modules*	

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Definitions / Abbreviations

Phrase to define:	Definition:
1oo2	*The KM architecture consists of two elements connected in parallel. During normal operation, both elements are able to perform a shutdown.* *In addition, if the diagnostic test in either element detects a fault then the faulty system is isolated and the other element keeps control. If the diagnostic tests find faults in both elements or a discrepancy that cannot be allocated to either element, then the output will go to the failsafe state.*
K-Safe	*KM Safety System. The K-Safe system has been designed for use in SIL applications and the solution has been certified by TÜV.*
Display	*The visual interface between the AIM system and the operator.*
Display active	*The RCU, in a node redundant pair which controls the displays.*
Ethernet address	*Network address that reflects the HW dipswitch settings on the network nodes.*
Hotspot	*Designated area on the VDU, programmed for performing a defined action. Typically used for navigation between process images.*
Inhibit	*Inhibit an input will disable automatic safeguard action, but allowing associated alarm to appear as manual and normal actions.*
Instrument Tag	*Field equipment tag.*
IP address	*All network nodes must have a unique IP (Internet Protocol) address that consists of a network part and a host part.*
KM C&E Tool	*The complete product range of KM Safety Tools, covering engineering, deployment, as-built and online.*

Phrase to define:	Definition:
Module	*A "module" is an independent software routine performing an algorithm and communicates with other module's or/and the I/O system via input/output terminals. Each module consists of a graphic symbol, a software algorithm and an associated data structure which is unique for this particular module.* *Flexi modules have no predefined algorithm. They consist of logic elements (AND, OR gates etc.) and can be re-configured.*
Override	*Override function intended to set the output signal to predefined state, independent of changes in logic states.*
Redundant network	*The main backbone network connecting the control system components, such as RCU's and OS'es.*
Scan Task	*Part of the software system that administrates the execution of function modules, and also scanning of the connected I/O cards and display updating. The task controls the timing and execution sequence.*
Shutdown	*An action initiated by the Safety system*
Tag Name	*TAGNAME or TAG is the name given for the object module as a unique identification. The tag name will often be identical to the name of the corresponding "instrumentation tag list", but may also designate units such as motor controls, control loops or static drawing objects.*
Terminal	*Each type of module has a set of predefined terminals.* *A module's terminals are the data connection points (or ports) of communication between the modules and/or the I/O system. The module terminals are used for different purposes.* *There are three different terminal types:* *Input terminals, Output terminals and Process terminals.* *The terminals may be configured with alarms, numerical value representation, bar graphs, as part of trend pages, reports etc., depending on the terminal type.*
Terminal Connection	*Terminals of two function modules, connected together, to enable exchange of data between these modules.*

Phrase to define:	Definition:
Visual Display Unit (VDU)	*The visual interface between the AIM control system and the operator.*

Abbreviation:	Explanation:
AC / DC	*Alternating / Direct Current*
ACK	*Acknowledge*
AFFF	*Aqueous Film Forming Foam*
AFS	*Autronica Fire & Security*
AI	*Analogue Input*
AIM	*Advanced Integrated Multifunction System (KM Control System Software)*
K-Safe	*Advanced Integrated Multifunction, Safety systems*
AVS	*Abandon Vessel Shutdown*
APS	*Abandon Platform Shutdown*
BCR	*Backup Control Room*
BOP	*Blow Out Preventer*
C&E	*Cause & Effect*
CB	*Circuit Breaker*
CAAP	*Critical Alarm and Action Panel*
CAT	*Customer Acceptance Test*
CCR	*Central Control Room*
CCTV	*Closed Circuit TV*
CER	*Central Equipment Room*
DA	*Display Active*
DCR	*Drilling Control Room*

Abbreviation:	Explanation:
DG	*Diesel Generator*
DI / DO	*Digital Input / Output*
DILM	*Digital Input with Line Monitoring*
DP	*Dynamic Position*
ESD	*Emergency ShutDown*
EUC	*Equipment Under Control*
Ex	*Explosion protection*
F&G	*Fire & Gas*
FAT	*Factory Acceptance Test*
FDS	*Functional Design Specification*
FOST	*Final Output Stage Test*
FPDS	*Fire Protection Data Sheet*
FPSO	*Floating Production, Storage and Offloading unit*
FS	*Field Stations*
H / HH	*High / HighHigh (alarm indicator)*
HART	*Highway Addressable Remote Transducer*
HMI	*Human Machine Interface*
HS	*History Station*
HVAC	*Heating, Ventilation and Air Conditioning*
HW	*HardWare*
HWLT	*HardWare Loop Typical*
I/O	*Input / Output*
IAT	*Internal Acceptance Test*
ICMS	*Integrated Control & Monitoring System*
ICS	*Integrated Control and Safety System*

Abbreviation:	Explanation:
IER	*Instrument Equipment Room*
IMS	*Information Management System*
IS	*Intrinsically Safe*
KFDD	*Kongsberg Functional Design Document*
KM	*Kongsberg Maritime*
L / LL	*Low / LowLow (alarm indicator)*
LAN	*Local Area Network*
LED	*Light Emitting Diode*
LEL	*Lower Explosion Limit*
LER	*Local Equipment Room*
LV	*Low Voltage*
MCC	*Motor Control Centre*
MCR	*Main Control Room*
N/A	*Not Applicable*
NC / NO	*Normally Closed / Open*
NDU	*Net Distribution Unit*
NE / NDE	*Normally Energized / DeEnergized*
OS	*Operator Station*
P&ID	*Piping & Instrument Diagram*
PA/GA	*Public Address / General Alarm*
PCS	*Process Control System*
PMS	*Power Management System*
PS	*Process Station, Process Control Cabinet*
PSD	*Process ShutDown*
RAIC	*Remote Analogue Input Card (Current)*

Abbreviation:	Explanation:
RAIV	*Remote Analogue Input Card (Voltage)*
RCU	*Remote Control Unit (Process Computer)*
RDIO	*Remote Digital Input/Output Card*
RIO	*Remote Input/Output Card*
RMP	*Remote Multi Purpose (IO card)*
SAR	*Safety Analysis Report*
SAS	*Safety & Automation System*
SAT	*Site Acceptance Test*
SIL	*Safety Integrity Level*
SW	*Software*
UPS	*Uninterruptible Power Supply*
VDU	*Visual Display Unit*
VMS	*Vessel Management System*

Table 1-1: Definitions/Abbreviations

1. Introduction

This document shall be used as:

- Introduction to the ESD and F&G functionality.
- Design document for ESD and F&G System.
- Reference for ESD and F&G specific Operation.
- Basis for the ESD and F&G Configuration.
- Part of the ESD and F&G SW FAT Test Documentation.

1.1. Responsibilities

The Safety Group at Kongsberg Maritime AS is responsible for this document.

1.2. Standards and Guidelines

- ABS Rule: 2010 Steel Vessel Rules 1-1-4/7.7, 4-9-7
- ABS Rule: Mobile Offshore Drilling Unit Rules 4-3-5/7, 5-2-5
- IEC 61508 parts 1-7: Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems
- ISO 9001:2000 Requirements for Contractor's Quality Assurance

2. SYSTEM DESCRIPTION

2.1. ESD System Description

The ESD System is designed to comply with SIL 2 requirements; this implies the K-Safe 2 solution with dedicated safety software and hardware.

Activation of the ESD system will ensure the safest possible condition of the installation to minimise the consequences of an emergency situation related to uncontrolled releases of hydrocarbons or an outbreak of fire. The ESD System is used to provide a safe and rapid shutdown of systems and equipment.

The ESD System processes input signals from the manual pushbuttons or signals such as confirmed gas from F&G System.

The ESD System shall be powered from two UPS with a capacity of at least 30 minutes continuous operation after loss of power. One UPS shall be powered from the main power system and one UPS shall be powered from the emergency system.

The main control point for ESD will be the ESD field station FS-81.

For more information of KM ESD see ref □.

2.2. F&G System Description

The F&G System is designed to comply with SIL 2 requirements; this implies the K-Safe 2 solution with dedicated safety software and hardware.

Activation of the system will ensure early and reliable detection of fire or gas, wherever such events are likely to occur. The F&G system is used to initiate alarm, initiate protective actions, shutdown equipments and alert personnel.

The F&G system processes input signals from the field mounted detectors, addressable detectors and manual call points.

The F&G system shall be powered from two UPS with a capacity of at least 30 minutes continuous operation after loss of power. One UPS shall be powered from the main power system and one UPS shall be powered from the emergency system.

The main control point for F&G will be the F&G field stations FS-71 & FS-72.

For more information of KM F&G System, see ref □.

2.3. ESD and F&G System Interface

The ESD and F&G System are two independent safety systems. The systems are interfaced according to the figure below:

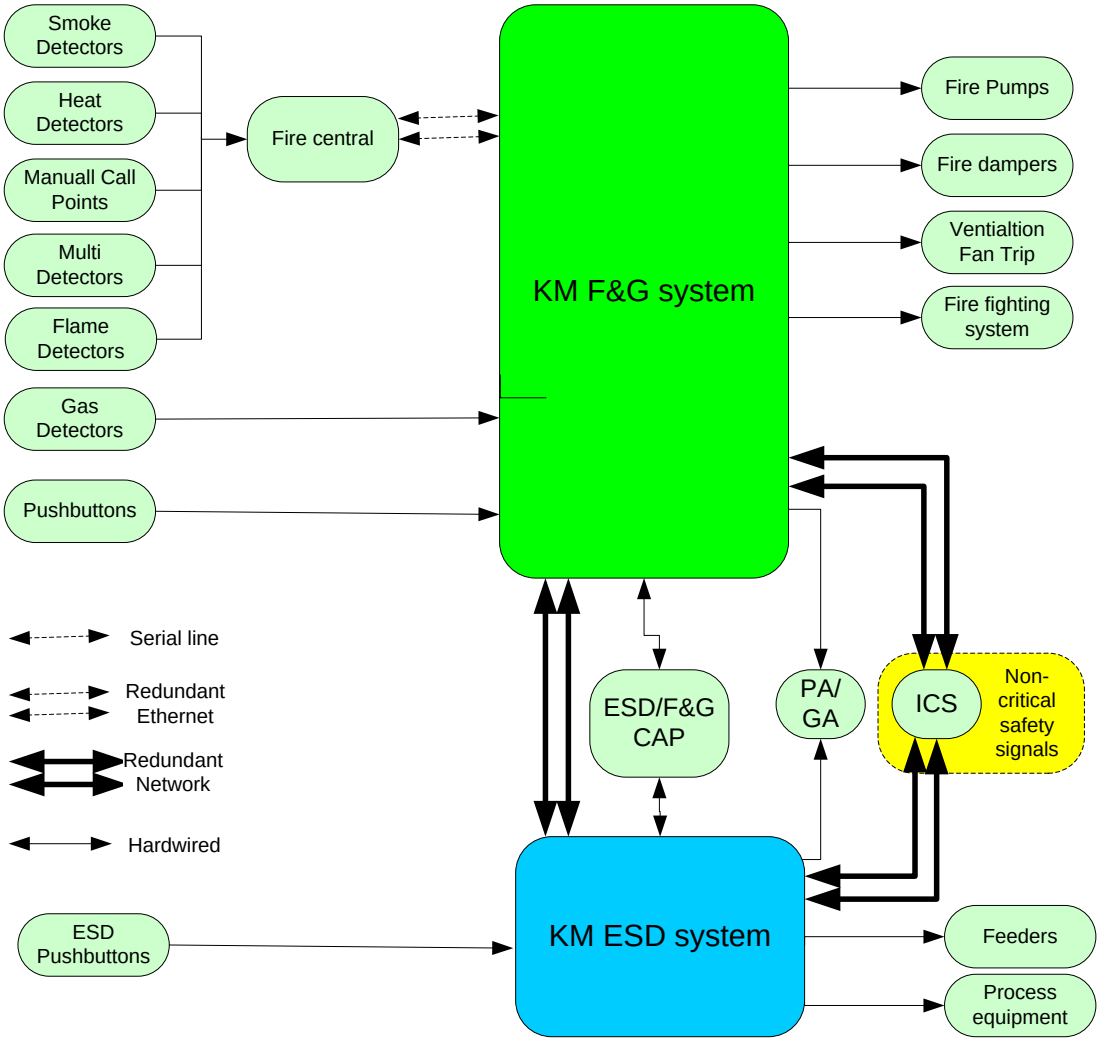


Figure 2-1: ESD and F&G System Interface

The figure illustrates the ESD and F&G interface, with main equipment and input/output signals. The figure also illustrates communication type between system equipments.

2.4. Topology

The ESD and F&G Systems are a part of the Integrated Control & Safety System (ICS), see ref □.

The ESD and F&G Systems are independent of and in addition to all other control systems. An event in the control system will not prevent the safety system from bringing the Drilling Unit to the safe state. Sharing information between the control system and the safety systems will increase the overall safety onboard the drilling unit by giving the operator a better overview of the overall situation.

The ESD and F&G Systems will be controlled and monitored from:

- The Safety Operation Station (OS 60) located in the Wheelhouse (WH).
- The ESD and F&G CAAP located in ECR, WH, Drilling Work Station (DWS), Fire Control Station (FCS) and Watermist / Inergen Room (WMIR).

The ESD and F&G System are monitored on all KM Operator Stations, and may be controlled from these OS'es if the command control is given to the specific OS. For more information about the command control, see chapter 6.4.

The ESD and F&G RCU's and RIO cards will be placed in cabinets in the General Electric Room.

2.5. Interface with Other Systems

Software signals will be sent via ICS network to and from the ESD, F&G and ICS Systems. This is the redundant backbone network for all KM RCU's and OS'es.

Software signals will be sent via fail-safe network modules, these modules monitor the connection between the RCU's, and they can be programmed to go to a fail-safe condition if one RCU loose contact with the other RCU's.

The fail-safe network modules and the redundant network comprise SIL 2 functionality for safety signal processing over network.

More details about fail safe settings, ref 10.2.

3. ESD System

The ESD system may be activated both manually and automatically.

Manual activation is possible from the ESD & F&G CAAP and from manual pushbuttons.

Automatic activation is confirmed fire or gas detection from the F&G system, and will be according to the C&E.

3.1. ESD Levels

The ESD System is divided into several levels, where ESD 1 is the highest level.

SHI ES No	MD ESD No	Description (from SHI document EF001.09)
ES1/2	ESD QUARTERS	Accommodation and (2 = soft signal) Port, Stbd secondary escape ways ventilation shutdown.
ES3	ESD 3.3	Fwd Thruster and machinery space vent. Bosun store ventilation
ES4	ESD 3.4	Fwd/Aft FO, base oil LO transfer etc
ES5	ESD 3.5	Topsides non hazardous area and HPR compartment ventilation
ES41	ESD3.41	Aft Thruster and machinery space ventilation
ES12	ESD 2.12	Ps Engine room ventilation
ES11	ESD2.11	Ps Engine room total
ES22	ESD 2.22	Center Engine room ventilation l
ES21	ESD 2.21	Center Engine room total
ES32	ESD 2.32	Stbd Engine room ventilation
ES31	ESD 2.31	Stbd Engine room total
ES61	ESD 2.61	Emg. Generator
ES81/82	ESD 2.81	DCR Shutdown (82 = soft signal)
ABANDON	ESD 1	Abandon

Table 3-1: ESD Main Levels

The ESD Levels are connected together in a hierarchy. The hierarchy is based on the ESD C&E, and is for general information only. ESD C&E Diagrams shall be used for ESD System detail design.

The APS level will shut down the entire Drilling Unit. Some shutdowns will be time delayed to allow controlled shutdown, muster and evacuation. Systems still active after APS are:

- Emergency lights (UPS>30 min)
- BOP control system
- PA/GA system
- Radio communication system
- Fire and Gas detection system
- TETRA UHF radio system in ‘low operation mode’

3.2. Manual Pushbuttons

The ESD System will include manual ESD pushbuttons for activation of different ESD levels.

The project will use Manual ESD Pushbuttons, connected to KM RIO card for the ESD System, ref □ □.

The ESD System will include manual AVS pushbuttons placed around on the Drilling Unit.

ESD Level	Placement
AVS	(1) Bridge (2) DCR

Table 3-2: Manual ESD Pushbuttons

ESD 1 – 3 will be placed in the CAAP's (ref 3.3).

The AVS function in WH and DCR matrix panels consists of two pushbuttons that must be pushed before AVS is activated.

The ESD software input modules (sd_dmeas) will be configured with the following alarms:

Value	Alarm text	Alarm terminal
1	ESD Alarm	MeasD
built in alarms	IO Error	IOErr
	Redundancy Deviation	RedDevStat

Table 3-3: Alarm limits for manual pushbuttons

3.3. ESD/F&G CAAP Panels

The ESD CAAP Panels is provided in

-Wheel House

- ECR

- Drilling Work Station

- Fire Control Station

- Watermist / Inergen Room

; within easy reach of the operators. For detailed drawing refer to document and 9.1.4.

4. F&G System

The F&G detection system reads inputs from detectors, manual call points and field mounted pushbuttons by using the relevant fire central- and HW input loop typicals, see 9.4.3. The signals are then controlled by the F&G system by using several different SW loop typicals. The SW loop typicals perform voting and set output signals and alarms according to F&G C&E chart. Detailed information about SW loop typicals is found in 7.1.

The main types of detection in the F&G system are combustible gas detection (e.g. HC), toxic gas detection (e.g. H_2S), smoke-, heat- and flame detection, and manual fire alarms from manual call points.

4.1. Fire Zones

Each section of the unit will be defined and divided into fire zones.

A fire zone has the purpose to limit the fire escalation, by the zones placement and boundary. The fire zones shall be arranged according to logical units, process areas / accommodation etc.

Each fire zone shall include fire detection and fire protection equipment. Whenever gas may reach the fire zone, gas detection shall be included.

The combination and number of detectors used within a Fire Zone shall reflect the type of hazards presented and the environmental conditions in the zone.

Each Fire Zone has a C&E diagram, refer document □.

The Fire Zones are listed in Appendix 12.1.

4.2. Gas Detection

The gas detection system monitors combustible and toxic gas detectors installed at locations throughout the drill rig according to the F&G detector layout. For the accommodation area, combustible gas detectors are also located inside air ducts. Gas detectors are hardwired to RIO cards.

Gas detectors are self-diagnostic type, connected to the F&G system using a 4 - 20 mA input signal. Alarm limits for the gas detectors are described in the sections below.

Activation is performed by the F&G according to the C&E.

4.2.1. Infra Red Point (HC) Gas Detectors

The project will use Infra Red Point Gas Detectors, connected to the KM RIO cards.

- AutroPoint HC 200:
    - 0-100 %LEL

Value	Alarm text	Alarm terminal
60 %LEL	HC gas high-high detected	AlarmHH
20 %LEL	HC gas high detected	AlarmH
0.51-1.5 mA	General Sensor Fault	parameter page 3 and IOErr
1.51-2.4 mA	Dirty Optics	parameter page 3 and IOErr
built in alarms	IO Error	IOErr
	Redundancy Deviation	RedDevStat

Table 4-1: Alarm limits for gas point detector

4.2.2. Toxic (H2S) Gas Detectors

The project will use H_2S Gas Detectors, connected to the KM RIO cards.

The F&G software input modules (sd_ainput) will be configured with the following alarms:

- TX50

Value	Alarm text	Alarm terminal
10 ppm	H2S gas high-high detected	AlarmHH
5 ppm	H2S gas high detected	AlarmH
0.51-1.5 mA	General Sensor Fault	parameter page 3 and IOErr
1.51-2.4 mA	Calibration Mode	parameter page 3 and IOErr
built in alarms	IO Error	IOErr
	Redundancy Deviation	RedDevStat

Table 4-2: Alarm limits for TX50 H_2S gas detector

- GT3000

Value	Alarm text	Alarm terminal
10 ppm	H2S gas high-high detected	AlarmHH
5 ppm	H2S gas high detected	AlarmH
0.51-3.6 mA	General Sensor Fault	parameter page 3 and IOErr
built in alarms	IO Error	IOErr
	Redundancy Deviation	RedDevStat

Table 4-3: Alarm limits for GT3000 H2S gas detector

4.3. Fire Detection

The fire detection system monitors heat-, smoke-, flame detectors and manual call points installed in locations throughout the drill rig according to the F&G detector layout.

Heat- and smoke detectors and manual call points are addressable units connected to fire central loops. Flame detectors are connected to alarm interfaces on the Autronica loops.

Activation is performed by the F&G according to the C&E.

4.3.1. Fire Central

The Fire Central chosen for this project is the Autronica Autrosafe Fire Central System.

All addressable detectors are connected to the Autrosafe unit. The Autrosafe fire central is integrated with the F&G RCU via the KSFC IO-driver through dual ethernet link. The communication meets the requirements for SIL 2.

The fire central will connect the addressable detectors to the F&G System through the dual ethernet link, all alarms, status, voting and actions will be done by the KM F&G System.

The project will use one fire alarm control panel, BS-420, and one controller, BC-420. Each of these may have 6 loops, and each loop may contain detectors in more than one fire zone. One Non-IS loop may contain 99 detectors, and one IS loop may contain 20. One fire central may contain 512 detectors.

More details ref □ and □.

4.3.2. Heat Detectors

The project will use Heat detectors, addressable and connected to the Autronica Fire Central.

The F&G software input modules (sfc_pt) will be configured with the following alarms:

- BD-501:

Value	Alarm text	Alarm terminal
From KSFC	Heat Prewarning	Prewarning
From KSFC	Heat Detected	Alarm
From KSFC	Fault	Fault
From RCU	Redundancy Deviation	RedDevStat

Table 4-4: Alarm limits for heat detector

4.3.3.Smoke Detectors

The project will use Optical Smoke detectors, addressable and connected to the Autronica Fire Central.

The F&G software input modules (sfc_pt) will be configured with the following alarms:

- BHH-500/X1:

Value	Alarm text	Alarm terminal
From KSFC	Smoke Prewarning	N/A
From KSFC	Smoke Detected	Alarm
From KSFC	Fault	Fault
From RCU	Redundancy Deviation	RedDevStat

Table 4-5: Alarm limits for smoke detector

4.3.4. Manual Alarm Call Points

The project will use Manual Alarm Call Point, addressable and connected to the Autronica Fire Central.

The F&G software input modules (sfc_pt) will be configured with the following alarms:

- BF-300:

Value	Alarm text	Alarm terminal
From KSFC	Manual Alarm Detected	Alarm
From KSFC	Fault	Fault
From RCU	Redundancy Deviation	RedDevStat

Table 4-6: Alarm limits for manual alarm

4.3.5. Flame Detectors

The project will use Flame detectors, connected to the Autronica Fire Central.

The F&G software input modules (sfc_pt) will be configured with the following alarms:

- AutroFlame X98:

Value	Alarm text	Alarm terminal
From KSFC	Flame Alarm	Alarm
From KSFC	Fault	Fault
From RCU	Redundancy Deviation	RedDevStat

Table 4-7: Alarm limits for flame detector

5. Fire Fighting Systems

The F&G System will include logic for the fire water pumps.

The firewater is distributed to following systems and equipment.

- Water mist systems
- Sprinkler system
- Deluge system
- Foam system

5.1. Fire & jockey pumps

Three (3) firewater pumps and two (2) fire jockey pumps are fitted in this facility for sea water fire fighting. The number 1 fire pump is located in fwd aux machinery space and is powered from 440V emergency switchboard. The number 2 fire pump is located in port engine room and number 3 is located in stbd engine room. These fire pumps are electric motor driven vertical, centrifugal pumps of capacity 750 m3/h and with a pumping head of 130 meters. All these three fire pumps are a self-priming type. The fire jockey pumps are electric motor driven vertical centrifugal pumps and have a capacity of 50 m3/h with a pumping head of 90 meters. Two jockey pumps continuously maintain the fire water main pressure by pumping firewater to the main through a hydrophore unit.

Start of Fire Water Pumps

The firewater pumps are provided with means of manual and automatic start activation.

A) Manual activation of the firewater pumps shall be possible by/from:

Local start PB (on fire pump starter or pump side)

From F&G Fire pump Mimic screen.

The aft fire pumps are on 11-KV switchboard. The Fwd fire pump is on 440 V emergency switchboards. The local Push Buttons for starting and stopping the aft fire pumps are installed adjacent to the pump. The IAS monitors electric motor winding temperatures and generate alarm on high temperature. The local pushbuttons for starting and stopping the Fwd fire pump are located on the starter panel. The fire pumps can also be started and stopped from the F&G screen. The above start and stop functions are manual.

When any manual start command is received either by the aft switchboards or by the fwd starter unit, the switch board/ starter starts the pump.

B) Automatic activation of the firewater pumps shall be through the F&G logic and shall be initiated upon loss of pressure in the firewater ring main below a pre-set level or when Confirmed Fire. F&G panel will output start command to Fire pump Swbd or Fire pump starter as per the logic.

Automatic firewater pump start will be decided based on the chosen start-up priority of the firewater pumps (forward / after location of vessel)

The fire pump will automatically start whenever requested as per C&E diagram

The port/stbd E/R fire pumps start function are automatically controlled from F&G when set to automatic operation. A lead/lag function is implemented for the port and starboard E/R fire pumps. The operator can select any pump to lead or lag by individual select buttons on the FGS screens.

If the fire ring main pressure falls below 6.0 bar, the selected Lead pumps will start. If the pressure further decreases (below 5 bar) the selected LAG pump will start as well.

There are no automatic stop facilities are provided for the E/R fire pumps.

On any incident that necessitates automatic start of the fire pumps, loss of pressure in the ring main or Confirmed Fire alarm, the internal F&G logic commands the fwd fire pump to start first (operator changeable). This start permissive and start command will be given to the starter unit after checking the power availability. In the event that the fwd fire pump does not start within a specified time "t_1"seconds (adjustable during commissioning), that is, pump running feedback not received within "t_1" seconds, OR if the fire header pressure is not recovered within a specified time "t_2" (adjustable), the next available aft fire pump shall be given start command after checking power availability, irrespective of whether the fwd pump is running or not.

If the Fwd pump has failed to start then "pump fail" alarm is generated in the F&G system. The pump to start first (Fwd or Aft port E/R or Aft stbd E/R) shall be programmable and it shall be possible to change the sequence.

If the Fwd fire pump is already running, the loss of ring main pressure below a certain point shall initiate the start of the aft pump.

Once started the fire pumps shall not stop unless commanded from IAS or local stop push button. If confirmed gas is detected in air intake of the room where fire pumps are located, room dampers shall be closed and the vent fans shall be stopped. The running fire pump will keep running until the operator at his discretion may stop the pump from the IAS screen.

5.2. Fire System (Aft E/R)

The fire system in aft engine rooms consists of Electric motor driven (11 kV) fire pumps with inlet filter and outlet non-return valve. The fire pump discharges water into the fire ring main through fire safe type isolation valve. The fire pump is a self-priming type pump. The fire pump is located below the draft level in floor deck. The fire pumps draws its suction from the Sea chest and a filter is installed in the suction side of the pump.

The fire ring main is routed through various compartments and decks as per the building specification and is provided with fire fighting outlets at each location. The outlet consists of an isolation valve, and a hose box.

5.2.1.Controls

5.2.1.1. F&G Control

The following signals are interfaced to F&G from aft fire pumps control circuit breakers in P and S HV SWBD.

Tag Number	Description
MC-091811A	AFT (P) FIRE PUMP START
MC-091811B	AFT (P) FIRE PUMP STOP
MI-091811A	AFT (P) FIRE PUMP RUNNING
MI-091811B	AFT (P) FIRE PUMP IN REMOTE
MA-091811	AFT (P) FIRE PUMP FAILURE
IIAH-091811	AFT (P) FIRE PUMP CURRENT
MC-091821A	AFT FIRE PUMP (STBD) START
MC-091821B	AFT FIRE PUMP (STBD) STOP
MI-091821A	AFT FIRE PUMP (STBD) RUNNING
MI-091821B	AFT FIRE PUMP (STBD) IN REMOTE
MA-091821	AFT FIRE PUMP (STBD) FAILURE
IIAH-091821	AFT (STBD) FIRE PUMP CURRENT
TIAH-091812	PORT E/R FIRE PP WIND TMP R
TIAH-091813	PORT E/R FIRE PP WIND TMP S
TIAH-091814	PORT E/R FIRE PP WIND TMP T
TIAH-091822	STBD E/R FIRE PP WIND TMP R
TIAH-091823	STBD E/R FIRE PP WIND TMP S
TIAH-091824	STBD E/R FIRE PP WIND TMP T

Tag Number	Description
PICAL-091801	FIRE MAIN LINE PRESSURE

By pressing the "ON" button on the operator panel, both pumps will be switched to auto mode and automatically start/stop according to the below description. Operating the "OFF" button will switch both to manual mode. At any time lead and lag pump can be switched by operating software buttons. The Aft fire pumps and the Fwd fire pump (MIC-091801) can be selected with priority 1,2 and 3. There is no automatic stop for these pumps.

Auto Lead/Lag start/stop by pressure control	
Lead Auto Start	6.0 +/- 0.1 bar
Lag Auto Start	5.0+/- 0.1 bar
Both auto stop	Not possible in any mode.

Port E/R Fire pump No.2 MIC-091811		
Function	**Description**	**Tag Number**
Remote Auto Start MC-091811A	Lead mode: (1) When ring main pressure is less than or equal to 6 bar and pump is ready. (OR) Ring pressure is less than or equal to 6 bar and No.1 fire pump is not ready. (OR)	PICAL-091801 is less than or equal to 6 bar AND MI-091811B is active AND MA-091811 is not active PICAL-091801 Alarm in F&G PICAL-091801 is less than or equal to 6 bar + MI-091801B is not active. PICAL–091801 Low / motor not ready alarm shall be generated.

Port E/R Fire pump No.2 MIC-091811		
Function	**Description**	**Tag Number**
	No.1 fire pump is commanded but feedback is not received within t1 sec.	MC-091801A is active and MI-091810A is not received within t1 sec. Motor not running Discrepancy alarm shall be generated in F&G.
	Lag mode: (1) When ring main pressure is less than or equal to 5bar and motor is ready.	PICAL-091801 is less than or equal to 5 bar AND MI-091811B is active AND MA-091811 is not active
	(OR) Ring pressure is less than or equal to 6 bar and lead pump is not ready.	PICAL-091801 is less than or equal to 6 bar AND MI-091821B is not active OR MA-091821 is active.
	(OR) No.1 and No.3 is commanded but feedback is not received within t1 sec.	MC-091801A & MC-091821A is active and MI-091801A & MI-091821A is not received within t1 sec.
Remote Auto stop	Not possible in any mode.	
Remote Manual Start MC-091811A	From F&G Screen when in Manual mode OR from local pump side.	

Port E/R Fire pump No.2 MIC-091811		
Function	**Description**	**Tag Number**
Remote Manual stop MC-091811B	From Local pump side or F&G Mimic.	

Stbd E/R Fire pump No.3 MIC-091821		
Function	**Description**	**Tag Number**
Remote Auto Start MC-091821A	Lead mode: (1) When ring main pressure is less than or equal to 6 bar and pump is ready. (OR) Ring pressure is less than or equal to 6 bar and No.1 fire pump is not ready. (OR) No.1 fire pump is commanded but feedback is not received within t1 sec. Lag mode: (1) When ring main pressure is less than or equal to 5bar and motor is ready. (OR) Ring pressure is less than or equal to 5 bar and lead pump is not ready.	PICAL-091801 is less than or equal to 6 bar AND MI-091821A is active And MA-091821 is not active PICAL-091801 Alarm in F&G PICAL-091801 is less than or equal to 6 bar + MI-091801B is not active. PICAL–091801 Low / motor not ready alarm shall be generated. MC-091801A is active and MI-091801A is not received within t1 sec. Motor not running Discrepancy alarm shall be generated in F&G. PICAL-091801 is less than or equal to 5 bar AND MI-091821B is active AND MA-091821 is not active. PICAL-091801 is less than or equal to 5 bar AND MI-091821B is not active.

Stbd E/R Fire pump No.3 MIC-091821		
Function	**Description**	**Tag Number**
	(OR) No.1 and No.2 is commanded but feedback is not received within t1 sec.	MC-091801A & MC-091811A is active and MI-091801A & MI-091811A is not received within t1 sec.
Remote Auto stop	Not possible in any mode.	
Remote Manual Start MC-091821A	From IAS Screen when in Manual mode OR from Fwd Emergency HQ or Water mist / Inergen room OR from local pump side.	
Remote Manual stop MC-091821B	From either Local pump side or IAS Mimic	

5.3. Fire System (Fwd Aux Mach Room)

The fire system in Fwd Aux machinery room consists of an Electric motor driven (Emergency 440V) fire-pump (MIC-091801) with inlet filter and outlet non-return valve. The fire pump discharges water into the fire ring main through fire safe type Isolation valve. The fire pump is a self-priming type pump. The fire pump is located below the draft level. The fire pumps draws its suction from the Sea chest and a filter is installed in the suction side of the pump.

The fire ring main is routed through various compartments and decks as per the building specification and is provided with fire fighting outlets at each location. The outlet consists of an isolation valve, and a hose box.

Fwd fire pump is driven by an electric motor that is started through a 440V starter unit.

5.4. Water mist system

Manual and automatic activation of water mist system is possible.

Automatic activation is performed by the F&G system according to F&G C&E.

Manual activation is possible from field mounted pushbuttons installed outside or in the outer limit of the areas protected by water mist.

Manual activation activates outputs according to F&G C&E.

Activation of water mist system is alarmed on F&G OS and on light signal columns in machinery spaces.

There are total nineteen (19) section valves for covering releases in the machinery spaces:

Section valve:	Area description:
M01	FWD Machinery Auxiliary room
M02	Ballast pump room
M03	Port Purifier room
M04	STBD Purifier room
M05	Port engine room lower level.
M06	Cent engine room lower level.
M07	STBD engine room lower level.
M08	Port Purifier room
M09	STBD Purifier room
M10	Port engine room
M11	Cent engine room
M12	STBD engine room
M13	Port main engine
M14	Cent main engine
M15	STBD engine
M16	Port engine room casing

M17	Cent engine room casing
M18	STBD engine room casing
M19	Incinerator.

5.4.1. TOTAL FLOODING:

Following section valves shall be activated area wise from 'Release cabinet' in FireControl station or 'Remote manually' from Operator station:

FWD Aux. Mach.	M1
Ballast pump room	M2
Port Purifier room	M3, M8
STBD Purifier room	M4, M9
Port engine room	M5,M10,M13,M16
Cent engine room	M6,M11,M14,M17
STBD engine room	M7,M12,M15,M18

5.4.2. LOCAL FIRE FIGHTING:

Following section valves on confirmed fire shall be activated area wise automatically by FGS:

Port Purifier room	M8
STBD Purifier room	M9
Port engine room	M13
Cent engine room	M14
STBD engine room	M15
Incinerator	M19

5.5.Inergen system

Operator shall perform Inergen release actions through:

- Remote manually from the operator station screen/mimic

- Remote manually from the Inergen remote release panel located in Fire Control station

- Manually in emergency situation from the Inergen bottle room.

Activation of inergen will go through the F&G system. Inergen release after 30 seconds (to be adjusted during commissioning) and other effects will be activated according to C&E.

The inergen release is alarmed on F&G OS and on light signal columns in machinery spaces.

There are thirteen (13) zones/compartments where Inergen fire fighting system is present. A high-pressure type central flooding Inergen system is provided for:

Zone 01	Port MSB room
Zone 02	Cent MSB room
Zone 03	STBD MSB room
Zone 04	ECR
Zone 05	Port stern Thruster room
Zone 06	Cent stern Thruster room
Zone 07	STBD stern Thruster room
Zone 08	Port Bow Thruster room
Zone 09	Cent Bow Thruster room
Zone 10	STBD Bow Thruster room
Zone 11	Emergency Gen. room
Zone 12	Cement room (Topsides)
Zone 13	SWBD room (Topsides)

Upon confirmed fire, the F&G system generate alarm on the ‘Fire alarm repeater panel’ in ‘Fire Control station’ to enable operator to know into which space the Inergen need to be released. This will ensure that Inergen will not be released into a wrong space. The alarm on ‘Fire alarm repeater panel’ shall be reset only when the fire alarm is reset.

5.5.1.1. CCTV Interface on Inergen release

Following are Inergen protected areas with CCTV Cameras:

- Hull side Main Switch Board Rooms (Port, Center, STBD)
- All Thruster Rooms
- Emergency Generator Room
- Topside SWBD Room
- Topside Cement Room

On confirmed fire in any of the above areas, the F&G system will send the confirmed fire signal to the CCTV system through MODBUS serial communication. CCTV system shall display that area on one screen in Bridge.

5.5.1.2. Doors with limit switches and Inergen release

The following rooms also have limit switches for door closed status, that will be indicated in the Inergen mimic:

- Hull side Main Switch Board Rooms (Port, Center, STBD)
- TopsideSwitch Gear Room

5.6. Water Tight Sliding Doors

There are 13(Thirteen) numbers of watertight sliding doors in this vessel. They are located in AFT engine rooms and in FWD machinery space.

Sl. No.:	**Location:**
WD-01	FWD Floor Dk – Door between FWD Aux Mach Room and Port Bow Thruster room
WD-02	FWD Floor Dk – Door between FWD Aux Mach Room and STBD Bow Thruster room
WD-03	FWD 2nd Dk – Door between Port Bow Thruster room and Accommodation space
WD-04	FWD 2nd Dk – Door between Port Bow Thruster room and Secondary escape way (P)
WD-05	FWD 2nd Dk – Door between STBD Bow Thruster room and Secondary escape way (S)
WD-06	Hull – Secondary escape way (P)
WD-07	Hull – Secondary escape way (S)
WD-08	AFT E/R 3rd Dk - Door between CENT E/R 3rd Dk and Port E/R 3rd Dk
WD-09	AFT E/R 3rd Dk - Door between CENT E/R 3rd Dk and Port E/R 3rd Dk STBD E/R 3rd Dk
WD-10	AFT E/R 2nd Dk - Door between Port E/R 2nd Dk And Secondary escape way (P)
WD-11	AFT E/R 2nd Dk - Door between STBD E/R 2nd Dk and Secondary escape way (S)
WD-12	AFT E/R 2nd Dk - Door between CENT E/R 2nd Dk and Port E/R 2nd Dk
WD-13	AFT E/R 2nd Dk - Door between CENT E/R 2nd Dk and STBD E/R 2nd Dk

All the doors will be normally kept closed. These doors can be operated by using the lever located near to door. During emergency condition opened door can be closed remotely from wheel house panel by switching the control switch in master position or emergency hand pump located in emergency head quarters. The doors will be closed automatically by F&G process station in the event of a fire incident in the adjacent rooms. This is required due to the fact that if they are kept open, the chances of smoke propagation from adjacent room to the other room are high and hence the chances of false fire alarms. F&G system will activate to close the opened doors, if any, automatically before the release of Inergen, in case of fire incident in any of these rooms.

The local panel for each sliding door is located beside the door together with the complete set of hydraulic unit. The hydraulic unit has an oil reservoir, Motor pump, hand pump, accumulator, hydraulic cylinder, solenoid valve etc. Local indications for reservoir low alarm, and discharge line low pressure alarm are provided on the Local Control panels. The limit switches are fitted on each door for indicating the door position. One buzzer and two sets of lamp stations are provided on each door to indicate that the door is operating,

A MIMIC panel is located in Engine control room and wheel house for indicating the doors position. The door position indicating panels with emergency hand pump are provided in Aft Inergen room for AFT engine room doors and Fwd Emergency Head Quarters for Fwd machinery space door.

6. SYSTEM OPERATION

6.1. Navigation in the ESD and F&G System

The ESD and F&G System are made up of several VDU pictures that can be displayed on the OS monitors.

The displays are systemized in a hierarchy of pictures, ref chapter 8.

The main overview display will show the operator the status of the ESD and F&G System, and will help the operator to navigate to the location were the alarm was activated.

6.2. Normal Operation

The ESD and F&G System will be in continuous operation.

6.2.1. Acknowledge

After locating the alarm, the operator shall acknowledge the alarm. The alarm must be acknowledged even if the alarm situation has returned to normal.

Each alarm may be acknowledged:

- From the geographical layout. Operate on the detector module, and select acknowledge (F&G only).
- From the alarm list on the OS.
- By operating Acknowledge button on the ESD CAAP (ESD only, ref 3.324).
- From the C&E View (ref 8.3). Operate on the detector module, and select acknowledge.

6.2.2. Reset Outputs

All ESD and F&G outputs (logic) are latched, and must be reset after an alarm situation.

All inputs must be back to normal and acknowledged before the reset.

Each output may be reset:

- By operating Reset button on the Level 1 Display (ref 8.1.1 and 8.2.1).
  This button will reset all ESD or F&G outputs, which are no longer in alarm.
- By operating Reset button on the ESD CAAP (ref 3.3).
  This button will reset all ESD outputs, which are no longer in alarm (ESD only).
- From the C&E View (ref 8.3). Operate on the output module (effect), and select reset.

6.2.3. Fire central, Reset

The fire central must be reset to remove alarms activated from the fire central (smoke, heat and manual fire alarm).

The fire central can be reset by:

- By operating the Reset fire central button on the F&G Level 1 Display (ref 8.2.1).
- By operation the reset button on the fire central.

The fire central will update the fire detector alarm status in the F&G system when it is reset.

6.2.4. Inhibit

Inhibit is a function for blocking an input signal, without losing status and alarm information. When inhibiting an input (detector module or cause module), an alarm situation will still enter the module when activated and give the alarms, but the alarm will not go further and will not activate the output modules according to the C&E.

This gives the benefit of testing in full operation and for maintenance of I/O cards.

Every transmitter module and cause module may be inhibited individually by operating on the module and select inhibit ON or OFF.

The user may have to be logged on as a specified user, to be able to inhibit a module, see 6.3.

The OS will clearly indicate the inhibit state in the VDU pictures and also contains a list of every inhibited module in the whole Safety System.

6.2.5. Override

Override is a function for blocking an output signal, without losing status information.

When overriding an output (effect module) the output signal will be set to normal.

An overridden shutdown signal will not activate I/O upon an automatic activation, but the module will show the status by changing to shutdown colour.

This gives the benefit of testing in full operation and for maintenance of I/O cards.

The operator has still the possibility of manually activating the output, by operating on the output module and select “manual activation”.

Every effect module may be overridden individually, by operating on the module and select override ON or OFF.

The user may have to be logged on as a specified user, to be able to override a module, see 6.3.

The OS will clearly indicate the override state in the VDU pictures and also contains a list of every overridden module in the whole Safety System.

6.2.6. Remove Inhibit / Override

The remove all inhibit and override button will be placed on the Level 1 Display (ref 8.1.1 and 8.2.1) and in the ESD and F&G CAAP (ref 3.3). This button removes all inhibits and overrides for the entire ESD and F&G System.

This remove all inhibit/override function will be used after commissioning before start up to ensure that no safety signals are blocked.

This remove function is realised in a software module global_reset. The global_reset module is not connected to any other software module, the module sends an inhibit/override off signal to all software modules in the RCU. Every RCU must have one global_reset module. The remove all inhibit and override button is connected to the global_reset modules on every F&G and ESD RCU.

6.2.7. Start up

During start up of process areas and equipment, the operator may inhibit and override software modules to avoid shutdown for a defined period.

The start up actions must be defined in a start up procedure.

6.2.8. Alarm and Event Log

All alarms and events will be logged on the history station.

Shutdown, inhibit, override, acknowledge and reset are defined as events.

6.2.9. Printer

Alarm and event logs may be printed.

6.3. User Access control

Access to the AIM system is protected by usernames and passwords.

Each user is member of a user group, where access rights and user privileges are defined.

Access rights and user privileges may be:

- Acknowledge alarms.
- Operate on valves.
- Changing alarm limits.
- Inhibit and Override Safety modules.
- Reset outputs.
- Change Parameter in software modules, parameter page 1, 2 and 3.
- Configuration of software, new or changed logic.
- Detailed list of users and privileges, ref □.

Configuration changes to the logic must be performed by personnel with system user access.

User group	Description
Guest	Members can only monitor the system.
User	Members can monitor and operate the system.
PowerUsers	Members can monitor, operate and change parameters.
Administrator	System level access, to be used for personnel administrating the control system and KM personel.

Table 6-1: Users groups and permissions

User	Password	User group
Guest	guest	Guests
Operator	operator	Users
Chief		PowerUsers
Captain		PowerUsers
Administrator		Administrators
Kongsberg		Administrators
System		Administrators

Table 6-2: Users and user groups (See K-Chief KFDD for details and passwords)

6.4.Command control

6.4.1.Command Group

Every AIM software function module is dedicated to a command group.

All safety system software modules shall use the command group **safety**.

The command group defines which OS group the safety system shall be controlled from.

6.4.2.OS Group

Each OS is a member of an OS group. Each OS group can have access to take control of command groups. When an OS controls a command group, the OS can control the modules belonging to this command group.

OS group	OS	Default Control	Acquirable Control
Bridge (Wheelhouse)	Safety OS (60)	Common, Ballast, Bilge, Safety	Power, Thrusters, Machinery, Ballast, Bilge, Safety, Drilling
ECR		Common, Power, Thrusters, Machinery	Power, Thrusters, Machinery, Ballast, Bilge, Safety
DCR		Common, Drilling	Drilling

Table 6-3: OS and OS group

Default Control means that the OS'es in this group are in charge and have to accept to give away control of a command group whilst they can regain control without asking.

Acquirable Control means that the OS'es in this group must request to take control of a command group, and this must be accepted by the OS presently in control.

7. System Design

7.1.Software logic

The ESD and F&G System will be configured by KM, and will be built using standard AIM safety software modules generally parameterised and connected according to the standard for Safety Systems. Changes in the configuration may be performed online from the OS; this will require a dedicated username and password, ref 6.3.

Below is a sketch of typical control logic for an ESD level, each box representing one software module.

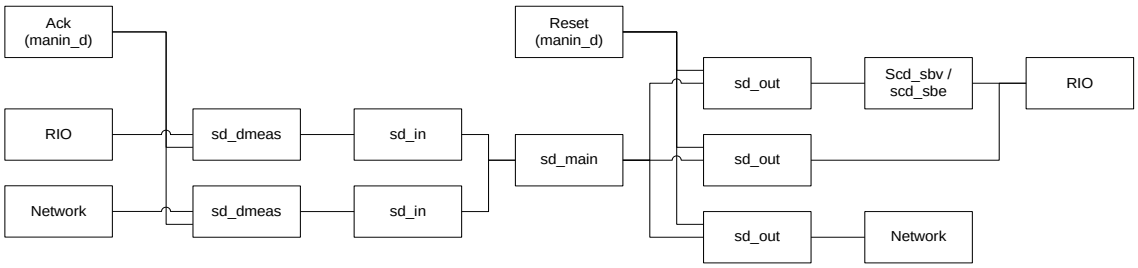


Figure 7-1: Typical ESD Control Logic

Below is a sketch of typical control logic for a Fire Zone, each box representing one software module.

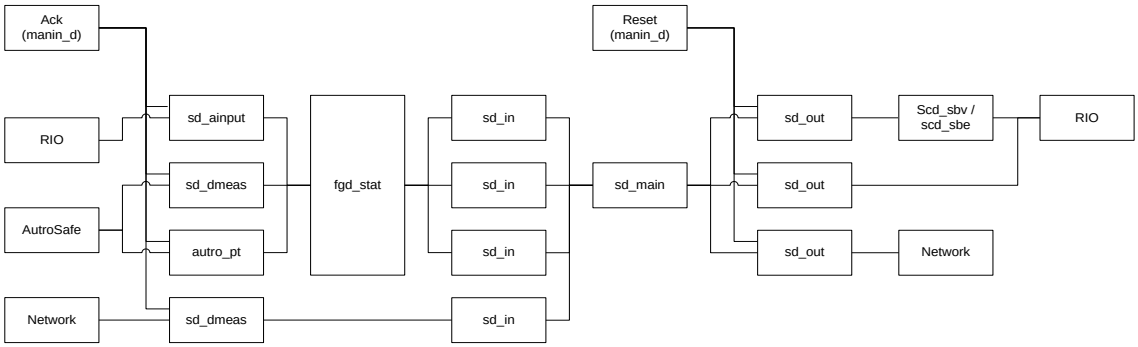


Figure 7-2: Typical F&G Control Logic

The configuration is built by software modules. The different software modules represent detectors/devices, Cause & Effect logic and outputs.

A list of all safety modules with revision number are defined in document □

Additionally there is customized software control logic which is different from a typical C&E control logic as described above. Typically control logic of such kind is solved by using modules like the plclg (flexi-module which can contain a combination of logic blocks configured to perform a certain task). The description and purpose of special software control logic is covered in document □.

7.2. Software modules

sw module	description
algrp_st	The module represents alarm groups.
arrow	The module represents a drawing.
sfc_dl	The module represents the fire central loops and will show the condition of the loop.
Sfc_fc	The module represents the fire central and will show the condition of the fire central.
sfc_pt	The module reads signals from Autrosafe, used to represents ex: heat, smoke, manual alarm.
fg_ddi	The module reads digital signals from other modules (not from RIO-cards), used to represent signals from logic or signals sent via network.
fgd_stat2	The module will include the voting logic.
flexi	The module represents configurable logic.
global_reset	This module removes every inhibit and override for one RCU.
info_pcu	The module includes information about the RCU.
logic	The module represents the logic function AND or OR.
manin_d	The module represents digital inputs, mainly pushbuttons from OS.
netdi / netdo	The modules represent the fail safe network.

sw module	description
sbmotor1	The module represents the motor/engine module, connected to I/O cards with both output and feedback/status.
scd_sbe	The module represents the motor/engine module, connected to I/O cards with both output and feedback/status.
scd_sbv	The module represents the valve module, connected to I/O cards with both output and feedback/status.
sd_ainput	The module reads analogue signals from RIO-cards, used to represent ex: gas, flame, level and pressure.
sd_dmeas	The module reads digital signals from RIO-cards, used to represent ex: switches and status.
sd_in2	The module represents the cause line in the C&E diagram. The cause module will be latched from the detector, and will be reset after the alarm is inactive and acknowledged.
sd_main	The module represents the matrix in the C&E diagram. This module connects the causes and effects together, and represents the Fire Zone or ESD level.
sd_out2	The module represents the effect line in the C&E diagram. The effect module will be connected to the I/O cards or via a valve module (scd_sbv) or a motor/engine module (scd_sbe) before the signal is connected to the I/O card. The effect modules will be individually latched and need to be reset. The reset will only take place, if the cause has been acknowledged and back to normal.
valved	The module represents the valve module, connected to I/O cards with both output and feedback/status.

7.3.SW Tag syntax

All instrument tags and software tags may be maximum 15 characters.

The tag syntax for each device is the Instrument tag.

Tag syntax for software modules is as follows:

- ESD:
  - Main module: ESD-MAIN-ZZ
  - Cause module: <instrument tag>-C
  - Effect module connected to valve/motor/pump: <instrument tag>-SD
  - Other logic modules: ESD-YYY-ZZ
- F&G:
  - Main module: FG-MAIN-ZZ
  - Cause modules: AA-XXX-ZZ
  - Voting modules: AA-VOT-ZZ
  - Effect module connected to valve/motor/pump: <instrument tag>-SD
  - Effect module connected io module: <instrument tag>+UU
  - Other logic modules: FG-YYY-ZZ

code	description
AA	detection code, like the instrument tag
XXX	VSA1: single alarm1 VSA2: single alarm2 VCA1: confirmed alarm1 VCA2: confirmed alarm2 VA12: combination of alarm1 and alarm2

code	description
YYY	INH: inhibit OVR: override AND: logic and OR: logic or PLC: flexi logic module SD: shutdown F: Fire alarm G: Gas alarm
ZZ	ESD level or Fire Zone
UU	Unique Index for each Fire Zone

Table 7-1: Software tag syntax

7.4. Voting logic

Voting is used to reduce the consequences of one detector/signal fault.

Voting is used where more than one detector is installed in a fire zone.

Several detector modules are connected to one voting block. The group of detectors will share the cause lines.

All alarm information is sent to the voting block.

Voting results in confirmed and single detection:

- Single alarm1, 1ooN (VSA1).
- Single alarm2, 1ooN (VSA2).
- Confirmed alarm1, 2ooN (VCA1).
- Confirmed alarm2, 2ooN (VCA2).
- Confirmed alarm combination, 2ooN (one alarm1 and one alarm2 / more than one alarm2) (VA12).

The voting module has two levels of alarms, alarm1 and alarm2. Alarm1 has lowest priority and alarm2 has highest priority.

Alarm1: ex: low gas alarm or prewarning flame/heat/smoke or low/high pressure alarm.

Alarm2: High alarm, ex: high gas alarm or alarm flame/heat/smoke or low-low / high-high pressure alarm.

In case of failure or maintenance of one detector the voting principle is degraded to:

- 2ooN → 2ooN-1, where N≥3
- 1oo2 → 1oo1

7.5. Alarms

During normal operation system fault alarms may occur (e.g. detector faults). Faults shall immediately be rectified.

System Faults will be displayed in the alarm list on the OS.

ESD and F&G alarms are indicated in the CCR via the following display units and audible alarms:

- Buzzer in the Operation Station
- Operator Stations (On every affected ESD and F&G Display).
- Alarm and event log.
- ESD and F&G CAAP.
- Large Screens
- Public Address and General Alarm (PA/GA) system.

7.5.1. Alarm Limits

The AIM System includes both system and process alarms.

System alarms:

- Alarming system faults like:
    - Network problems
    - I/O card failures
    - I/O failures like open circuit, closed circuit and earth failure.
    - Power failure
    - IS barrier fault

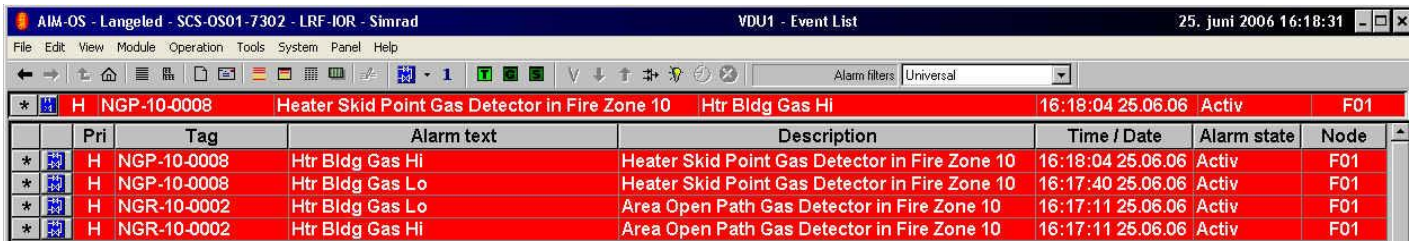
Process alarms:

- Defined by the project.
- Detector and device alarms, like gas detected and high pressure.
- Feedback alarms, from e.g. valve position and pump start.

Alarm limits for the ESD and F&G push buttons, detectors and devices, see 3.2, 4.2 and 4.3.

7.5.2. Alarm List

All alarms will be listed in the alarm list and logged on the history station.



The alarm will be listed with tag, alarm text, tag description, terminal, time.

7.5.3. Alarm Priority

All alarms shall have an allocated alarm priority.

The definition for setting an alarm priority, are outlined in the following alarm priority:

	Description	ESD	F&G
Critical	Safety Critical Alarms (MAGENTA)	ESD Activated Redundancy deviation Network failure	Fire Detection Gas Detection High High Redundancy deviation Network failure
High	Safety Alarms (RED)	Feedback errors on outputs I/O failure Manual Activation Activation Conflict	Gas Detection High Feedback errors on outputs I/O failure Manual Activation Activation Conflict
Medium	Non Critical Warning Alarm (YELLOW)	Pre-warning	Pre-warning
Low	Non Critical System Alarms (WHITE)		

Table 7-2: Alarm priorities

7.5.4. Trends

All analogue input values may be prepared for trending in the AIM system. The trends will be presented on the OS monitor, and may be printed out.

7.6. Audible Alarms

Audible alarms will be generated by the alarm in the Operation Stations, by the buzzer in ESD and F&G Matrix and by the Public Address and General Alarm (PA/GA) system, and will consist of separate sounds for different alarms.

Activation of the audible alarms will be defined in the C&E.

Fire & Gas alarms must be acknowledged by the operator. If an alarm stays unacknowledged for more than 2 minutes, the alarm is transferred to the PA/GA system.

This functionality will be described and defined in the C&E.

7.6.1. The following alarm audible tones are applied in PA GA System

In this project there will be 3 audible alarm tones are applied in PA GA System as per MAERSK Station Bill:

1. Evacuation Alarm / Muster alarm: Constant tone of 1000Hz.
2. General alarm: Intermittent alarm signal.

To be used in case of :

- Fire/explosion
- Man over board
- Possible collision
- Other states of Emergency.
- Loss of well control.
- Gas release.
- Helicopter accident.

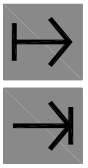
3. Toxic Gas alarm /H2S Gas alarm : Multi tone siren 1200Hz with 500Hz falling for 1second.

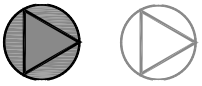
In addition to above alarm signal, light columns provides following alarms for high noise area:

1. Local Fire fighting (Water Mist release).
2. Inergen alarm.
3. Machinery alarm.
4. Dead Man alarm.
5. Telephone Call alarm.

7.7.Symbols

Module:	Function:	Symbol	Symbol number:
Detectors:			
Standard symbols: (8001-8010)			
Sd_ainput	Analogue Input		8001
Sd_dmeas	Digital Input		8001
Analogue inputs: (8011-8020)			
Sd_ainput	Analogue input with value. Symbol is hidden behind value and sized very small.	15.0 barg	8011
Flame: (8021-8030)			
Sd_ainput	Flame		8021
Sd_ainput	CCTV		8022
Heat: (8031-8040)			
sfc_pt	Heat		8031
Smoke: (8041-8050)			
sfc_pt	Smoke		8041
Manual alarm: (8051-8060)			
sfc_pt Sd_dmeas	Manual Alarm		8051
Sd_dmeas	ESD Alarm		8053

Module:	Function:	Symbol	Symbol number:
Gas: (8061-8090)			
Sd_ainput	Gas Point HC	 %LEL	8086
Sd_ainput	Gas Point H2S	 ppm	8087
Sd_ainput / fg_ddi	Gas Line Transceiver / Receiver	 %LELm	8071/8072
Sd_dmeas	Gas Leak	 dB	8074
Sd_ainput	Oxygen	 ppm	8075
Fire Fighting: (8091-8110)			
Sd_dmeas	Deluge		8091
Sd_dmeas	Sprinkler		8093
Sd_dmeas	Foam		8094
Sd_dmeas	Inergen		8095
Sd_dmeas	CO2		8099
Sd_dmeas	Argonite		8101
C&E logic: (8201-8210)			
Fgd_stat	Voting		8201
Sd_in	Cause Module		8202

Module:	Function:	Symbol	Symbol number:
Sd_main	Main Module		8203
Sd_out	Digital Output / Effect module		8204
Special sd_in: (8211-8220)			
Sd_in	Shadow symbol, used in process view to show the status on sd_in. Colour combination and text are changeable.	PAHH	8211
Special sd_out: (8221-8240)			
Sd_out	Matrix lamp		8221
Sd_out	Beacon		8222
Outputs: (8241-8260)			
Scd_sbe/ Sbmotor1	Motor, pump		8241/8242
Scd_sbv/ Valved	Valve		8243/8244
Scd_sbv	Valve		8245/8246
AutroSafe: (8261-8270)			
Sfc_fc	AutroSafe central		8261
Sfc_dl	AutroSafe loop		8262
Status: (8271-8281)			
Modgrp_st	Fire Alarms		8271

Module:	Function:	Symbol	Symbol number:
Modgrp_st	Gas Alarms		8272
Modgrp_st	Manual Call Points		8273
Modgrp_st	Override/Inhibit Active		8274
Modgrp_st	ShutDown Out Active		8275
Modgrp_st	Outputs Active		8276
Modgrp_st	ShutDown Out Active		8279
Modgrp_st	Alarm		8280
Modgrp_st	Fire Fighting System Active		8281
Modgrp_st	Inhibit/Override Active		8287
Modgrp_st	System Fault		8500

Misc: (8301-8400)			
Netdi Netdo	Net signals		8301
Manin_d	Button in		8311
Manin_d	Button out		8312
Flexi	PLC		8321
Logic	And		8322

Logic	Or		8323
Info	Info		8331
Algrp_st	WC group status		8001
Geographic layout:			
Arrow	ESD and F&G layouts		8400-

Table 7-3: Table of symbols

7.7.1.Symbol colours

Colours are used to indicate the state of detectors and equipment.

Colour	Description
Grey	Static modules
White	Normal
Magenta	Critical alarm
Red	High alarm
Yellow	Medium alarm
Cyan	Inhibit / override / blocked / suppressed status
Dark Blue	Disabled status from Autronica Fire Central

Table 7-4 Symbol colours

7.7.2.Symbol layers

The AIM software configuration includes display layer functionality. This function gives the possibility to arrange different software symbols and tags on different visibility layers.

Safety uses the following display layers:

Layer profile	Layer	Description
K-Safe-1	Safety main 1	symbols, buttons, status
	Safety logic 1	spare
	Safety tag 1	tag, logic
	Safety non-hittable 1	graphical pictures / layouts
K-Safe-2	Safety main 2	symbols, status
	Safety logic 2	spare
	Safety tag 2	tag, logic
	Safety non-hittable 2	graphical pictures / layouts
K-Safe-3	Safety main 3	symbols, detectors/devices
	Safety logic 3	sd_main
	Safety tag 3	tag, logic
	Safety non-hittable 3	graphical pictures / layouts
	Safety non-hittable 2	graphical pictures / layouts, common for level 2 and 3.

Table 7-5: Display layers.

7.8. Software configuration

7.8.1. Scan task

The ESD and F&G System will be configured in scan task 1. The scan task 1 meets the demand on 2 sec response time for the system logic.

If a higher response time is required, the affected part of the software will be configured in scan task 2.

If no modules require Scan Task 2, Scan Task 2 will be set to 1 sec in the system (PS) files.

In this project, Scan Task 2 is not used for modules, but set to 5Hz for F&G, for use for Net Storm Protection.

	Scan Task 1:	Scan Task 2:
ESD:	1 sec	1 sec
F&G:	1 sec	0.2 sec

Table 7-6: Scan Task

8. VDU Pictures

8.1. ESD System Display Hierarchy

The ESD System includes one main overview picture that shows the status of the ESD Systems different levels.

Each ESD level has a C&E view.

The ESD valves and other equipment will be placed into the Process Control System pictures.

The navigation is illustrated in the figure below:

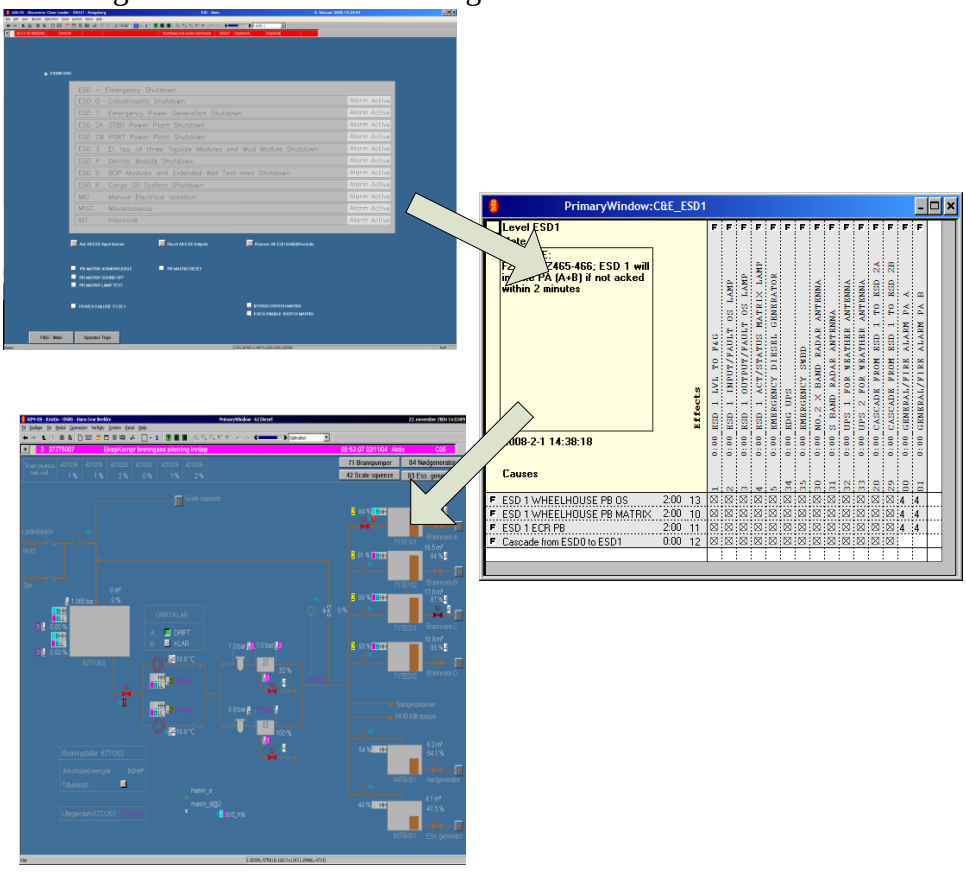


Figure 8-1: ESD navigation structure.

8.1.1.ESD Main Overview

This display will show all ESD levels in one picture, with status for alarm, inhibit / override and shutdown actions.

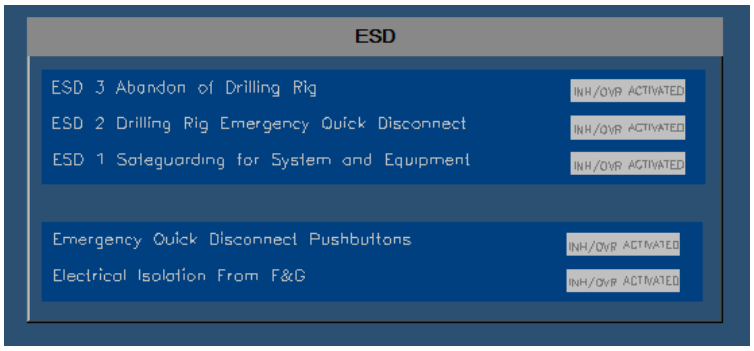


Figure 8-2: ESD Main View (example)

The function “alarm group” will be used to collect the status on every module in each ESD level.

The status field will be divided into alarm – shutdown - inhibit/override.

The C&E view for each ESD level will be displayed as a pop-up window, activated from the different ESD level in the main overview.

This view will be placed in the F&G main overview:

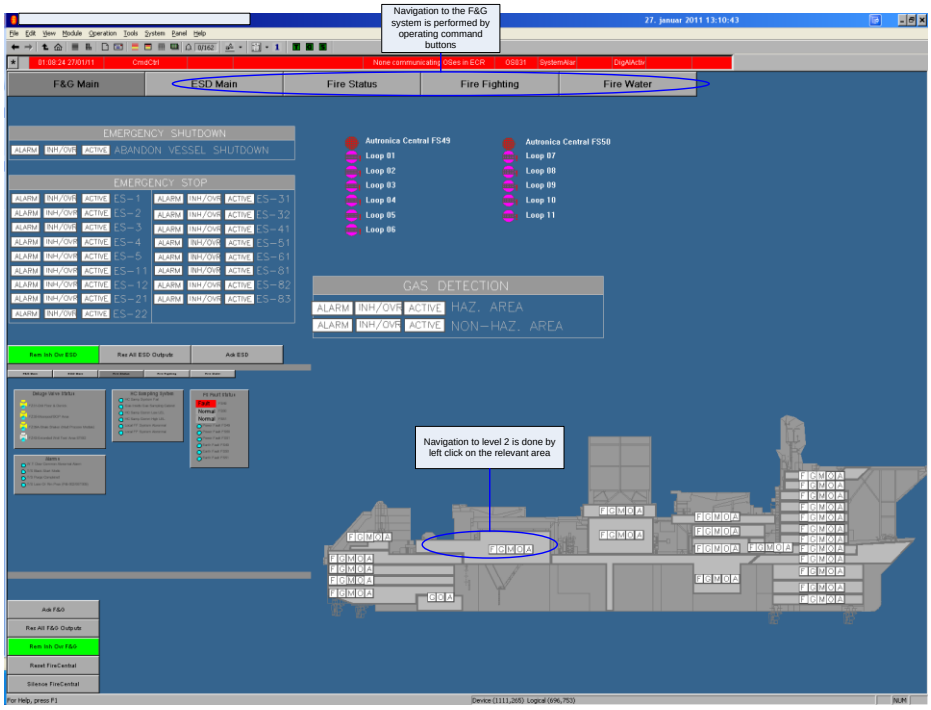


Figure 8-3: ESD & F&G Main View (example)

8.1.2. ESD Process View

The process view is the same display as for the process control. The display will be based on the P&ID's, and will contain all ESD signals.

The process view will be activated from the C&E view by operating on the detector or instrument tag, see 8.3.

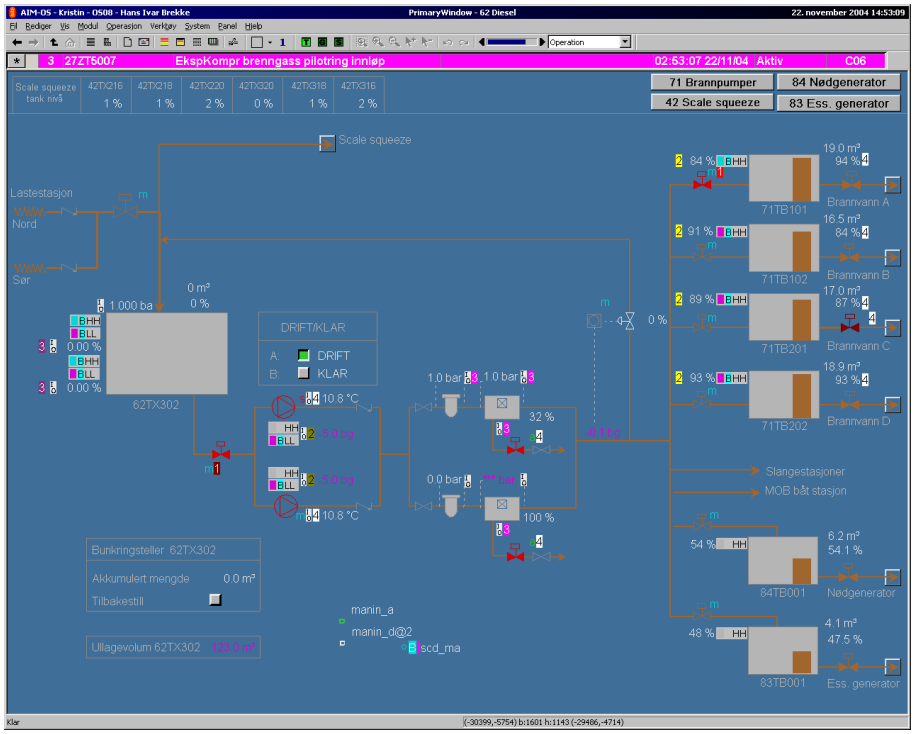


Figure 8-4: Process View (example)

Upon alarm, the detector module symbol changes to flashing alarm colour (steady when acknowledged).

Operations typical performed in the process view are:

- Acknowledgement of alarm.
- Inhibit of individual input signals.
- Open / close valves.

8.2. F&G System Display Hierarchy

The Fire & Gas System is divided into a display hierarchy:

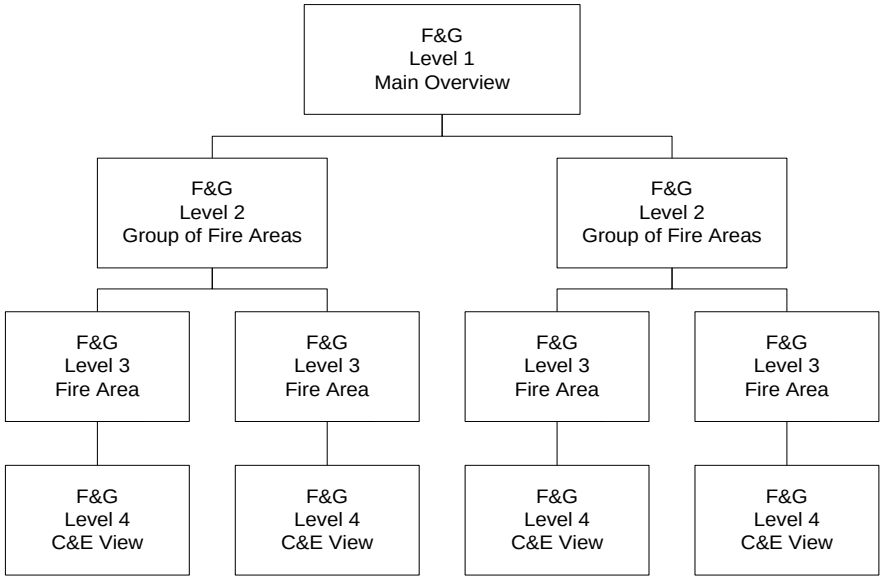


Figure 8-5: F&G Hierarchy

The Level 1 display is a main overview of the Drilling Unit.

The Level 2 display is a detailed view of a group of fire zones, such as a process area or a deck in the accommodation. This level is used to see if a fire or gas leak is spread to more than one fire zone, and to manoeuvre to Level 3 Display.

The Level 3 display is a detailed view of a fire zone with all detectors displayed.

The Level 4 display is the Cause & Effect view.

The navigation is illustrated in the figure below:

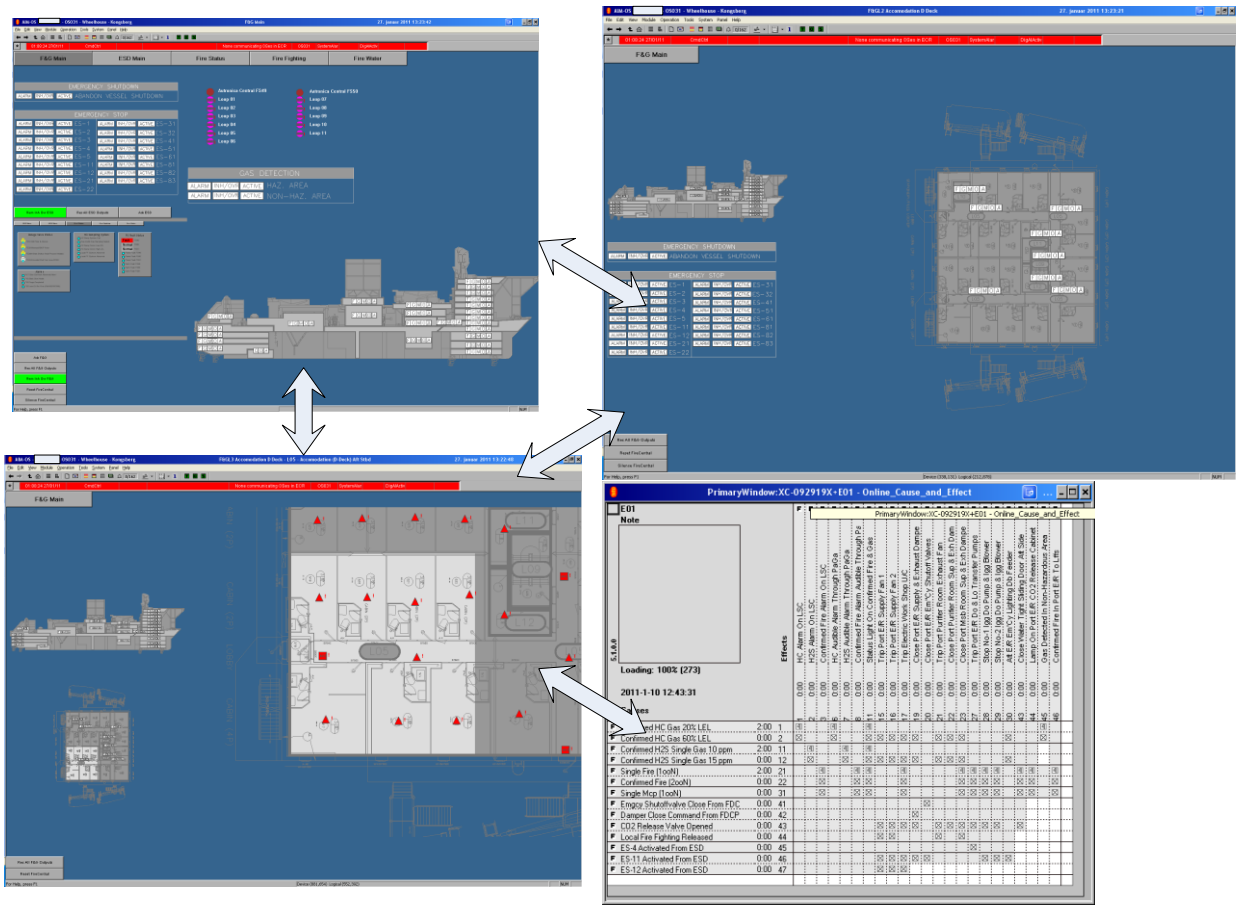


Figure 8-6: F&G navigation structure.

8.2.1. Level 1, F&G Main Overview

The Level 1 Display will be a main overview of the Drilling Unit.

This display will show alarm and inhibit/override status for the F&G System.

This display will contain buttons for acknowledge, silence, reset and inhibit/override, ref 6.2 for more details about the functionality of the buttons.

This display will also contain navigation buttons to other main areas such as the fire pump logic, fire fighting systems and the ESD main display.

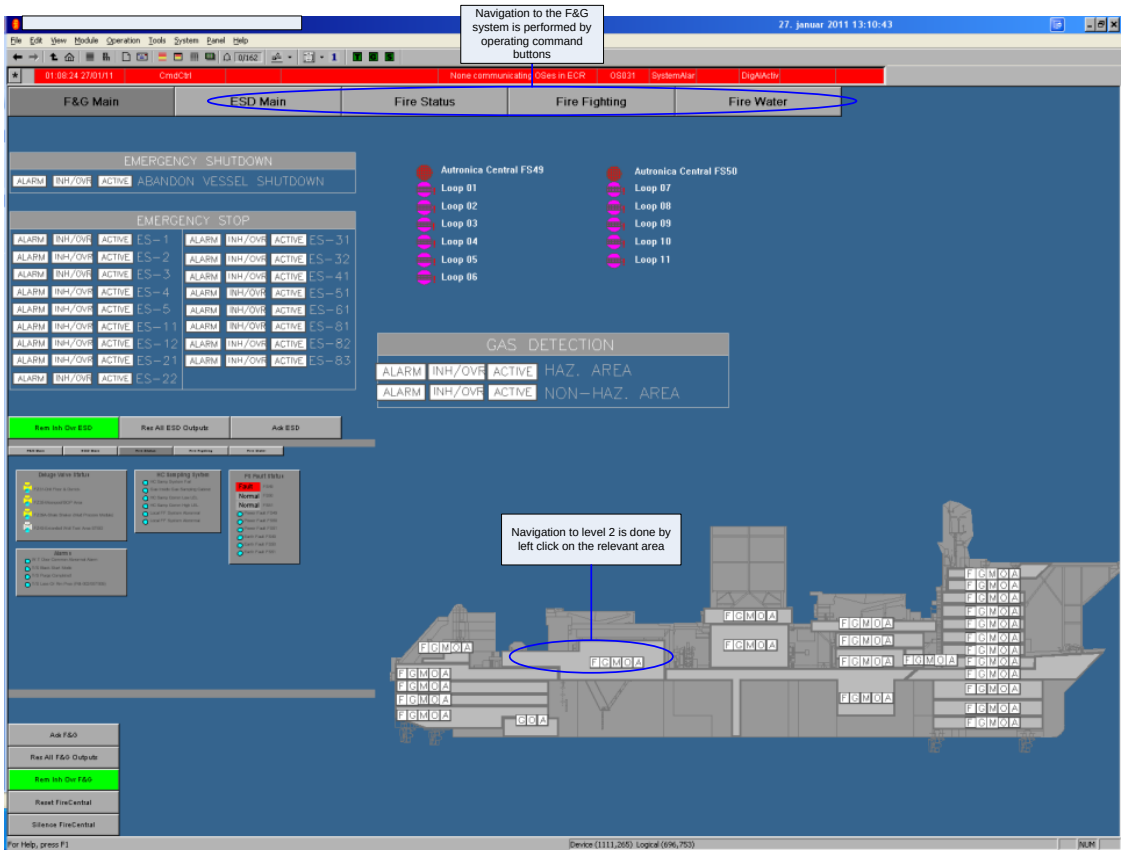


Figure 8-7: Level 1 Display, Main overview of the whole Drilling Unit (example)

The alarm and status indicators will change colours according to the situation.

The operator will be able to navigate to the affected area by moving the marker to the alarm indicators, and operate on the hand-marker.

The AIM function “module group” will be used to collect the status on every module in each F&G level 2.

8.2.2. Level 2, Group of Fire Zones

The Level 2 Display will contain a group of Fire Zones.

The display shows a simple general layout of a deck or process area. The display is based on the detector layouts, ref □. Some details are removed due to readability and display update requirements.

The display will show alarm and status for each fire zone in the group. The alarm and status indicators will change colours according to the situation.

The operator will be able to navigate to the affected area by moving the marker to the alarm indicators, and operate on the hand-marker.

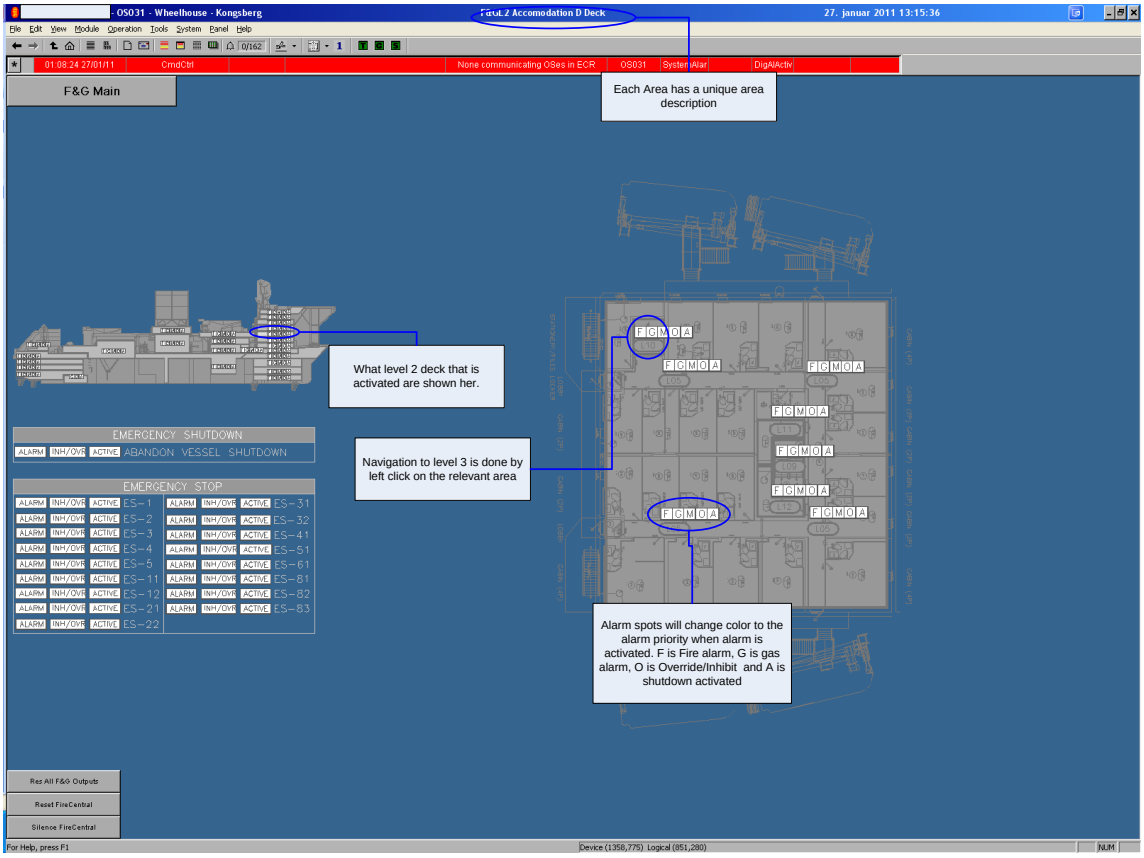


Figure 8-8: Level 2 Display (example)

The function “module group” will be used to collect the status on every module in each fire zone.

8.2.3. Level 3, Fire Zone

The Level 3 Display is a detailed view of a Fire Zone, with all the detectors shown at their geographical location.

The level 3 display is created with the “view port” functionality. This means that level 2 and level 3 displays are created together as one big picture built up with layers.

The level 2 shows the whole picture with the geographical drawing and status indicators.

The level 3 shows part of the picture with the geographical drawing and the detectors. The level 3 display will show the affected fire zone in the center, and part of the surrounding area.

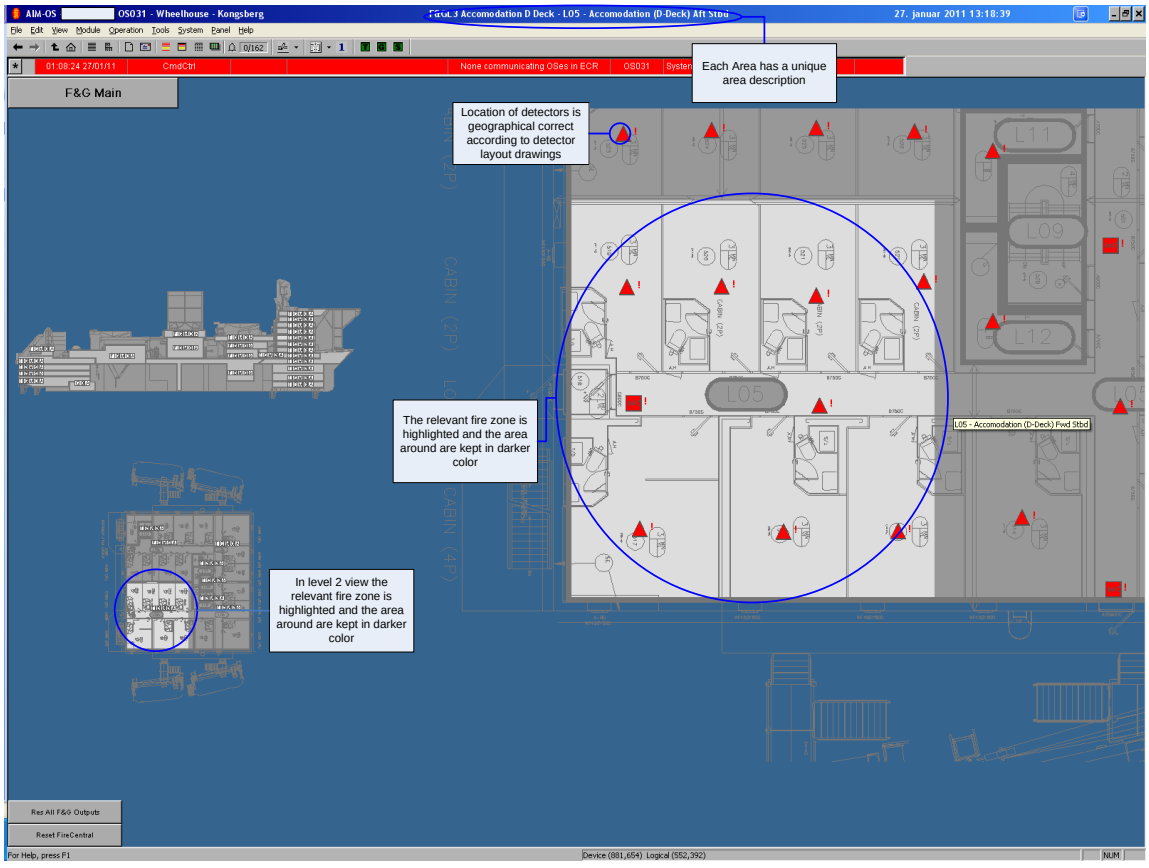


Figure 8-9: Display Level 3 (example)

The display level 3 shows the details of the detectors on each deck represented by the symbols in chapter 7.7.

Upon alarm the detector module symbol changes to flashing alarm colour (steady when acknowledged).

Operations typical performed in the F&G detector layout image are:

- Acknowledgement of alarm.
- Inhibit of individual input signals.
- Open C&E view.

8.3. ESD and F&G C&E View

The C&E view is available for both ESD and F&G.

The view is activated from the operation menu of each detector module in the Fire Area and from the ESD Main View.

The C&E view will show the C&E for the activated ESD level or Fire Area.

The C&E View will include the alarm, activation, test, inhibit and override status for all cause/effect/io modules.

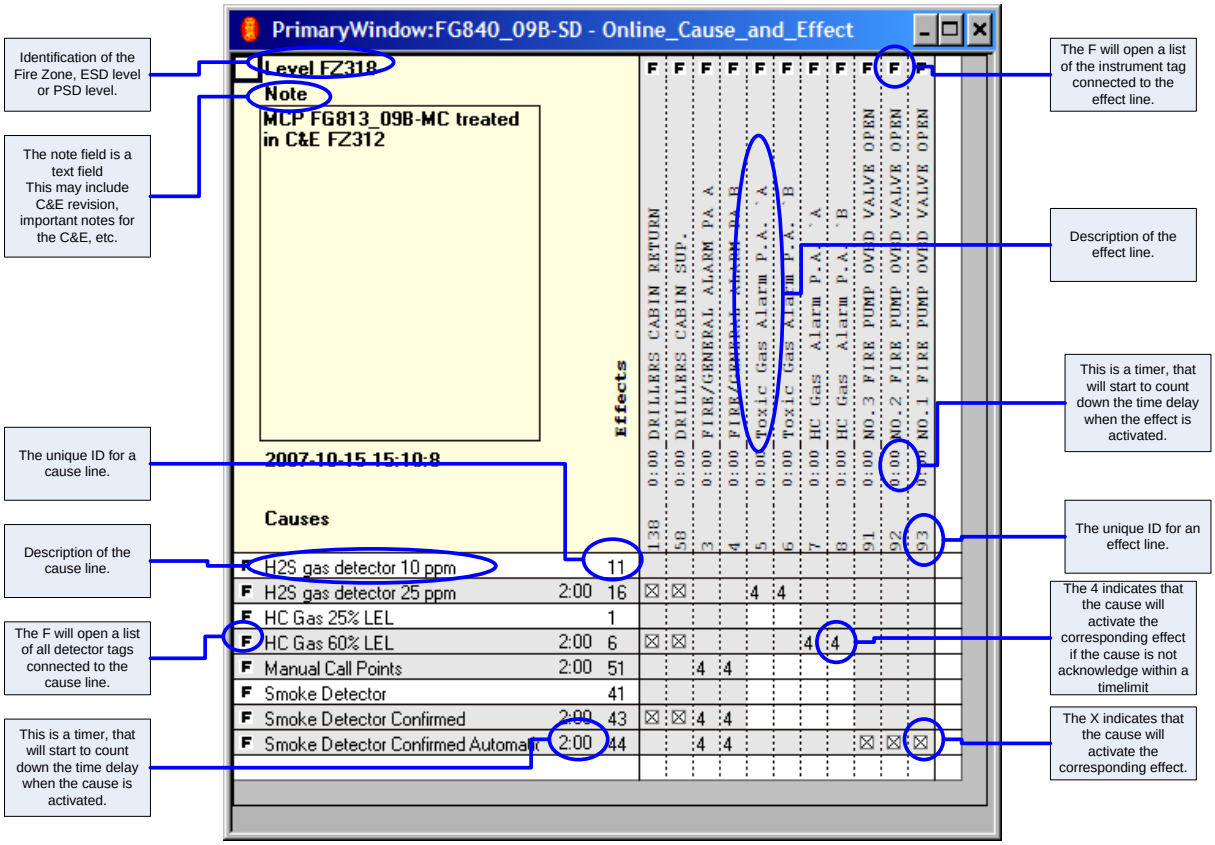


Figure 8-10: C&E View.

Operations typically performed in the C&E view are:

- Acknowledgement of alarm.
- Inhibit of individual input signals.
- Test C&E.
- Open Process view from the detector or instrument tag.

9. Hardware Implementation

9.1. Main components

9.1.1. Cabinets and computers

The F&G system consists of two nodes, F01 and F02. Node F01 and F02 consist of one cabinet each. The F&G system includes one fire central located in F01, and one fire central located in F02. For more information about the fire central see chapter 4.3.1.

The ESD system consists of one node, E01. Node E01 consists of one cabinet.

The ESD and F&G cabinets are located in the dedicated equipment room. Refer to the topology for further information about location of each cabinet.

The ESD and F&G systems consist of five CAAP's located in Fire Control Station, WM/Inergen RM, Wheel House, ECR and DCR, more details of the CAAP see chapter 9.1.4.

Each node in the ESD and F&G system includes a dual redundant RCU (computer) pair and shared RIO cards, see chapter 9.2.

The RIO cards combine IO-processing and IO-termination. A simplified illustration of this configuration is shown in Figure 9-2 . For simplicity only one of each type of RIO card is shown for each node.

The table below shows the RCU's and the cabinets.

Node	Field station	RCU A	RCU B	Yard tag	Redundancy Type
F01	FS-71	PS 71	PS 171	FS71	1oo2
F02	FS-72	PS 72	PS 172	FS72	1oo2
F03	FS-73	PS 73	PS 173	FS73	1oo2
E01	FS-81	PS 81	PS 181	FS81	1oo2

Table 9-1: RCU and cabinets.

9.1.2. Network

The AIM controllers and Operator Stations will be connected to a dedicated dual redundant industrial network (Ethernet).

The Safety System shall use a segregated part of the network, to minimise the traffic on the safety network.

Each RCU in the network has a unique IP and Ethernet address, see table below:

Node	RCU	IP address Net A	IP address Net B	Redundancy Type
F01	PS 71	172.21.1.71	172.22.1.71	1oo2
F01	PS 171	172.21.1.171	172.22.1.171	1oo2
F02	PS 72	172.21.1.72	172.22.1.72	1oo2
F02	PS 172	172.21.1.172	172.22.1.171	1oo2
F03	PS 73	172.21.1.73	172.22.1.73	1oo2
F03	PS 173	172.21.1.173	172.22.1.173	1oo2
E01	PS 81	172.21.1.81	172.22.1.81	1oo2
E01	PS 181	172.21.1.181	172.22.1.181	1oo2

9.1.3. Operator Station

One Operator Station (OS60) on the Bridge is dedicated for operation and monitoring of the ESD and F&G system.

All OS’es are connected to the dual redundant network, and it is possible to operate on and display ESD and F&G images from all OS’es. This functionality is controlled through the AIM command control system, see chapter 6.4.

The ESD and F&G OS is application software server for all RCU’s located in ESD and F&G cabinets.

9.1.4. ESD and F&G Critical Alarm and Action Panel (CAAP)

The ESD and F&G CAAP's are within easy reach of the operators, located in :

- Wheel House

- ECR

- Drilling Work Station

- Fire Control Station

- Watermist / Inergen Room

The CAAP's in Wheel House and ECR are Non-IS, and the CAAP's in Fire Control Station, WM/Inergen Room and DCR are Ex type.

If an ESD push button is pressed anywhere in the five CAAP panels, the concerned lamps will glow on all the Push Button panels.

All signals to/from the matrix are hardwired to line monitored RIO card, see 9.4.3.

ESD signals are hardwired to the ESD cabinet and F&G signals are hardwired to the F&G cabinets.

For detailed drawings refer to document □.

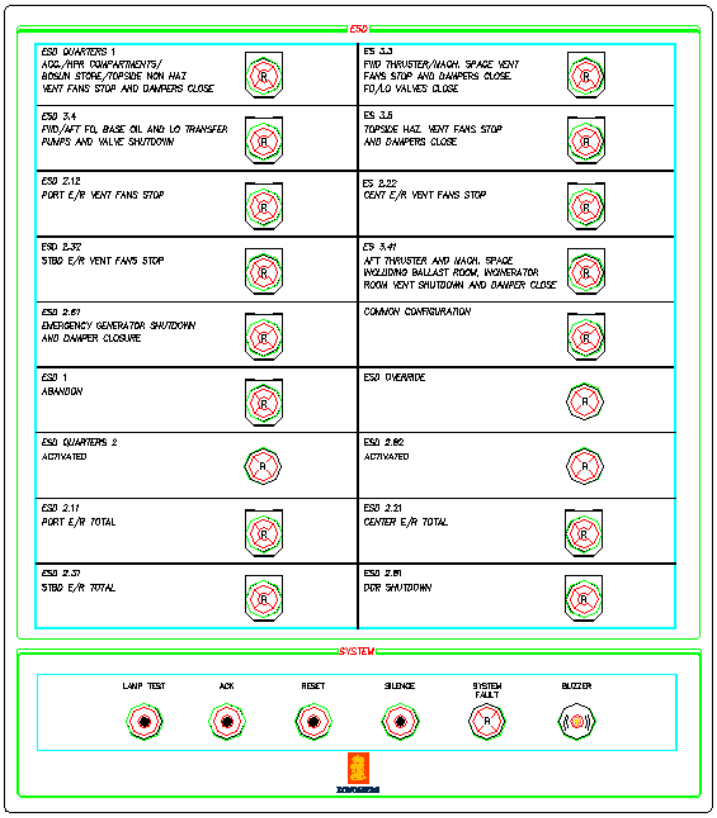


Figure 9-1: ESD Push Button Panels

The ESD Push Button Panels will include:

- Emergency stop pushbuttons for activation of the ES/ESD levels.
- Feedback lamps.
- Two lamps to indicate the field fault indication and over ride present signals.
- Acknowledge button ESD, for acknowledge of all alarm situations in the ESD.
- Reset button for reset all ESD System outputs, that are no longer in alarm. (See chapter 6.2.2 for more information about the reset function.)
- Silence button that will silence the audible alarm (internal buzzer in CAP).
- Lamp Test for the status lamps.
- Buzzer for audible alarms.
- Confirmation button, that must be pushed at the same time as the ESD button, to activate the shut downs.

See table below for the Pushbuttons on each ESD Push Button panel.

The matrixes have different functionality (ESD pushbuttons), ref table below:

ES No	Description/ Function	Location				
		Fire Control Station	WM / Inergen Room	Bridge / Wheel House	DCR	ECR
ESD Quarters 1	Accommodation and Port & Stbd secondary escape way ventilation and Damper close. (Manual)	X	X	X	X	X
ESD Quarters 2	Accommodation and Port & Stbd secondary escape way ventilation and Damper close. (Automatic activation through F&G)	X	X	X	X	X
ESD 3.3	Forward thruster and machinery spaces and Bosun store ventilation shutdown and damper close. Fwd FO & LO valves close.	X	X	X	X	X
ESD 3.4	Fwd/Aft FO, base oil and LO transfer pumps and valve shutdown except QCV.	X	X	X	X	X
ESD 3.5	Topsides non Hazardous-area and HPR compartment ventilation shutdown and Damper close.	X	X	X	X	X
ESD 2.11	Port E/R total shutdown	X	X	X	X	X

ESD 2.12	Port E/R Ventilation Fan Shutdown	X	X	X	X	X
ESD 2.21	Center E/R total shutdown	X	X	X	X	X
ESD 2.22	Center E/R Ventilation Fan Shutdown	X	X	X	X	X
ESD 2.31	Stbd E/R total shutdown	X	X	X	X	X
ESD 2.32	Stbd E/R ventilation shutdown	X	X	X	X	X
ESD 3.41	Aft thruster and Machinery space (Including Ballast Pump room, Boiler room ventilation shutdown and damper close)	X	X	X	X	X
ESD 2.61	Emergency generator Shutdown and damper close	X	X	X	X	
ESD 2.81	DCR Shutdown			X	X	
ESD 2.82	Automatic DCR ventilation shutdown through F&G.	X	X	X	X	X
Abandon	Abandon Vessel Shutdown from Bridge or DCR matrix panels			X	X	

Table 9-2: ESD Push Button Panels

X = function available

= function not available

9.1.4.1. Buzzer

Upon critical alarm the buzzers in the CAAP's will be activated. The buzzer activation is based on the acknowledge state of alarms in module groups. If the alarm acknowledges state within a module group changes from acknowledged to un-acknowledged, the buzzer is activated.

The Silence buttons is for the common ESD and F&G buzzer. The Silence button is local to the CAAP where it is located. Operation of the button only silences the buzzer in the actual CAAP, not all CAAP's.

Module groups are described in □.

9.2. Redundancy

9.2.1. 1oo2 shared I/O redundancy

The ESD and F&G System are defined as 1oo2 shared I/O to comply with SIL 2 requirements.

The system contains redundant power supplies, RCU's and net, with single RIO units and Fire Central.

In a 1oo2 set-up, both processors are active and may perform shutdown of the process at any time, independent of the other processor.

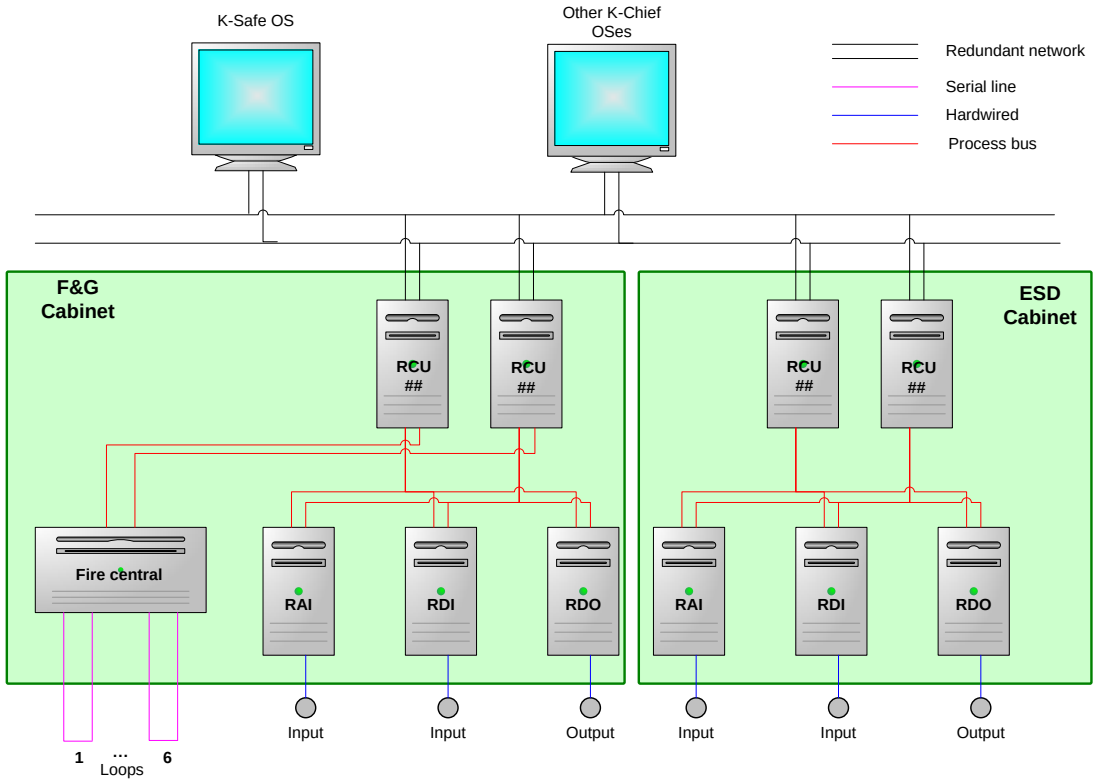


Figure 9-2: ESD and F&G Redundancy

With this 1oo2 system, a single fault will not prevent an initiated shutdown. The fail-safe settings of the output loops will also prevent a single fault from provoking a shutdown.

For more details of redundancy, refer document □.

9.2.2. Redundancy monitoring

ESD and F&G are based on redundant computers (RCU). Both computers are active, but only one RCU is displaying information on the OS displays (display active).

The redundancy functionality is controlled by basis AIM2000 redundancy functionality.

An automatic switch between the Display Active RCU and the Display Passive RCU is performed by AIM2000 on certain criteria.

9.2.3. Discrepancy alarm

Both RCU's in a redundant pair reads the I/O card individually. This means that a change in I/O value may be first detected by one RCU. If the RCU detect different values for more than a pre-defined number of scans, a discrepancy alarm will be set.

The alarm and acknowledge status for each software module is monitored for discrepancy between the redundant pair of RCU's. The function is implemented for all safety software modules.

The first RCU that detects an alarm will perform the shutdown action connected to the alarm, even if it's not display active.

The discrepancy alarm may be checked by selecting the parameter page or the terminal page for the affected software module. The AIM module parameter page and the terminal page show the status on both RCU's.

9.3.I/O Information

All I/O-information will be listed in the I/O-list. This document will include:

- Instrument Tag
- Instrument Description
- Location / P&ID / Fire Zone
- I/O Type
- IS / non IS
- NE / NDE
- Power consuption
- Hardware Loop Typical
- RIO card
- Electrical Certification
- Manufacture / Model no
- Cabinet no
- RCU no
- Signal Range
- Units
- Alarm settings
- Cable no and termination
- RIO Card no, channel and termination [note 1]

KM will allocate input and output signals to I/O card and channels.

Detectors, devices and outputs will be allocated to different I/O card, as far as possible. The philosophy is to minimise the impact of a failure from one I/O card.

I/O included in one fire zone / shutdown level must be connected to the same RCU, as far as possible. This will reduce the number of network connection, and will give a better configuration and will ease the maintenance of both hardware and software.

Note 1: Provided by KM

9.4. Hardware information

9.4.1. Hardware monitoring, built in alarms

Built in alarms:

- All input and output signals will be monitored and alarmed upon failure; open circuit, closed circuit and earth fault.
- Temperature monitoring: A temperature sensor located inside the RIO module is monitored by the controller software. An alarm will be activated if the temperature rises above the limit.
- Watchdog: The Watchdog is controlled from the RCU. A coloured LED visible on the front of the RIO modules indicates the status of the operation.
    - A green light indicates that the module is receiving “module alive” messages from the RCU.
    - A red light indicates that the module is regarded as not running in the system.
- Card, RCU, network and power failures will be alarmed, see 10.3.

Built in tests:

- FOST (final output stage test; the test will verify the ability to operate the output without tripping the connected field device.)
- Software test: When starting both RCU’s and RIO’s, the hardware is checked by a BIT program for potential faulty components and software. Typical tests are: RAM test, Stack overflow test, WD timer test and Checksum test.

9.4.2.IO card settings

9.4.2.1. Fail-safe settings

All RIO output signals will be configured with fail-safe settings (digital 0). Input signals will be frozen at the input software module upon loss of communication with RIO.

If the RIO module loses contact with the RCU, the signals will go to fail-safe status after a configured (timeout) delay.

9.4.2.2. RMP420S (AI)

Typical parameters:

- Detect Cable Break/ Open Loop.
- Detect Short Circuit / Over Current.
- Fail Safe Value = Freeze last value.

9.4.2.3. RDIO420S (DI / DO)

The RDIO 420S card has some limitations:

- Groups of 8 channels must be set to the same type of signals: DI / DO-NE / DO-NDE.
- Groups of 8 channels must be set with the same type of impedance (DO).

9.4.2.3.1. Digital Inputs

There are three different modes for loop monitoring:

- Off: Only over-current monitoring.
- No Resistor Network: Used for circuits with no external resistor.
- With Resistor Network: Used for circuits with external resistors.

9.4.2.3.2. Digital Outputs:

There are three different modes for loop monitoring:

- Off: Only over-current monitoring.
- Low Impedance: Used for circuits with low impedance, e.g. solenoids.
- High Impedance: Used for circuits with high impedance, e.g. relays.

NE outputs must be inverted.

Fail-safe settings for each channel:

- Off: The output is set to 0.
- On: the output is set to 1.

9.4.3. Hardware loop typicals

Typical hardware loop typicals for the project will be:

Loop typical	I/O card	Description	Purpose
ASF FD 2001	Autrosafe	Addressable, Non IS	Smoke, heat, manual alarm in safe area.
ASF FD 2002	Autrosafe	Addressable, IS	Smoke, heat, manual alarm in hazardous area.
AI-01	RMP420S	Non-IS analogue input	Gas detectors, 2 wire
AI-12	RMP420S	Non-Is analogue input	Gas and flame detectors, 3 wire
DI-04	RDIO420S	Non-IS digital input	Feedback from fire dampers
DI-04	RDIO420S	Non-IS digital input, monitored	Field mounted pushbuttons, CAAP pushbuttons, shutdown signals to ESD system
DI-05	RDIO420S	IS digital inputs	CAAP pushbuttons, field mounted pushbuttons in zone 1 / 2
DO-04	RDIO420S	Non-IS digital outputs	Fire dampers, process valves trip signals, signals to PA/GA system
DO-06	RDIO420S	IS digital outputs	Signals to CAAP

Table 9-3: Hardware loop typical

Detailed information for each Hardware loop typical will be included in document □.

9.4.4. Power Supply

The ESD and F&G System will be powered from two UPS'es with a capacity of at least 30 minutes continuous operation after loss of power. One UPS will be powered from the main power system and one UPS will be powered from the emergency system.

9.5. Spare capacity

The Safety Systems shall be designed with spare capacity.

Typical spare for I/O and power is at design freeze:

- 10 % Engineering Spare.
- 20 % Spare channels on installed I/O cards.
- 20 % Spare place in cabinets.

The KM RCU's have the limits of 4000 software-tags. Each safety I/O-tag generate about 5 software-tags, this gives the limit of about 800 I/O-tags for one RCU pair.

The project should start with a count of 400 I/O-tags for each RCU pair, to comply with the spare requirement.

10. FAILURE HANDLING

10.1. Fail safe status of equipment

If both RCU's in a redundant pair stop, all outputs will go to safe position.

NDE:

- Normally DeEnergized outputs will have no action when the RCU's stop.
- The fail safe state must be defined as the DeEnergized position.

NE:

- Normally Energized outputs will lose power when the RCU's stop.
- The fail safe state must be defined at the DeEnergized position.

The table below defines the fail safe states, must be defined by the project.

Typical Equipment	Normal state	Output Type	Fail Safe State
Fire pump (start function)	Stop	NDE	Operational
Drilling system	Operational	NDE	Operational
Fire damper solenoids (non-DP)	Open	NE	Closed
Fire damper solenoids (DP)	Open	NDE	Open
Electrical power generation (active positioning keeping)	Operational	NDE	Operational
UPS for power generation, control and safety systems	Operational	NDE	Operational
Propulsion and steering (active positioning keeping)	Operational	NDE	Operational
Utility systems which do not affect essential functions	Operational	NE	Shutdown

Table 10-1: Fail safe states of equipment

10.2. Fail-safe states of network connections

The ESD and F&G System communicate together and with the control system over the redundant network.

All signals between the systems will go through dedicated network modules.

The safety modules (sd_dmeas / sd_in2) include fail safe settings. The modules will set the output signals to a pre-defined state after 10 sec. The time delays may be changed.

The safety modules have these fail safe settings:

Parameter name	Parameter value
Fault limit (scan)	10 (sec)
Fault value	2 (action)
Init value	0 (no action)

Table 10-2: Fail safe settings for safety modules

The network modules (netdi / netdo) include fail safe settings. The modules will give an alarm after 5 sec if the communication is lost, and will set all network signals to a pre-defined state after 15 sec. The time delays may be changed.

The network modules have three fail safe settings:

Fail safe setting	Signal value
-1	Freeze last state
0	Set signal value = 0 (no action)
1	Set signal value = 1 (action)

Table 10-3: Fail safe settings for network modules

The table below define the fail safe states, must be defined by the project.

Typical Signals / Signal Tags	From system	To system	Fail Safe State
Feedback signals	PCS	ESD or F&G	Freeze
Shutdown actions	ESD F&G	F&G ESD	NE signals Action NDE signals Freeze
Confirmed fire	F&G	ESD	Freeze

Table 10-4: Fail safe states of network signals

All signals between RCU's shall be listed in appendix 0.

10.3. Failures and Effects

Item failure	Effect
Failure in serial interface communication	Alarm initiated. No shutdowns are activated, but manual actions must be performed.
Failure of I/O bus system	Alarm initiated. The I/O bus system is redundant. Inputs and outputs are handled by the other bus system.
Loop / signal failure of inputs	Loop / signal failure will be alarmed on the affected input. No shutdown action will be activated.
Loop / signal failure of outputs	Loop / signal failure will be alarmed on the affected output. NE outputs will be activated. NDE outputs will have no action.
Power failure	RIO power failure will be alarmed. Actions, ref loop / signal failures.
UPS failure	UPS power failure will be alarmed. The power units are redundant. If both sets of powers fail, the RCU will stop and the system will go to fail safe state.
Network failure	Network failure will be alarmed. If both nets fail, the communication between systems is lost, sw network action, ref 10.2.
RCU SW failure	Monitored by SW watchdog. Will cause a fail-safe RCU-stop.
RCU stop	RCU stop will be alarmed. The ESD System is redundant, and the other RCU will still be active. If both RCU's in redundant pair stop, the system will go to fail safe state.

Table 10-5: Failures and effects

11. System Testing

Test frequency, during normal operation: According to Class regulations and company standards.

Operation on the software modules during test; the user need to be logged on as a specific user.

11.1. Test Period

The test period will contain several tests before the production period may start.

1. **IAT**: Prior to FAT the entire test is run through with only KM personnel present. The FAT procedure will be followed and errors will be corrected before FAT.
2. **FAT**: A complete functional test will be performed in accordance with a test procedure approved by Client. Test by KM and Client at Kongsberg.
3. **CAT** / Commissioning: Test by KM and Client at site.
    a. All equipment will be verified in accordance with □.
    b. It will be verified that comments from FAT is implemented.
    c. System performance will be tested, such as RCU load, network load, redundancy, IMS performance etc.

See □ and □ for more information.

11.2. Testing of inputs

The operator can test every ESD and F&G input signals, usually one signal at the time.

When an input shall be tested:

- Inhibit the signal tag from OS. Observe that the inhibited message is logged on the event log and that inhibit indication is presented on the OS.
- Activate device in field after confirmation of tag number from the operator in CCR. Observe that alarm is indicated on OS for the affected tag.
- Silence and acknowledge the alarm and observe on OS that the alarm really has been acknowledged.
- Set the field device back to normal, and reset the system from the OS and observe that everything is back to normal.
- Remove the inhibit flag and observe on OS and event log that inhibit is off.

11.3. Testing of logic functions

This test can be performed during operations. This test will use the built in test function in the AIM modules.

- Select one input (detector or cause module).
- Operate on the selected module and select “test on”.
- Observe on OS that the right C&E actions are made, all involved modules will change to test mode (green colour).
- Use KM C&E Tool for verifying the right C&E actions.

11.4. Testing of outputs

This test should as far as possible be put to situations where operations are stopped for maintenance, but may be performed during operations.

- Ensure that the actual trip or closing of valve is acceptable; confirm tag number from the operator in CCR.
- Operate on the selected module and select “manual activation on”.
- Observe feedback on the OS.

The operating company may decide that it is acceptable to test the outputs by installing jumpers and simply observe that the actual relays and coils are pulled, without activation of the final field device.

12. Appendix

12.1. Project specific logic

12.1.1. CCTV

The project have some outputs in the C&E's for activating specific cameras on the CCTV screen.

There are 12 CCTV camera signals, going out on a Modbus link in FS71. The telegrams are set up with FC 5and write on change, address 33 to 44.

12.1.2. Watch Call groups

The K-Safe system is using the following WC groups:

3 – Fire pump current alarms

7 – Fire Fighting system alarms

251 – Fire alarms

252 – Gas alarms

253 – ESD alarms

254 – Fault alarms

255 – Redundancy deviation alarms

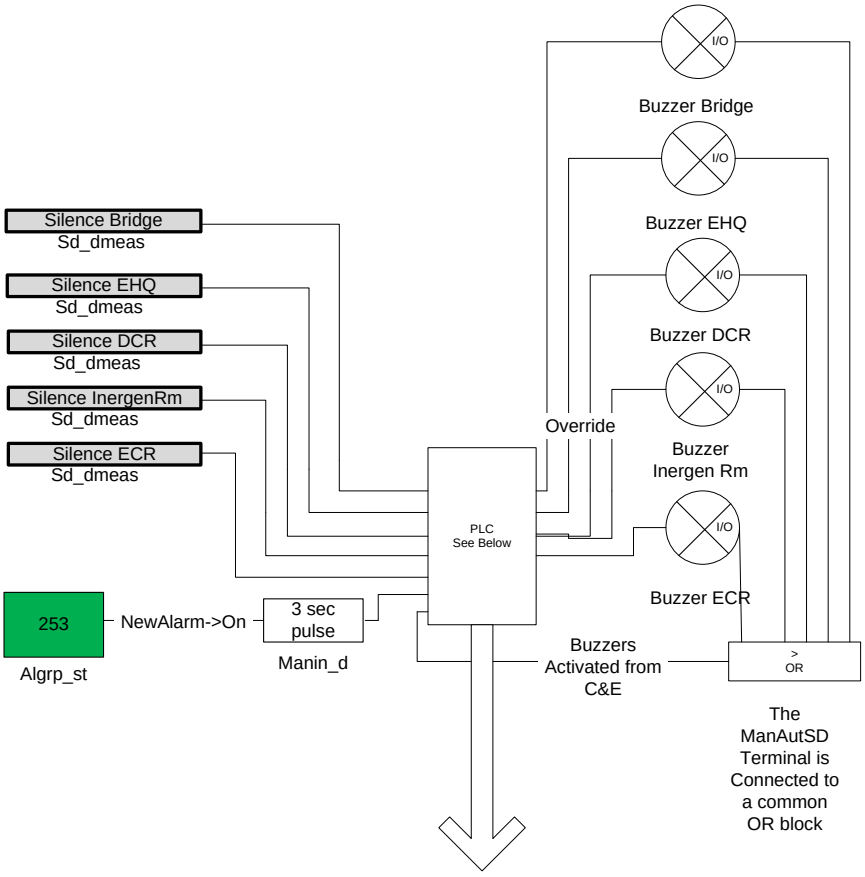
Algrp_st modules are set up with WC group 251 to gather fire alarms in the system and send a HW IO signal to the WC system, tag XC-091115, "816F2 Fire Alarm To Watch Call".

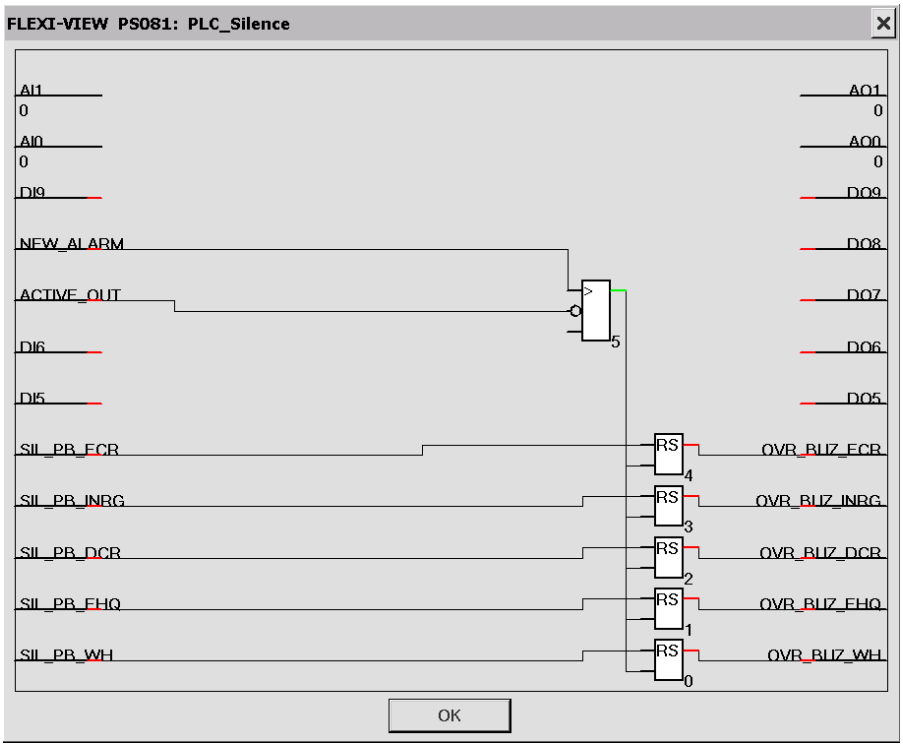
12.1.3. Buzzer logic

The buzzer logic is placed on PS81, all effects in the C&E's to each buzzer is connected to the sd_out2 module connected to the IO-card.

The Watch Call group 253 is used to alarm ESD alarms in the buzzer logic.

Sketch of the logic:





12.1.4. Inhibit button in L3

Each level 3 image have a button called “Inhibit Fire Detectors”. This button will inhibit **all** detectors in the fire zone, except gas detectors.

The operator needs to be logged in as Captain or Chief to operate this button.

The manin_d modules in the F&G system with the tag syntax FG-INH-<FZ> have a parameter to automatically reset the inhibit after 12 hours.

The parameter on page 3 ‘Automatic Reset’ Puls length’ is set to 43200 seconds, which equals 12 hours.

Note: The operator must be aware that the inhibit will be automatically removed after 12 hours if this button is used.

12.1.5. HVAC Buttons in L3 images

Each L3 mimic have a ‘HVAC’ button, defined in the generic image L3-A3.

The generic image have the following function in the hotspot:

ImageManager.ShowImage.<CurrentImageWindowName>.ProcessImage.%HVAC%

Each Fire Zone have configured a HVAC parameter in the cloned deck flow sheets, in addition to the FZ-property, used for ack/reset buttons in L3.

Example from FZ L01 hotspot found in flow sheet ‘X-F&GL2 – 1st Deck FWD’:

Function: FZ="L01";HVAC="HVAC Main Accommodation 1"

The FZ’s that don’t have any HVAC shutdowns are linked directly to ‘HVAC main’.

A list of which L3 mimic links to which HVAC mimic can be found in the appendix under.

12.2. Deck:	12.3. FZ Name:	12.4. FZ:	12.5. HVAC:
12.6. Upper Deck Midship	12.7. A01-HPR Compartment FWD (P)	12.8. A01	12.9. Ventilation HPR Compartment and Ballast Pump Room
12.10. Upper Deck Midship	12.11. A02-HPR Compartment FWD (S)	12.12. A02	12.13. Ventilation HPR Compartment and Ballast Pump Room
12.14. Well test - Aft casing-Riser Storage	12.15. A03-HPR Compartment AFT (P)	12.16. A03	12.17. Ventilation HPR Compartment and Ballast Pump Room
12.18. Well test - Aft casing-Riser Storage	12.19. A04-HPR Compartment AFT (S)	12.20. A04	12.21. Ventilation HPR Compartment and Ballast Pump Room
12.22. Upper Deck Midship	12.23. B01-Bulk Tank Area (HAZ Area)	12.24. B01	12.25. Ventilation Upper Deck
12.26. AFT Funnel Casing A Deck	12.27. C01-Incinerator Room	12.28. C01	12.29. Ventilation Incinerator & AUX Machinery RM
12.30. AFT Machinery Upper Deck	12.31. C01-Incinerator Room	12.32. C01	12.33. Ventilation Incinerator & AUX Machinery RM
12.34. Drill Floor	12.35. D31-Drill Floor & Derrick-Aft-Port	12.36. D31	12.37. HVAC Main
12.38. Drill Floor	12.39. D31-Drill Floor & Derrick-Fwd-Port	12.40. D31	12.41. HVAC Main
12.42. Drill Floor	12.43. D31-Drill Floor & Derrick-Fwd-Stbd	12.44. D31	12.45. HVAC Main

12.46. Drill Floor	12.47. D31-Drill Floor & Derrick-Aft-Stbd	12.48. D31	12.49. HVAC Main
12.50. Drill Floor	12.51. D31-MWD	12.52. D31	12.53. HVAC Main
12.54. Drill Floor	12.55. D31-Mud Logging Unit 1	12.56. D31	12.57. HVAC Main
12.58. Drill Floor	12.59. D32-Drillers Cabin _ LER_TDCR	12.60. D32	12.61. HVAC Ducting Driller Cabin
12.62. Well test - Aft casing-Riser Storage	12.63. D34-Riser storage general area-Aft-Port	12.64. D34	12.65. HVAC Main
12.66. Well test - Aft casing-Riser Storage	12.67. D34-Riser storage general area-Fwd-Port	12.68. D34	12.69. HVAC Main
12.70. Well test - Aft casing-Riser Storage	12.71. D34-Riser storage general area-Fwd-Stbd	12.72. D34	12.73. HVAC Main
12.74. Well test - Aft casing-Riser Storage	12.75. D34-Riser storage general area-Aft-Stbd	12.76. D34	12.77. HVAC Main
12.78. Well test - Aft casing-Riser Storage	12.79. D34-Riser storage general area-Fwd-Mid	12.80. D34	12.81. HVAC Main
12.82. Well test - Aft casing-Riser Storage	12.83. D34-Riser storage general area-Aft-Mid	12.84. D34	12.85. HVAC Main
12.86. Upper Deck Midship	12.87. D35-BOP_Moonpool area-Fwd-Port	12.88. D35	12.89. HVAC Main
12.90. Upper Deck Midship	12.91. D35-BOP_Moonpool area-Aft-Port	12.92. D35	12.93. HVAC Main
12.94. Upper Deck Midship	12.95. D35-BOP_Moonpool area-FWD-Stbd	12.96. D35	12.97. HVAC Main

12.98. Deck:	12.99. FZ Name:	12.100. FZ:	12.101. HVAC:
12.102. Upper Deck Midship	12.103. D35-BOP_Moonpool area-Aft-Stbd	12.104. D35	12.105. HVAC Main
12.106. Upper Deck Midship	12.107. D35-BOP_Moonpool area-Aft-Mid	12.108. D35	12.109. HVAC Main
12.110. Upper Deck Midship	12.111. D35-BOP_Moonpool area-Fwd-Mid	12.112. D35	12.113. HVAC Main
12.114. Drill Pipe Casing Storage Area	12.115. D36-Drillpipe _ Casing storage area-Fwd-Port	12.116. D36	12.117. HVAC Main
12.118. Drill Pipe Casing Storage Area	12.119. D36-Drillpipe _ Casing storage area-Fwd-Stbd	12.120. D36	12.121. HVAC Main
12.122. Drill Pipe Casing Storage Area	12.123. D36-Drillpipe _ Casing storage area-Aft-Stbd	12.124. D36	12.125. HVAC Main
12.126. Drill Pipe Casing Storage Area	12.127. D36-Drillpipe _ Casing storage area-Aft-Port	12.128. D36	12.129. HVAC Main
12.130. Drill Pipe Casing Storage Area	12.131. D36-Drillpipe _ Casing storage area-Aft-Mid	12.132. D36	12.133. HVAC Main
12.134. Drill Pipe Casing Storage Area	12.135. D36-Drillpipe _ Casing storage area-Fwd-Mid	12.136. D36	12.137. HVAC Main
12.138. Mud Pump Area	12.139. D38-Mud Lab	12.140. D38	12.141. HVAC Sack Storage
12.142. Sub-sea control module	12.143. D39-Shale shaker area	12.144. D39	12.145. HVAC Cutting Trans Shale Shakers
12.146. Sub-sea control module	12.147. D37A-Sub sea Workshop EL 30420	12.148. D3A	12.149. HVAC Subsea
12.150. Sub-sea control module	12.151. D37B-APV Room EL 27260	12.152. D3B	12.153. HVAC Subsea
12.154. Sub-sea control	12.155. D37C-BOP Equipment Room EL 23000	12.156. D3C	12.157. HVAC Subsea

module			
12.158. Sub-sea control module	12.159. D37D-Main HPU Room EL23000	12.160. D3D	12.161. HVAC Subsea
12.162. Sack Room	12.163. Topside Module El3000 - D40-Drilling SWGR room-Aft	12.164. D40	12.165. HVAC Switch Transformer
12.166. Sack Room	12.167. Topside Module El3000 - D40-Drilling SWGR room-Fwd	12.168. D40	12.169. HVAC Switch Transformer
12.170. Sack Room	12.171. D41-Sack storage area-Aft	12.172. D41	12.173. HVAC Sack Storage
12.174. Sack Room	12.175. D41-Sack storage area-Fwd-Stbd	12.176. D41	12.177. HVAC Sack Storage
12.178. Sack Room	12.179. D41-Sack storage area-Fwd-Port	12.180. D41	12.181. HVAC Sack Storage
12.182. Sack Room	12.183. D42-Cementer room	12.184. D42	12.185. HVAC Sack Storage
12.186. Well test - Aft casing-Riser Storage	12.187. D43-Extended well test area-Port	12.188. D43	12.189. HVAC Main
12.190. Well test - Aft casing-Riser Storage	12.191. D43-Extended well test area-Stbd	12.192. D43	12.193. HVAC Main
12.194. Well test - Aft casing-Riser Storage	12.195. D43-Extended well test area-Mid	12.196. D43	12.197. HVAC Main
12.198. Mud Pump Area	12.199. D46-Mud tank area-Port	12.200. D46	12.201. HVAC Mud Pit Tank Top Mud Pump
12.202. Mud Pump Area	12.203. D46-Mud tank area-Stbd	12.204. D46	12.205. HVAC Mud Pit Tank Top Mud Pump
12.206. Deck:	12.207. FZ Name:	12.208. FZ:	12.209. HVAC:
12.210. Mud Pump Area	12.211. D46-Mud tank area-Mid	12.212. D46	12.213. HVAC Mud Pit Tank

			Top Mud Pump
12.214. Mud Pump Area	12.215. D47-Mud pump area-Port	12.216. D47	12.217. HVAC Mud Pit Tank Top Mud Pump
12.218. Mud Pump Area	12.219. D47-Mud pump area-Mid	12.220. D47	12.221. HVAC Mud Pit Tank Top Mud Pump
12.222. Mud Pump Area	12.223. D47-Mud pump area-Stbd	12.224. D47	12.225. HVAC Mud Pit Tank Top Mud Pump
12.226. HVAC Plant RM Area	12.227. D48-Workshop & Stores-Port 23000	12.228. D48	12.229. HVAC Switch Transformer
12.230. HVAC Plant RM Area	12.231. D48-Workshop & Stores-Stbd 23000	12.232. D48	12.233. HVAC Switch Transformer
12.234. Well test - Aft casing-Riser Storage	12.235. D49-Drilling welding workshop	12.236. D49	12.237. HVAC Sack Storage
12.238. HVAC Plant RM Area	12.239. D50-HVAC Plant Room-Port	12.240. D50	12.241. HVAC Switch Transformer
12.242. HVAC Plant RM Area	12.243. D50-HVAC Plant Room-Stbd	12.244. D50	12.245. HVAC Switch Transformer
12.246. Sub-sea control module	12.247. D51-Cutting Transport area	12.248. D51	12.249. HVAC Cutting Trans Shale Shakers
12.250. Sub-sea control module	12.251. D52-UPS Room A	12.252. D52	12.253. HVAC Subsea
12.254. Sub-sea control module	12.255. D53-UPS Room B	12.256. D53	12.257. HVAC Subsea
12.258. Sub-sea control module	12.259. D54-Rubber Good Store	12.260. D54	12.261. HVAC Subsea
12.262. Sack Room	12.263. D55-Mud Control Room	12.264. D55	12.265. HVAC Sack Storage

12.266. Sub-sea control module	12.267. D56-Shale Shaker Operator Room	12.268. D56	12.269. HVAC Cutting Trans Shale Shakers
12.270. Upper Deck Midship	12.271. D57-Pod Test Room	12.272. D57	12.273. HVAC Subsea
12.274. HVAC Plant RM Area	12.275. D58-Drilling Mechancal workshop	12.276. D58	12.277. HVAC Plant RM Area
12.278. HVAC Plant RM Area	12.279. D58-Workshop & Stores-Stbd 26500	12.280. D58	12.281. HVAC Switch Transformer
12.282. HVAC Plant RM Area	12.283. D58-Workshop & Stores-Port 26500	12.284. D58	12.285. HVAC Switch Transformer
12.286. AFT Funnel Casing C Deck	12.287. E01-Port Engine Room	12.288. E01	12.289. Ventilation Engine & Thruster Room Port
12.290. AFT Machinery 2nd Deck	12.291. E01-Port Engine Room-Fwd	12.292. E01	12.293. Ventilation Engine & Thruster Room Port
12.294. AFT Machinery 2nd Deck	12.295. E01-Port Engine Room-Aft	12.296. E01	12.297. Ventilation Engine & Thruster Room Port
12.298. AFT Machinery 3rd Deck	12.299. E01-Port Engine Room-Fwd	12.300. E01	12.301. Ventilation Engine & Thruster Room Port
12.302. AFT Machinery 3rd Deck	12.303. E01-Port Engine Room-Aft	12.304. E01	12.305. Ventilation Engine & Thruster Room Port
12.306. AFT Machinery 4th & Floor Deck	12.307. E01-Port Engine Room-Fwd	12.308. E01	12.309. Ventilation Engine & Thruster Room Port
12.310. AFT Machinery 4th & Floor Deck	12.311. E01-Port Engine Room-Aft	12.312. E01	12.313. Ventilation Engine & Thruster Room Port

12.314. Deck:	12.315. FZ Name:	12.316. FZ:	12.317. HVAC:
12.318. AFT Funnel Casing C Deck	12.319. E02-Cent Engine Room	12.320. E02	12.321. Ventilation Engine & Thruster Room Centre
12.322. AFT Machinery 2nd Deck	12.323. E02-Cent Engine Room	12.324. E02	12.325. Ventilation Engine & Thruster Room Centre
12.326. AFT Machinery 3rd Deck	12.327. E02-Cent Engine Room-Fwd	12.328. E02	12.329. Ventilation Engine & Thruster Room Centre
12.330. AFT Machinery 3rd Deck	12.331. E02-Cent Engine Room-Aft	12.332. E02	12.333. Ventilation Engine & Thruster Room Centre
12.334. AFT Machinery 4th & Floor Deck	12.335. E02-Cent Engine Room-Fwd	12.336. E02	12.337. Ventilation Engine & Thruster Room Centre
12.338. AFT Machinery 4th & Floor Deck	12.339. E02-Cent Engine Room-Aft	12.340. E02	12.341. Ventilation Engine & Thruster Room Centre
12.342. AFT Funnel Casing C Deck	12.343. E03-Stbd Engine Room	12.344. E03	12.345. Ventilation Engine & Thruster Room Stbd
12.346. AFT Machinery 2nd Deck	12.347. E03-Stbd Engine Room-Fwd	12.348. E03	12.349. Ventilation Engine & Thruster Room Stbd
12.350. AFT Machinery 2nd Deck	12.351. E03-Stbd Engine Room-Aft	12.352. E03	12.353. Ventilation Engine & Thruster Room Stbd
12.354. AFT Machinery 3rd Deck	12.355. E03-Stbd Engine Room-Fwd	12.356. E03	12.357. Ventilation Engine & Thruster Room Stbd

12.358. AFT Machinery 3rd Deck	12.359. E03-Stbd Engine Room-Aft	12.360. E03	12.361. Ventilation Engine & Thruster Room Stbd
12.362. AFT Machinery 4th & Floor Deck	12.363. E03-Stbd Engine Room-Fwd	12.364. E03	12.365. Ventilation Engine & Thruster Room Stbd
12.366. AFT Machinery 4th & Floor Deck	12.367. E03-Stbd Engine Room-Aft	12.368. E03	12.369. Ventilation Engine & Thruster Room Stbd
12.370. AFT Machinery 4th & Floor Deck	12.371. E11-Port Purifier Room	12.372. E11	12.373. Ventilation Engine & Thruster Room Port
12.374. AFT Machinery 4th & Floor Deck	12.375. E12-Stbd Purifier Room	12.376. E12	12.377. Ventilation Engine & Thruster Room Stbd
12.378. AFT Machinery 2nd Deck	12.379. E21-Engine Control Room	12.380. E21	12.381. Ventilation Engine & Thruster Room Centre
12.382. AFT Machinery Upper Deck	12.383. E21-Engine Control Room	12.384. E21	12.385. Ventilation Engine & Thruster Room Centre
12.386. AFT Machinery 2nd Deck	12.387. E31-Port MSB Room	12.388. E31	12.389. Ventilation Engine & Thruster Room Port
12.390. AFT Machinery 2nd Deck	12.391. E32-Cent MSB Room	12.392. E32	12.393. Ventilation Engine & Thruster Room Centre
12.394. AFT Machinery 2nd Deck	12.395. E33-Stbd MSB Room	12.396. E33	12.397. Ventilation Engine & Thruster Room Stbd
12.398. FWD Upper Deck	12.399. F01-Bosun Store-Port	12.400. F01	12.401. Ventilation Upper Deck

12.402. FWD Upper Deck	12.403. F01-Bosun Store-Stbd	12.404. F01	12.405. Ventilation Upper Deck
12.406. Deck:	12.407. FZ Name:	12.408. FZ:	12.409. HVAC:
12.410. AFT Machinery Upper Deck	12.411. G01-Paint Store (HAZ Area)	12.412. G01	12.413. Ventilation Misc
12.414. AFT Machinery Upper Deck	12.415. G02-Oxy_Acetylene Room (HAZ Area)	12.416. G02	12.417. HVAC Main
12.418. Heli Deck Top Deck	12.419. H01-Heli Deck (Haz Area)-AFT-Port	12.420. H01	12.421. HVAC Main
12.422. Heli Deck Top Deck	12.423. H01-Heli Deck (Haz Area)-FWD-Port	12.424. H01	12.425. HVAC Main
12.426. Heli Deck Top Deck	12.427. H01-Heli Deck (Haz Area)-FWD-Stbd	12.428. H01	12.429. HVAC Main
12.430. Heli Deck Top Deck	12.431. H01-Heli Deck (Haz Area)-AFT-Stbd	12.432. H01	12.433. HVAC Main
12.434. Heli Deck Top Deck	12.435. H02-Battery Room-I (806) (Haz Area)	12.436. H02	12.437. HVAC Main Accommodation 3
12.438. Heli Deck Top Deck	12.439. H03-Battery Room-II (802) (Haz Area)	12.440. H03	12.441. HVAC Main Accommodation 3
12.442. Heli Deck Top Deck	12.443. H04-Elec Equip Rm (807)	12.444. H04	12.445. HVAC Main Accommodation 1
12.446. Heli Deck Top Deck	12.447. H05-Heli Safety Equip Rm (808)	12.448. H05	12.449. HVAC Main Accommodation 1
12.450. Heli Deck Top Deck	12.451. H06-Heli Lounge_Trg Rm_Movie Room (801)	12.452. H06	12.453. HVAC Main Accommodation 1
12.454. Upper Deck Midship	12.455. J01-Agitator Room (HAZ Area)	12.456. J01	12.457. Ventilation Upper Deck
12.458. Secondary	12.459. K01-Fwd (P) Emergency Esc Way	12.460. K01	12.461. Ventilation Escape

Escapeway FWD			Ways
12.462. Secondary Escapeway MID	12.463. K01-Fwd (P) Emergency Esc Way-Fwd	12.464. K01	12.465. Ventilation Escape Ways
12.466. Secondary Escapeway MID	12.467. K01-Fwd (P) Emergency Esc Way-Aft	12.468. K01	12.469. Ventilation Escape Ways
12.470. Secondary Escapeway FWD	12.471. K02-Fwd (S) Emergency Esc Way	12.472. K02	12.473. Ventilation Escape Ways
12.474. Secondary Escapeway MID	12.475. K02-Fwd (S) Emergency Esc Way-Fwd	12.476. K02	12.477. Ventilation Escape Ways
12.478. Secondary Escapeway MID	12.479. K02-Fwd (S) Emergency Esc Way-Aft	12.480. K02	12.481. Ventilation Escape Ways
12.482. Secondary Escapeway AFT	12.483. K03-Aft (P) Emergency Esc Way-Aft	12.484. K03	12.485. Ventilation Escape Ways
12.486. Secondary Escapeway AFT	12.487. K03-Aft (P) Emergency Esc Way-Fwd	12.488. K03	12.489. Ventilation Escape Ways
12.490. Secondary Escapeway MID	12.491. K03-Aft (P) Emergency Esc Way-Aft	12.492. K03	12.493. Ventilation Escape Ways
12.494. Secondary Escapeway AFT	12.495. K04-Aft (S) Emergency Esc Way-Aft	12.496. K04	12.497. Ventilation Escape Ways
12.498. Secondary Escapeway AFT	12.499. K04-Aft (S) Emergency Esc Way-Fwd	12.500. K04	12.501. Ventilation Escape Ways
12.502. Secondary Escapeway MID	12.503. K04-Aft (S) Emergency Esc Way-Aft	12.504. K04	12.505. Ventilation Escape Ways
12.506. 1st Deck Fwd	12.507. L01-Accom 1st Deck-Port	12.508. L01	12.509. HVAC Main Accommodation 1
12.510. 1st Deck Fwd	12.511. L01-Accom 1st Deck-Stbd	12.512. L01	12.513. HVAC Main Accommodation 1

12.514. FWD Upper Deck	12.515. L02-Accom Upper Deck-Port	12.516. L02	12.517. HVAC Main Accommodation 1
12.518. FWD Upper Deck	12.519. L02-Accom Upper Deck-Stbd	12.520. L02	12.521. HVAC Main Accommodation 1
12.522. FWD Upper Deck	12.523. L02-Accom Upper Deck-Mid	12.524. L02	12.525. HVAC Main Accommodation 1
12.526. Deck:	12.527. FZ Name:	12.528. FZ:	12.529. HVAC:
12.530. Accommodation A Deck	12.531. L03-Accom A-Deck-Port	12.532. L03	12.533. HVAC Main Accommodation 1
12.534. Accommodation A Deck	12.535. L03-Accom A-Deck-Stbd	12.536. L03	12.537. HVAC Main Accommodation 1
12.538. Accommodation A Deck	12.539. L03-Accom A-Deck-Mid	12.540. L03	12.541. HVAC Main Accommodation 1
12.542. Accommodation B Deck	12.543. L04-Accom B-Deck-Aft-Port	12.544. L04	12.545. HVAC Main Accommodation 1
12.546. Accommodation B Deck	12.547. L04-Accom B-Deck-Fwd-Port	12.548. L04	12.549. HVAC Main Accommodation 1
12.550. Accommodation B Deck	12.551. L04-Accom B-Deck-Fwd-Stbd	12.552. L04	12.553. HVAC Main Accommodation 1
12.554. Accommodation B Deck	12.555. L04-Accom B-Deck-Aft-Stbd	12.556. L04	12.557. HVAC Main Accommodation 1
12.558. Accommodation C Deck	12.559. L05-Accom C-Deck-Aft-Port	12.560. L05	12.561. HVAC Main Accommodation 1
12.562. Accommodation C Deck	12.563. L05-Accom C-Deck-Fwd-Port	12.564. L05	12.565. HVAC Main Accommodation 1
12.566. Accommodation C	12.567. L05-Accom C-Deck-Fwd-Stbd	12.568. L05	12.569. HVAC Main

Deck			Accommodation 1
12.570. Accommodation Deck C	12.571. L05-Accom C-Deck-Aft-Stbd	12.572. L05	12.573. HVAC Main Accommodation 1
12.574. Accommodation Deck D	12.575. L06-Accom D-Deck-Aft-Port	12.576. L06	12.577. HVAC Main Accommodation 1
12.578. Accommodation Deck D	12.579. L06-Accom D-Deck-Fwd-Port	12.580. L06	12.581. HVAC Main Accommodation 1
12.582. Accommodation Deck D	12.583. L06-Accom D-Deck-Fwd-Stbd	12.584. L06	12.585. HVAC Main Accommodation 1
12.586. Accommodation Deck D	12.587. L06-Accom D-Deck-Aft-Stbd	12.588. L06	12.589. HVAC Main Accommodation 1
12.590. Accommodation Deck E	12.591. L07-Accom E-Deck-Aft-Port	12.592. L07	12.593. HVAC Main Accommodation 1
12.594. Accommodation Deck E	12.595. L07-Accom E-Deck-Fwd-Port	12.596. L07	12.597. HVAC Main Accommodation 1
12.598. Accommodation Deck E	12.599. L07-Accom E-Deck-Fwd-Stbd	12.600. L07	12.601. HVAC Main Accommodation 1
12.602. Accommodation Deck E	12.603. L07-Accom E-Deck-Aft-Stbd	12.604. L07	12.605. HVAC Main Accommodation 1
12.606. Accommodation Deck A	12.607. L08-Galley	12.608. L08	12.609. HVAC Main Accommodation 2
12.610. Accommodation Deck B	12.611. L08-Galley - Mech Air Supply	12.612. L08	12.613. HVAC Main Accommodation 2

12.614. Deck:	12.615. FZ Name:	12.616. FZ:	12.617. HVAC:
12.618. FWD Upper Deck	12.619. L08-Galley-Fwd	12.620. L08	12.621. HVAC Main Accommodation 2
12.622. FWD Upper Deck	12.623. L08-Galley-Aft	12.624. L08	12.625. HVAC Main Accommodation 2
12.626. 1st Deck Fwd	12.627. L09-Accom Stairway	12.628. L09	12.629. HVAC Main Accommodation 2
12.630. 2nd Deck Fwd	12.631. L09-Accom Stairway	12.632. L09	12.633. HVAC Main Accommodation 2
12.634. Accommodation A Deck	12.635. L09-Accom Stairway	12.636. L09	12.637. HVAC Main Accommodation 2
12.638. Accommodation B Deck	12.639. L09-Accom Stairway	12.640. L09	12.641. HVAC Main Accommodation 2
12.642. Accommodation C Deck	12.643. L09-Accom Stairway	12.644. L09	12.645. HVAC Main Accommodation 2
12.646. Accommodation D Deck	12.647. L09-Accom Stairway	12.648. L09	12.649. HVAC Main Accommodation 2
12.650. Accommodation E Deck	12.651. L09-Accom Stairway	12.652. L09	12.653. HVAC Main Accommodation 2
12.654. FWD Upper Deck	12.655. L09-Accom Stairway	12.656. L09	12.657. HVAC Main Accommodation 2
12.658. FWD Upper Deck	12.659. L09-Accom Stairway-Aft	12.660. L09	12.661. HVAC Main Accommodation 2
12.662. Heli Deck Top Deck	12.663. L09-Accom Stairway-Stbd	12.664. L09	12.665. HVAC Main Accommodation 2

12.666. Heli Deck Top Deck	12.667. L09-Accom Stairway-Port	12.668. L09	12.669. HVAC Main Accommodation 2
12.670. Navigation Bridge Deck	12.671. L09-Accom Stairway	12.672. L09	12.673. HVAC Main Accommodation 2
12.674. 1st Deck Fwd	12.675. L10-Lift Shaft	12.676. L10	12.677. HVAC Main Accommodation 2
12.678. 2nd Deck Fwd	12.679. L10-Lift Shaft	12.680. L10	12.681. HVAC Main Accommodation 2
12.682. Accommodation A Deck	12.683. L10-Lift Shaft	12.684. L10	12.685. HVAC Main Accommodation 2
12.686. Accommodation B Deck	12.687. L10-Lift Shaft	12.688. L10	12.689. HVAC Main Accommodation 2
12.690. Accommodation C Deck	12.691. L10-Lift Shaft	12.692. L10	12.693. HVAC Main Accommodation 2
12.694. Accommodation D Deck	12.695. L10-Lift Shaft	12.696. L10	12.697. HVAC Main Accommodation 2

12.698. Deck:	12.699. FZ Name:	12.700. FZ:	12.701. HVAC:
12.702. Accommodation E Deck	12.703. L10-Lift Shaft	12.704. L10	12.705. HVAC Main Accommodation 2
12.706. FWD Upper Deck	12.707. L10-Lift Shaft	12.708. L10	12.709. HVAC Main Accommodation 2
12.710. Heli Deck Top Deck	12.711. L10-Lift Shaft-Fwd	12.712. L10	12.713. HVAC Main Accommodation 2
12.714. Heli Deck Top Deck	12.715. L10-Lift Shaft-Aft	12.716. L10	12.717. HVAC Main Accommodation 2
12.718. Navigation Bridge Deck	12.719. L10-Lift Shaft	12.720. L10	12.721. HVAC Main Accommodation 2
12.722. 1st Deck Fwd	12.723. L11-Cable Trunk (P)	12.724. L11	12.725. HVAC Main Accommodation 3
12.726. Accommodation A Deck	12.727. L11-Cable Trunk (P)	12.728. L11	12.729. HVAC Main Accommodation 3
12.730. Accommodation B Deck	12.731. L11-Cable Trunk (P)	12.732. L11	12.733. HVAC Main Accommodation 3
12.734. Accommodation C Deck	12.735. L11-Cable Trunk (P)	12.736. L11	12.737. HVAC Main Accommodation 3
12.738. Accommodation D Deck	12.739. L11-Cable Trunk (P)	12.740. L11	12.741. HVAC Main Accommodation 3
12.742. Accommodation E Deck	12.743. L11-Cable Trunk (P)	12.744. L11	12.745. HVAC Main Accommodation 3
12.746. FWD Upper Deck	12.747. L11-Cable Trunk (P)	12.748. L11	12.749. HVAC Main Accommodation 3

12.750. Navigation Bridge Deck	12.751. L11-Cable Trunk (P)	12.752. L11	12.753. HVAC Main Accommodation 3
12.754. 1st Deck Fwd	12.755. L12-Cable Trunk (S)	12.756. L12	12.757. HVAC Main Accommodation 3
12.758. Accommodation A Deck	12.759. L12-Cable Trunk (S)	12.760. L12	12.761. HVAC Main Accommodation 3
12.762. Accommodation B Deck	12.763. L12-Cable Trunk (S)	12.764. L12	12.765. HVAC Main Accommodation 3
12.766. Accommodation C Deck	12.767. L12-Cable Trunk (S)	12.768. L12	12.769. HVAC Main Accommodation 3
12.770. Accommodation D Deck	12.771. L12-Cable Trunk (S)	12.772. L12	12.773. HVAC Main Accommodation 3
12.774. Accommodation E Deck	12.775. L12-Cable Trunk (S)	12.776. L12	12.777. HVAC Main Accommodation 3
12.778. FWD Upper Deck	12.779. L12-Cable Trunk (S)	12.780. L12	12.781. HVAC Main Accommodation 3

12.782. Deck:	12.783. FZ Name:	12.784. FZ:	12.785. HVAC:
12.786. Navigation Bridge Deck	12.787. L12-Cable Trunk (S)	12.788. L12	12.789. HVAC Main Accommodation 3
12.790. Accommodation E Deck	12.791. L13-El Trunk E-Dk	12.792. L13	12.793. HVAC Main
12.794. 1st Deck Fwd	12.795. L14-P_D Trunk	12.796. L14	12.797. HVAC Main
12.798. Accommodation A Deck	12.799. L14-P_D Trunk	12.800. L14	12.801. HVAC Main
12.802. Accommodation B Deck	12.803. L14-P_D Trunk	12.804. L14	12.805. HVAC Main
12.806. Accommodation C Deck	12.807. L14-P_D Trunk	12.808. L14	12.809. HVAC Main
12.810. Accommodation D Deck	12.811. L14-P_D Trunk	12.812. L14	12.813. HVAC Main
12.814. Accommodation E Deck	12.815. L14-P_D Trunk	12.816. L14	12.817. HVAC Main
12.818. FWD Upper Deck	12.819. L14-P_D Trunk	12.820. L14	12.821. HVAC Main
12.822. Accommodation E Deck	12.823. L15-Nav Inst Rm	12.824. L15	12.825. HVAC Main Accommodation 1
12.826. Accommodation E Deck	12.827. L16-Dp Backup Rm	12.828. L16	12.829. HVAC Main Accommodation 1
12.830. 2nd Deck Fwd	12.831. M01-AHU Room-Port	12.832. M01	12.833. HVAC Main Accommodation 1
12.834. 2nd Deck Fwd	12.835. M01-AHU Room-Stbd	12.836. M01	12.837. HVAC Main

			Accommodation 1
12.838. Accommodation A Deck	12.839. M01-AHU Room	12.840. M01	12.841. HVAC Main Accommodation 1
12.842. Accommodation A Deck	12.843. M02-Fwd Aux Mach Room	12.844. M02	12.845. Ventilation Incinerator & AUX Machinery RM
12.846. FWD Machinery 3rd Deck	12.847. M02-Fwd Aux Mach Room	12.848. M02	12.849. Ventilation Incinerator & AUX Machinery RM
12.850. FWD Machinery Floor Deck	12.851. M02-Fwd Aux Mach Room	12.852. M02	12.853. Ventilation Incinerator & AUX Machinery RM
12.854. AFT Machinery Upper Deck	12.855. M03-Hyd Power Pack Rm	12.856. M03	12.857. Ventilation Misc
12.858. AFT Machinery Upper Deck	12.859. M04-Funnel Casing-Port	12.860. M04	12.861. HVAC Main
12.862. AFT Machinery Upper Deck	12.863. M04-Funnel Casing-Stbd	12.864. M04	12.865. HVAC Main
12.866. AFT Machinery Upper Deck	12.867. M04-Funnel Casing-Mid	12.868. M04	12.869. HVAC Main
12.870. Navigation Bridge Deck	12.871. N01-Nav Deck-Port	12.872. N01	12.873. HVAC Main Accommodation 1
12.874. Navigation Bridge Deck	12.875. N01-Nav Deck-Stbd	12.876. N01	12.877. HVAC Main Accommodation 1
12.878. Navigation Bridge Deck	12.879. N02-Wheel House-Port	12.880. N02	12.881. HVAC Main Accommodation 3
12.882. Navigation Bridge Deck	12.883. N02-Wheel House-Stbd	12.884. N02	12.885. HVAC Main Accommodation 3

12.886. Deck:	12.887. FZ Name:	12.888. FZ:	12.889. HVAC:
12.890. 2nd Deck Fwd	12.891. O01-Fwd Store	12.892. O01	12.893. HVAC Main
12.894. AFT Machinery 2nd Deck	12.895. O02-Rope Store	12.896. O02	12.897. Ventilation Misc
12.898. AFT Machinery 4th & Floor Deck	12.899. P01-Ballast Pump Room (HAZ Area)	12.900. P01	12.901. Ventilation HPR Compartment and Ballast Pump Room
12.902. AFT Machinery Upper Deck	12.903. P01-Ballast Pump Room (HAZ Area)	12.904. P01	12.905. Ventilation HPR Compartment and Ballast Pump Room
12.906. FWD Upper Deck	12.907. S01-FWD Fire Control Station	12.908. S01	12.909. HVAC Main Accommodation 1
12.910. AFT Funnel Casing A Deck	12.911. S02-Watermist_Inergen Rm	12.912. S02	12.913. Ventilation Misc
12.914. AFT Machinery Upper Deck	12.915. S02-Watermist_Inergen Rm	12.916. S02	12.917. Ventilation Misc
12.918. Accommodation B Deck	12.919. S03-Emcy Generator Room	12.920. S03	12.921. HVAC Main Accommodation 3
12.922. FWD Upper Deck	12.923. S03-Emcy Generator Room	12.924. S03	12.925. HVAC Main Accommodation 3
12.926. 2nd Deck Fwd	12.927. T01-Cent Bow Thruster Room	12.928. T01	12.929. Ventilation Engine & Thruster Room Centre
12.930. Accommodation C Deck	12.931. T01-Cent Bow Thruster Room	12.932. T01	12.933. Ventilation Engine & Thruster Room Centre

12.934. FWD Machinery 3rd Deck	12.935. T01-Cent Bow Thruster Room	12.936. T01	12.937. Ventilation Engine & Thruster Room Centre
12.938. FWD Machinery Floor Deck	12.939. T01-Cent Bow Thruster Room	12.940. T01	12.941. Ventilation Engine & Thruster Room Centre
12.942. FWD Upper Deck	12.943. T01-Cent Bow Thruster Room	12.944. T01	12.945. Ventilation Engine & Thruster Room Centre
12.946. 2nd Deck Fwd	12.947. T02-Port Bow Thruster Room	12.948. T02	12.949. Ventilation Engine & Thruster Room Port
12.950. FWD Machinery 3rd Deck	12.951. T02-Port Bow Thruster Room	12.952. T02	12.953. Ventilation Engine & Thruster Room Port
12.954. FWD Machinery Floor Deck	12.955. T02-Port Bow Thruster Room	12.956. T02	12.957. Ventilation Engine & Thruster Room Port
12.958. FWD Upper Deck	12.959. T02-Port Bow Thruster Room	12.960. T02	12.961. Ventilation Engine & Thruster Room Port
12.962. 2nd Deck Fwd	12.963. T03-Stbd Bow Thruster Room	12.964. T03	12.965. Ventilation Engine & Thruster Room Stbd
12.966. FWD Machinery 3rd Deck	12.967. T03-Stbd Bow Thruster Room	12.968. T03	12.969. Ventilation Engine & Thruster Room Stbd
12.970. FWD Machinery Floor Deck	12.971. T03-Stbd Bow Thruster Room	12.972. T03	12.973. Ventilation Engine & Thruster Room Stbd
12.974. FWD Upper Deck	12.975. T03-Stbd Bow Thruster Room	12.976. T03	12.977. Ventilation Engine & Thruster Room Stbd

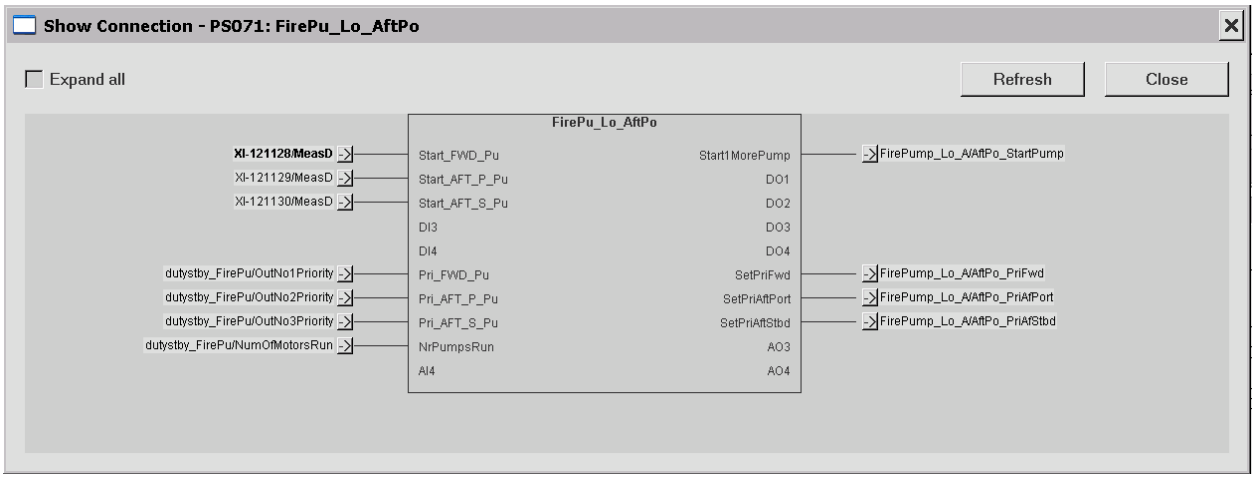
12.978. Deck:	12.979. FZ Name:	12.980. FZ:	12.981. HVAC:
12.982. AFT Machinery 2nd Deck	12.983. T04-Port Stern Thruster Room	12.984. T04	12.985. Ventilation Engine & Thruster Room Port
12.986. AFT Machinery 3rd Deck	12.987. T04-Port Stern Thruster Room	12.988. T04	12.989. Ventilation Engine & Thruster Room Port
12.990. AFT Machinery 4th & Floor Deck	12.991. T04-Port Stern Thruster Room	12.992. T04	12.993. Ventilation Engine & Thruster Room Port
12.994. AFT Machinery Upper Deck	12.995. T04-Port Stern Thruster Room	12.996. T04	12.997. Ventilation Engine & Thruster Room Port
12.998. AFT Machinery 2nd Deck	12.999. T05-Stbd Stern Thruster Room	12.1000. T05	12.1001. Ventilation Engine & Thruster Room Stbd
12.1002. AFT Machinery 3rd Deck	12.1003. T05-Stbd Stern Thruster Room	12.1004. T05	12.1005. Ventilation Engine & Thruster Room Stbd
12.1006. AFT Machinery 4th & Floor Deck	12.1007. T05-Stbd Stern Thruster Room	12.1008. T05	12.1009. Ventilation Engine & Thruster Room Stbd
12.1010. AFT Machinery Upper Deck	12.1011. T05-Stbd Stern Thruster Room	12.1012. T05	12.1013. Ventilation Engine & Thruster Room Stbd
12.1014. AFT Machinery 2nd Deck	12.1015. T06-Cent Stern Thruster Room	12.1016. T06	12.1017. Ventilation Engine & Thruster Room Centre
12.1018. AFT Machinery 3rd Deck	12.1019. T06-Cent Stern Thruster Room	12.1020. T06	12.1021. Ventilation Engine & Thruster Room Centre

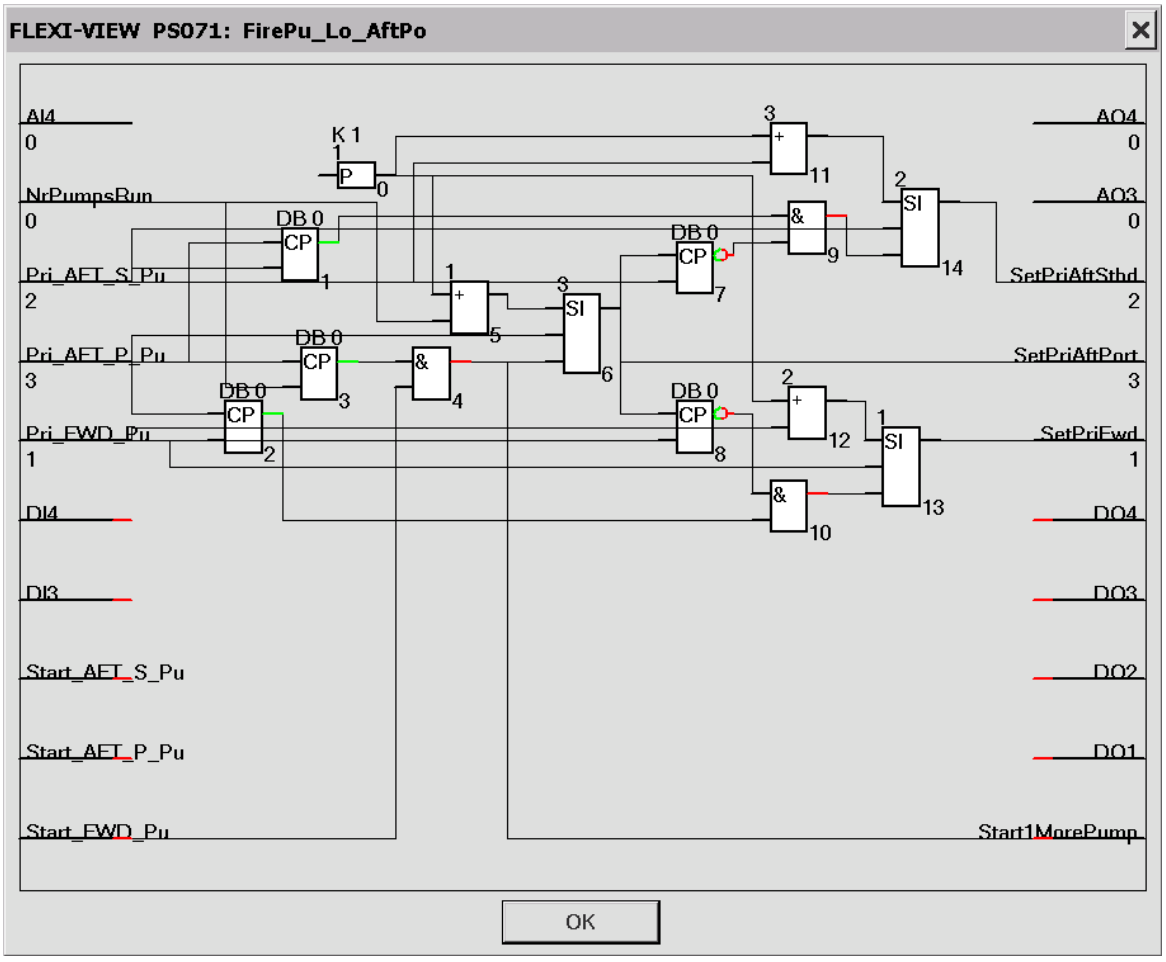
12.1022. AFT Machinery 4th & Floor Deck	12.1023. T06-Cent Stern Thruster Room	12.1024. T06	12.1025. Ventilation Engine & Thruster Room Centre
12.1026. AFT Machinery Upper Deck	12.1027. T06-Cent Stern Thruster Room	12.1028. T06	12.1029. Ventilation Engine & Thruster Room Centre

12.1029.1. Fire Pump logic

The fire pump logic is configured using several PLC-modules and a dutystby module. The following PLC-modules are used:

FirePu_Lo_AftPo, “Logic for start of Fire Pumps”



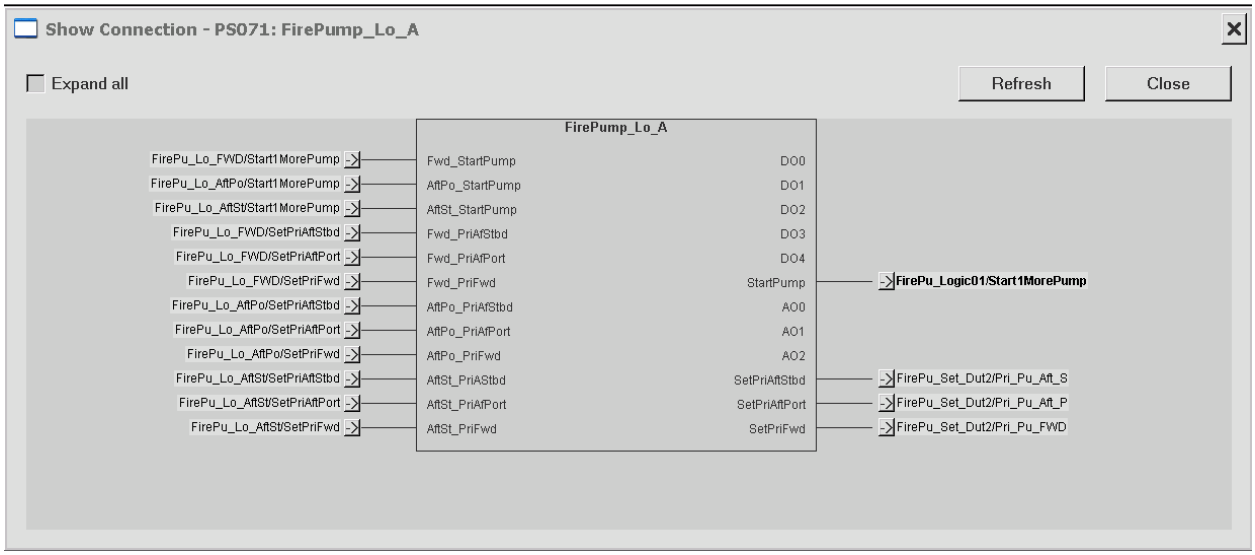


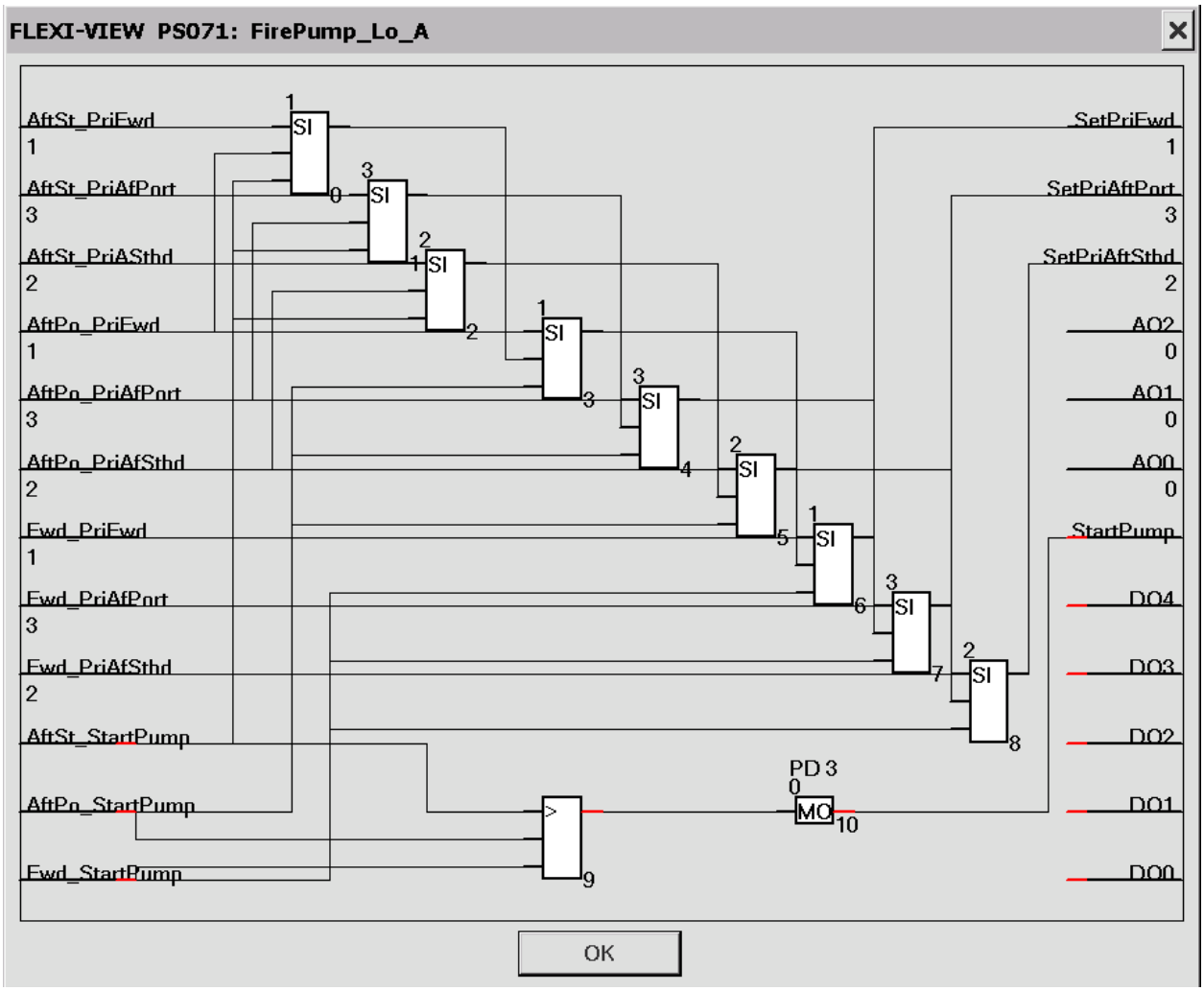
This logic is for start of the AFT PS Fire Pump from a Push Button. This function is not applicable in this project. (But was mentioned in the FDS from customer).

FirePu_Lo_AftSt, “Logic for start of Fire Pumps” – This PLC have the same functionality as the one above, but for the SFT SB fire pump.

FirePu_Lo_FWD, “Logic for start of Fire Pumps” – This PLC have the same functionality as above, but for the FWD fire pump.

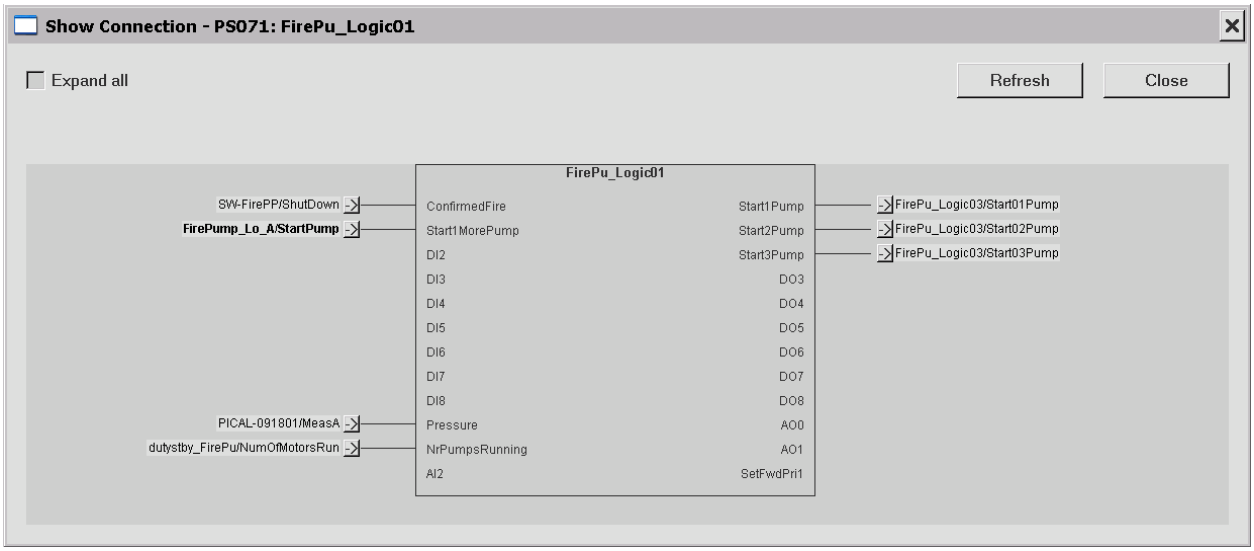
FirePump_Lo_A, “Logic for start of Fire Pumps”

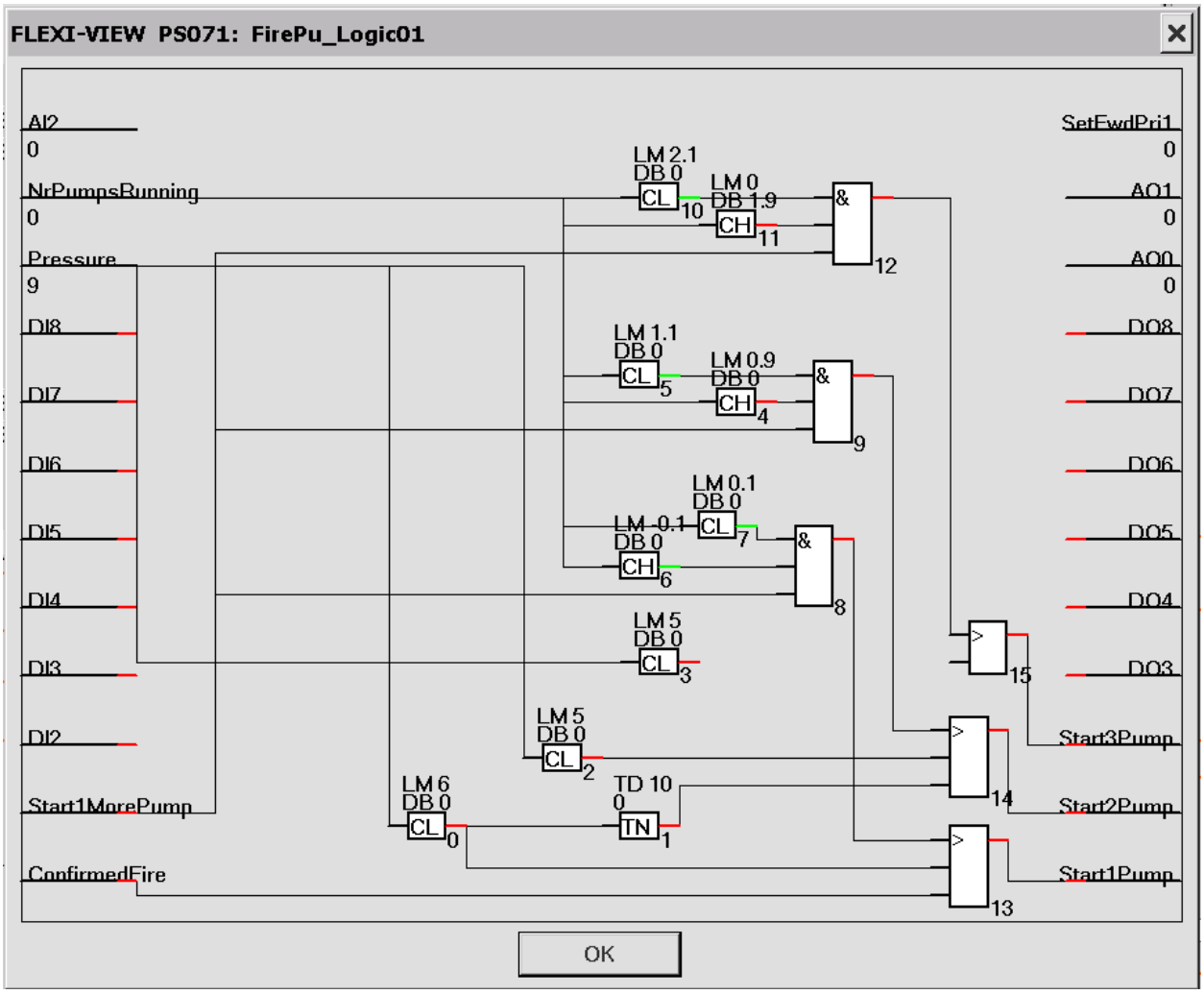




This PLC is shifting the duty priority for the fire pumps according to which pump to start from the push button, and sending a signal to the FirePu_Logic01 PLC to start one more pump. This is part of the logic to start a specific pump from a push button.

FirePu_Logic01, “Control Of Fire Pumps Numer Of Pumps”





This PLC logic is for start of pumps based on confirmed fire and/or pressure limits from the pressure transmitter in the fire ring main.

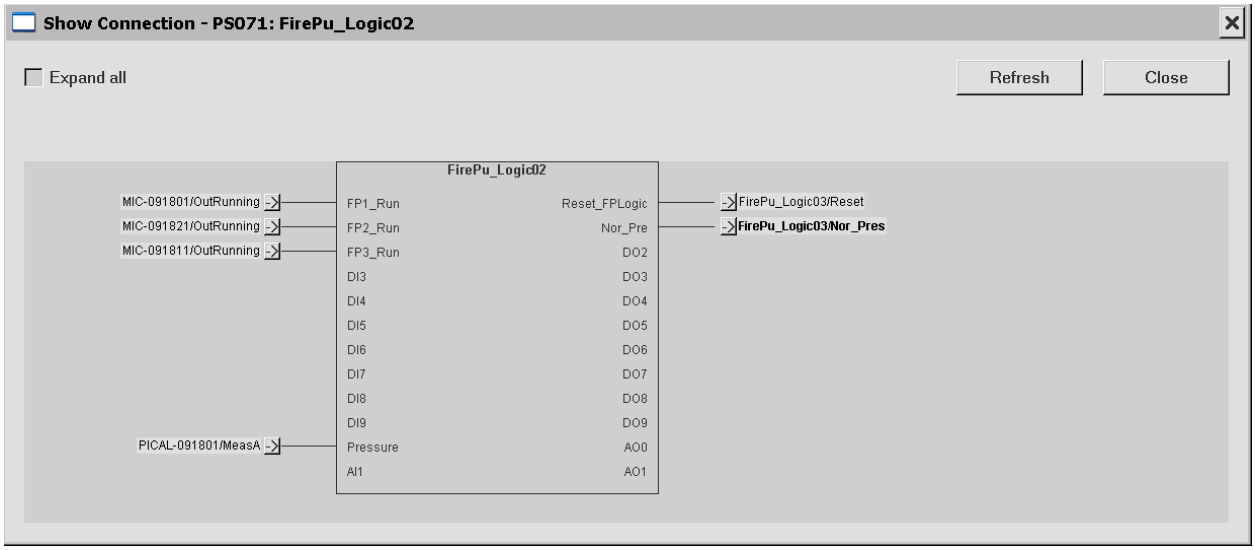
A confirmed fire signals from the C&E's will start one fire pump, the one in duty.

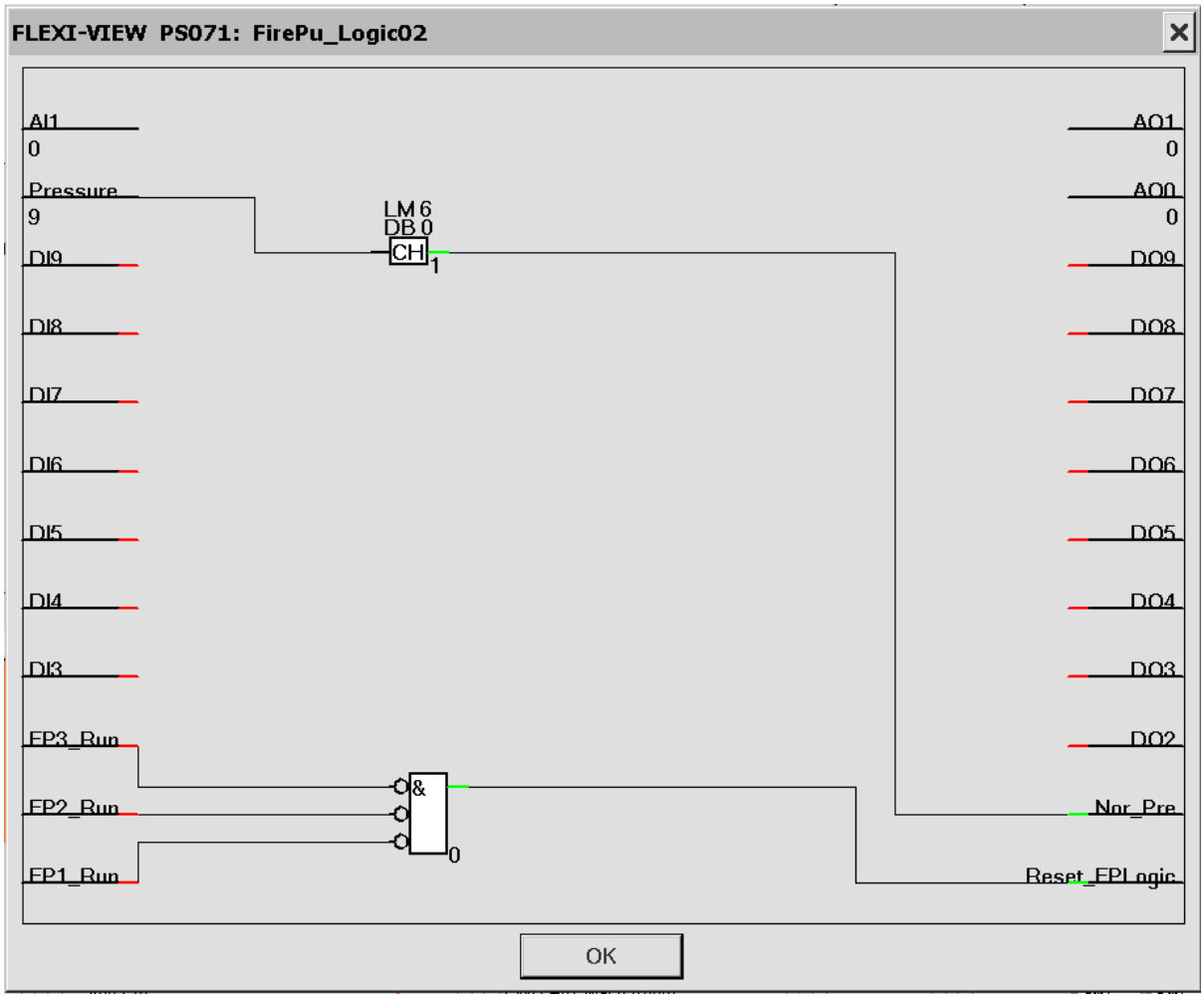
The logic will start one fire pump, the one in duty, if the pressure goes below 6 bars (adjustable). If the pressure is not above 6 bars within 10 seconds (adjustable), the logic will start one more pump, the next in duty.

The logic will start 2 pumps, duty #1 & #2, if the pressure goes below 5 bars.

The logic will start the third pump if activated from the push button.

FirePu_Logic02, “Control Of Fire Pumps Remove Latch”

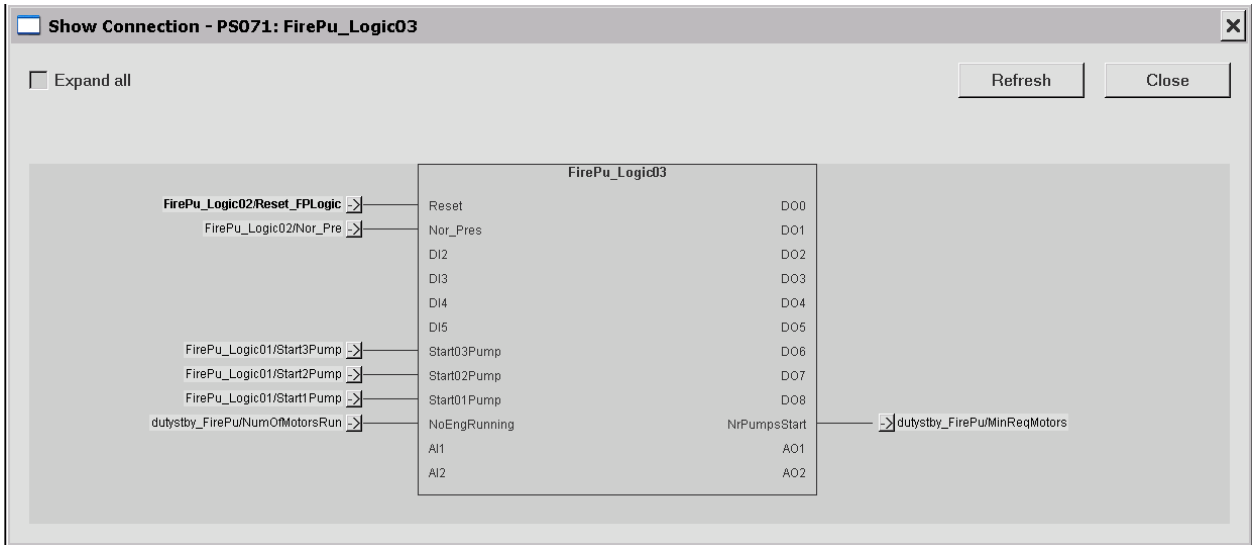


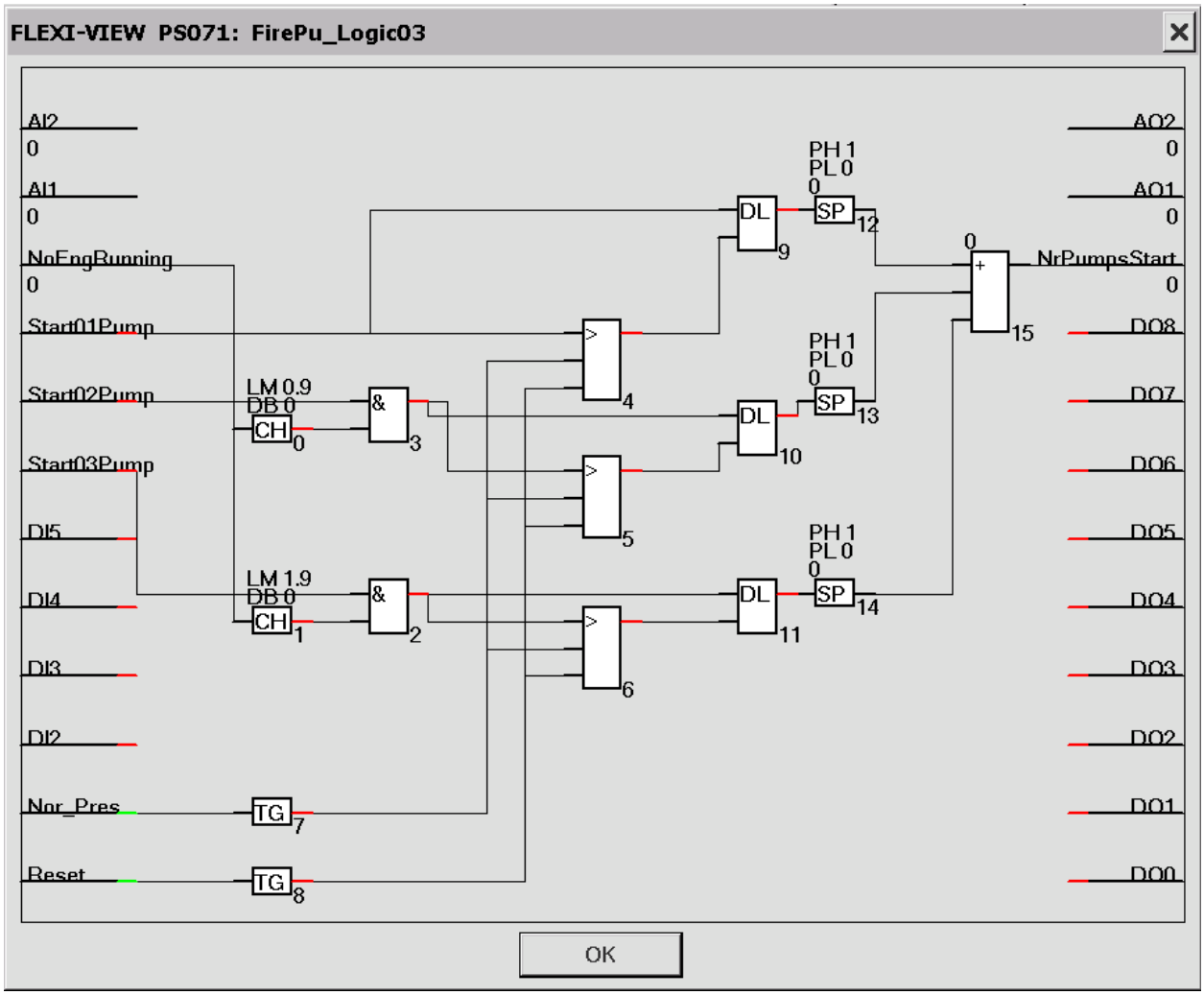


This PLC logic is to reset the number of pumps to start, when all pumps have been set in manual and stopped.

It will also check that the Fire Ring main pressure is above 6 bars.

FirePu_Logic03, “Control Of Fire Pumps”





This PLC logic will set to the dutystdby module how many pumps to start , based on number of pumps which are running, and input from ‘FirePu_Logic01’.

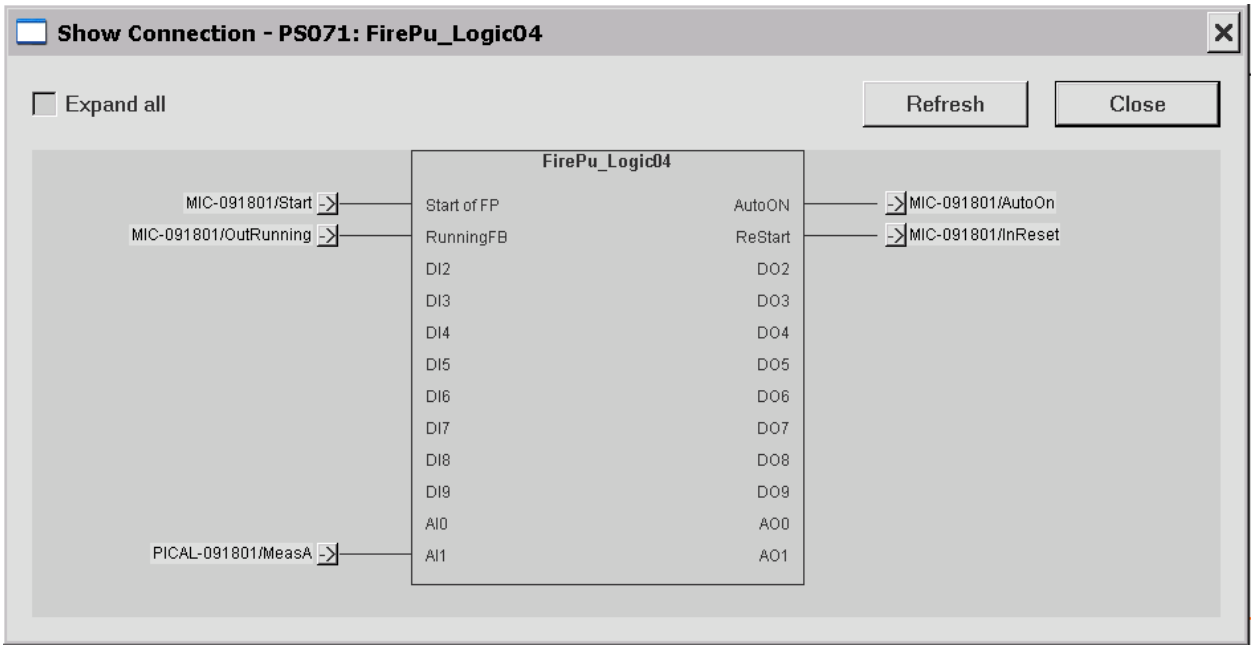
If there is a signal to start 1 pump, the logic will send a signal to start one pump. If the dutystdby module can not start the first pump in duty, it will try to start the other pumps when the first one in duty have failed.

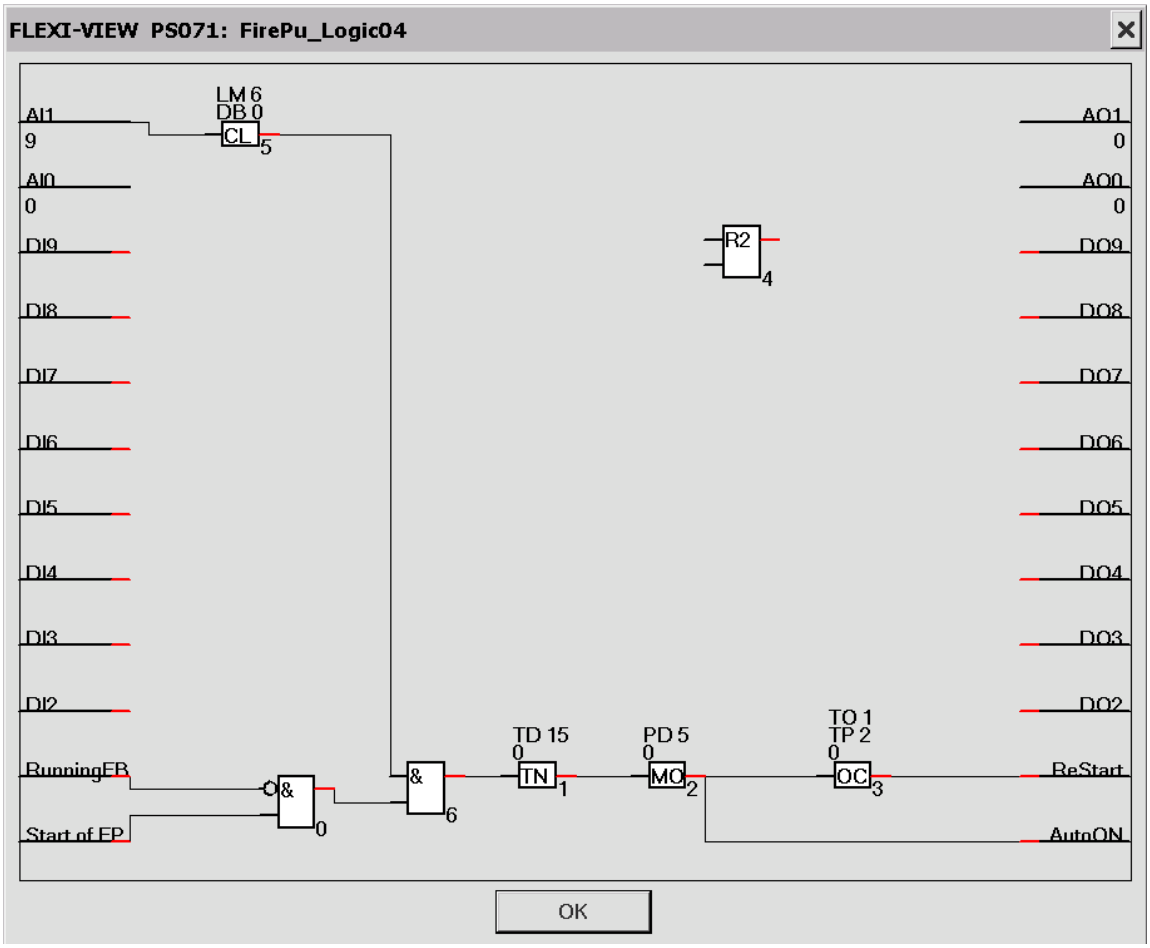
If there are a signal to start two pumps, a signal to start two pumps are sent when one pump is running.

If there are a signal to start three pumps, a signal to start three pumps are sent when two pumps are running.

If the signals to start pumps are gone, the logic will reset the dutystandby logic (set number of pumps to start = 0) if all three pumps are set to manual and stopped OR the pressure in fire ring main is normalized.

FirePu_Logic04, “Logic for 1 automatic restart of main Fire Pump”

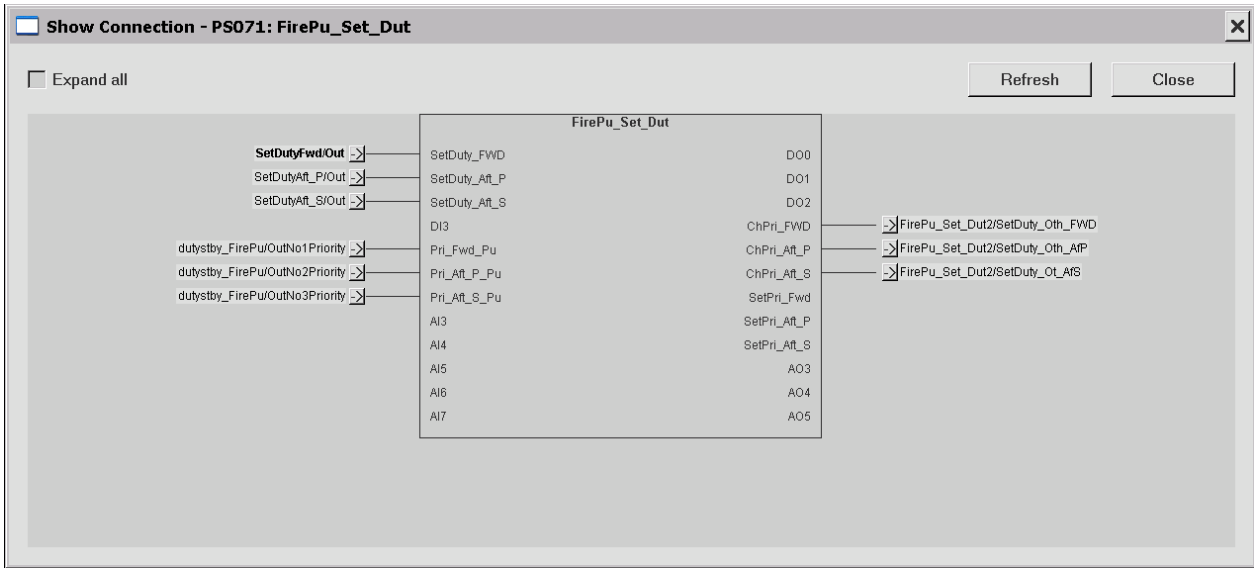


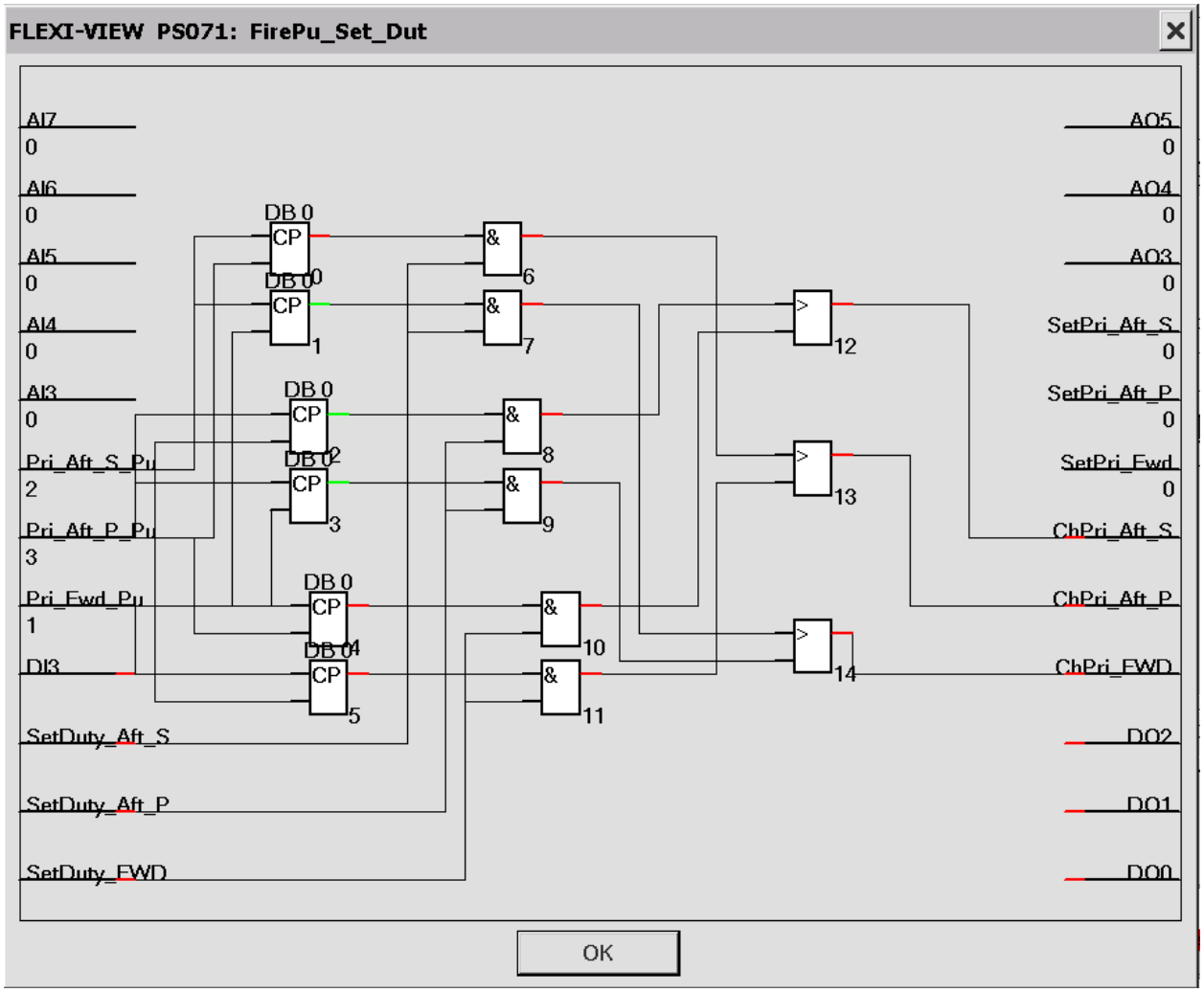


This PLC will try to restart the FWD fire pump once, if the dutystdby logic have tried to start the pump AND the pressure in the Fire Ring Main is below 6 bars.

The logic will give a pulse on the AutoOn and InReset terminals of the FWD fire pump module if the above mentioned criteria’s are met.

FirePu_Set_Dut, “Logic for setting Fire Pump priority”





This PLC logic is setting the duty priority for the three Fire Pumps, according to the manin_d modules in the Fire Pump mimic, and what priority the pumps currently have.

If for example the manin_d button for setting AFT SB pump in duty is activated, the logic will check if the pump is already the first in duty. If the pump is already first in duty, the logic will not do anything more.

If the pump is number 2 or 3 in duty, a signal will be sent to the PLC 'FirePu_Set_Dut2' to change the two other pump duty number.

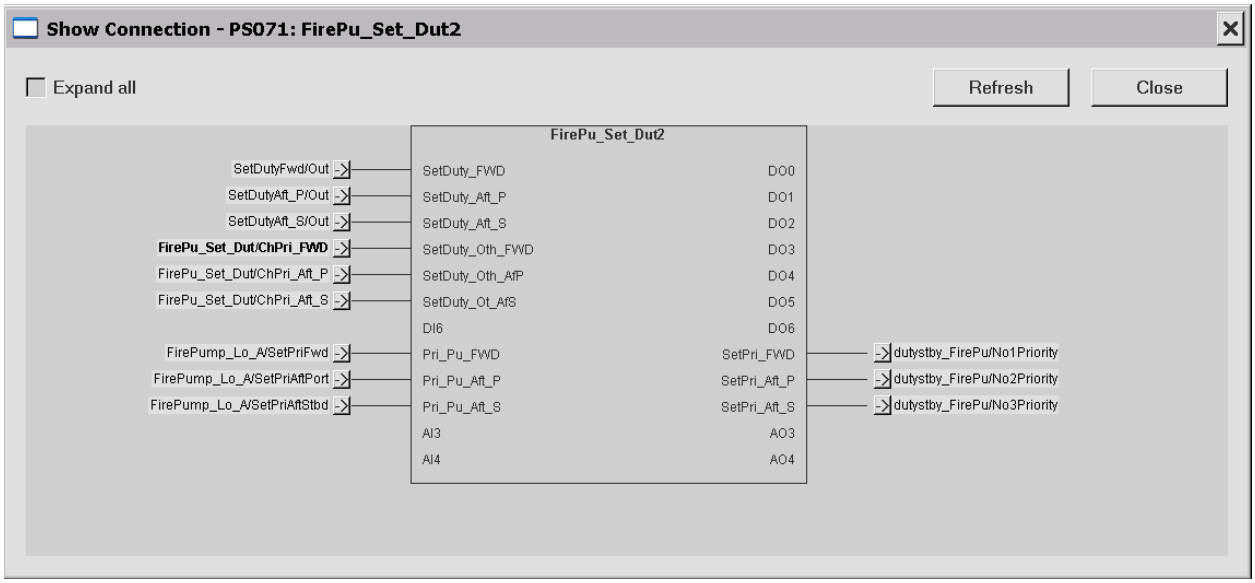
Each pump have two Comp-I modules, which checks if the priority on it's pump is higher or lower than the other pumps.

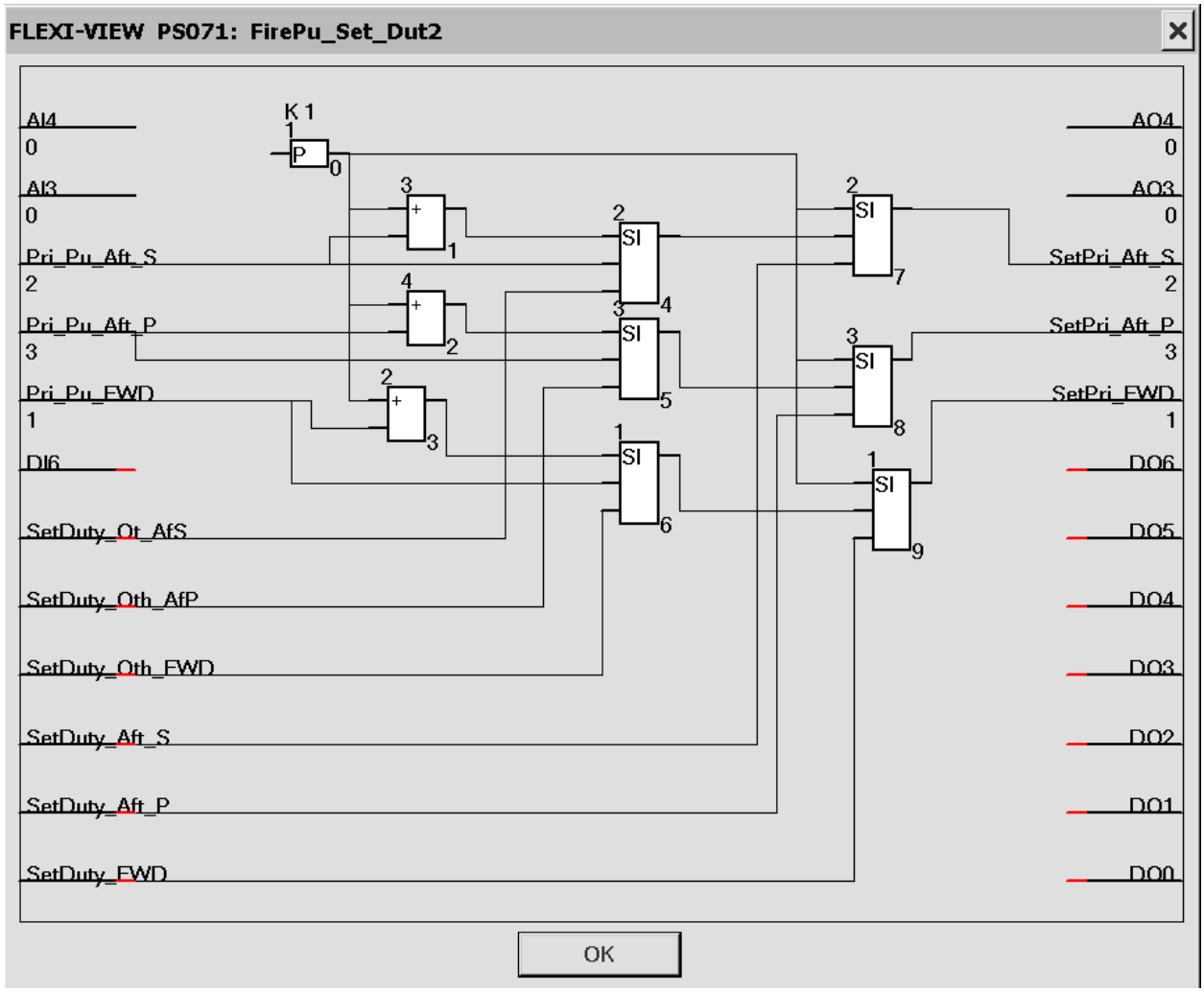
If the other pumps have a higher priority number than itself, the comp-I modules will give a positive output.

If the manin_d button to set the pump in duty is activated, it will send a signal to the AND modules which will send a signal to change the priority of the other two pumps, IF they have a lower duty number (at least one will).

Example: If FWD pump is duty 1, AFT PS pump is duty 2 and AFT SB pumps is duty 3. If the button is activated to set AFT SB pump to first duty, a signal is sent to the PLC 'FirePu_SetDut2', on terminal 'ChPri_FWD' (since FWD have pri 1, it must change to Pri 2).

FirePu_Set_Dut2, “Logic for setting Fire Pump priority”





This PLC logic will change the duty sequence of the 3 Fire Pumps, based on the signal from ‘FirePu_Set_Dut2’.

The SEL-INP modules 7, 8 & 9 will set the duty to one from the Par module if the manin_d module for setting the pump in duty 1 is activated.

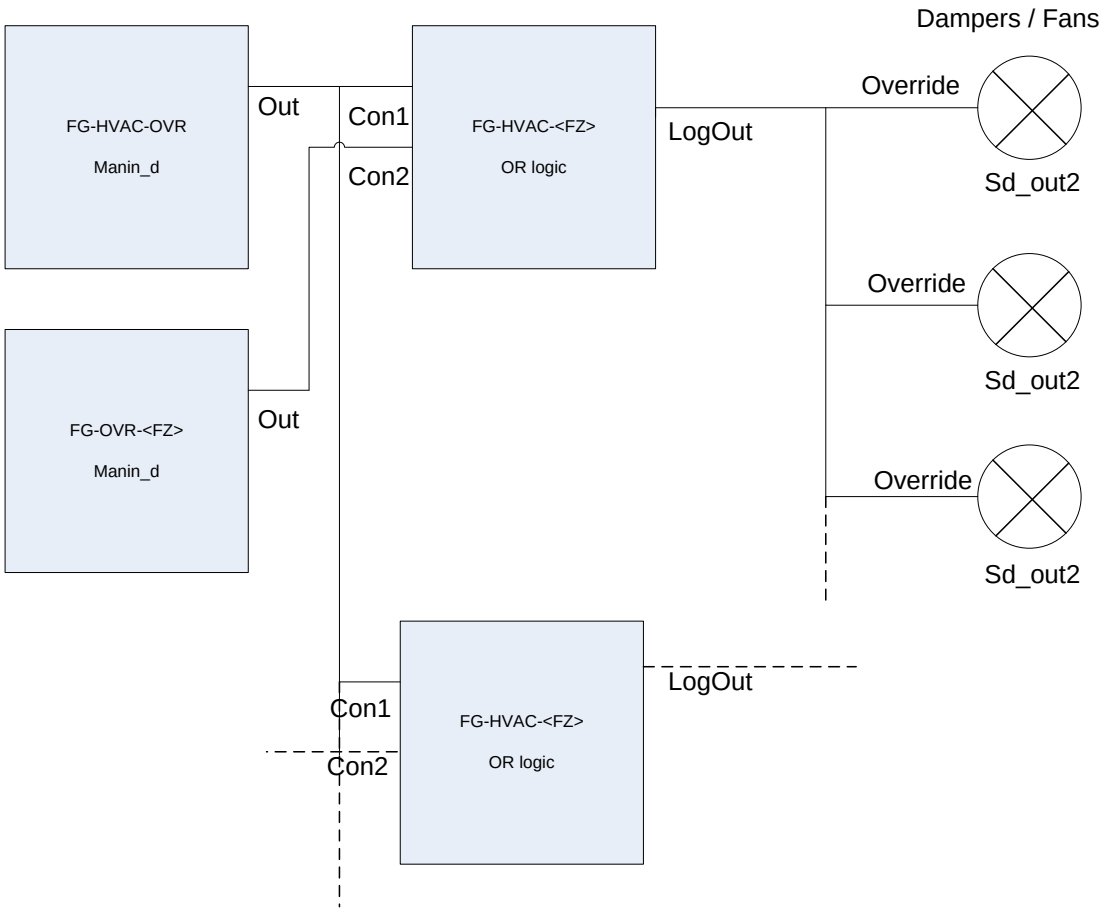
The SEL-INP modules 1, 2 & 3 will set the duty priority to it’s current + 1, if a signal to change duty priority is received from the ‘FirePu_Set_Dut’ PLC.

When the pulse to change the priorities from the manin_d / ‘FirePu_Set_Dut’ module is gone, the PLC will be reading the changed priority from the dutystdby module.

12.1029.2. Manual Shutdown of Accommodation Ventilation Mode

On the F&G Main mimic, there is a manin_d button for manual shutdown of Accommodation Ventilation. The user must be logged in as Chief or Captain to be able to toggle this button. The button will override the automatic shutdown of the ventilation in the accommodation, **leaving it up to the operator to do manual shutdown of the ventilation as needed.**

The button is connected to one OR module per affected Fire Zone, with this syntax; FG-HVAC-<FZ>



Under is the list of the fans & dampers overridden from automatic shutdown from C&E when the Manual ShutDown of Accommodation Ventilation Mode is activated.

List of damper & fan shutdowns that must be shut down by the operator in ‘Manual ShutDown of Accommodation Ventilation’ mode:

12.10	12.10	12.1032.Tag	12.1033.C&E Description
12.1034.	12.1035.	12.1036.XC-123106+H02	12.1037.Stop Battery Rm 1 Exh Fan
12.1038.	12.1039.	12.1040.NCC-123239+H02	12.1041.Battery Rm 1 Natural Supply Damper Close
12.1042.	12.1043.	12.1044.NCC-123240+H02	12.1045.Battery Rm 1 Exh Damper Close
12.1046.	12.1047.	12.1048.NCC-123241+H03	12.1049.Battery Rm 2 Natural Supply Damper Close
12.1050.	12.1051.	12.1052.NCC-123242+H03	12.1053.Battery Rm 2 Exh Damper Close
12.1054.	12.1055.	12.1056.XC-123106A+H03	12.1057.Stop Battery Rm 2 Exh Fan
12.1058.	12.1059.	12.1060.NCC-123289+H04	12.1061.Heli Dk Main Supply Damper Close

12.10	12.10	12.1032.Tag	12.1033.C&E Description
12.1062.	12.1063.	12.1064.NCC-123244+H04	12.1065.Elec Equip Rm Exh Damper Close
12.1066.	12.1067.	12.1068.NCC-123289+H05	12.1069.Heli Dk Main Supply Damper Close
12.1070.	12.1071.	12.1072.NCC-123243+H05	12.1073.Safety Equipment Rm Exh Damper Close
12.1074.	12.1075.	12.1076.NCC-123287+H06	12.1077.Heli Lounge Exh Damper Close
12.1078.	12.1079.	12.1080.NCC-123289+H06	12.1081.Heli Dk Main Supply Damper Close
12.1082.	12.1083.	12.1084.NCC-123233+H06	12.1085.Sanitary Exh Fan Damper Close (Port)
12.1086.	12.1087.	12.1088.NCC-123291+H06	12.1089.Sanitary Exh Fan Damper Close (Stbd)
12.1090.	12.1091.	12.1092.NCC-123272+L01	12.1093.1st Dk Main Supply Damper Close

12.10	12.10	12.1032.Tag	12.1033.C&E Description
12.1094.	12.1095.	12.1096.NCC-123273+L01	12.1097.1st Deck Main Return Damper Close
12.1098.	12.1099.	12.1100.NCC-123274+L01	12.1101.1st Deck Sanitary Exhaust Damper Close
12.1102.	12.1103.	12.1104.NCC-123263+L01	12.1105.Laundry Supply Damper Close In 1st Deck
12.1106.	12.1107.	12.1108.NCC-123204+L02	12.1109.Upp Dk Main Supply Damper Close
12.1110.	12.1111.	12.1112.NCC-123205+L02	12.1113.Upp Dk Main Return Damper Close
12.1114.	12.1115.	12.1116.XC-123102+L02	12.1117.Stop Dry Provision Exh Fan
12.1118.	12.1119.	12.1120.NCC-123207+L02	12.1121.Dry Provision Exh Damper Close
12.1122.	12.1123.	12.1124.NCC-123215+L03	12.1125.A Dk Main Supply Damper Close

12.10	12.10	12.1032.Tag	12.1033.C&E Description
12.1126.	12.1127.	12.1128.NCC-123216+L03	12.1129.A Dk Main Return Damper Close
12.1130.	12.1131.	12.1132.XC-123102A+L03	12.1133.Stop Recreation Rm(Smoker), Hospital Exh. Fan
12.1134.	12.1135.	12.1136.NCC-123294+L03	12.1137.Recreation Rm Exh Fan Damper Close
12.1138.	12.1139.	12.1140.NCC-123295+L03	12.1141.Hospital Exh Fan Damper Close
12.1142.	12.1143.	12.1144.NCC-123217+L04	12.1145.B Dk Main Supply Damper Close
12.1146.	12.1147.	12.1148.NCC-123218+L04	12.1149.B Dk Main Return Damper Close
12.1150.	12.1151.	12.1152.NCC-123225+L05	12.1153.C Dk Main Supply Damper Close
12.1154.	12.1155.	12.1156.NCC-123226+L05	12.1157.C Dk Main Return Damper Close

12.10	12.10	12.1032.Tag	12.1033.C&E Description
12.1158.	12.1159.	12.1160.NCC-123227+L06	12.1161.D Dk Main Supply Damper Close
12.1162.	12.1163.	12.1164.NCC-123228+L06	12.1165.D Dk Main Return Damper Close
12.1166.	12.1167.	12.1168.NCC-123285+L07	12.1169.E Dk Main Supply Damper Close
12.1170.	12.1171.	12.1172.NCC-123286+L07	12.1173.E Dk Main Return Damper Close
12.1174.	12.1175.	12.1176.XC-123102+L08	12.1177.Stop Dry Provision Exh Fan
12.1178.	12.1179.	12.1180.XC-123108+L08	12.1181.Stop No.1 & No.2 Galley Ahu
12.1182.	12.1183.	12.1184.NCC-123222+L08	12.1185.B DK Galley Mech. Supply Fan Damper Close(Air Intake)
12.1186.	12.1187.	12.1188.NCC-123210+L08	12.1189.Galley Mach Supp Damper Close(In Galley)

12.10	12.10	12.1032.Tag	12.1033.C&E Description
12.1190.	12.1191.	12.1192.NCC-123212+L08	12.1193.Galley Mach Exh Damper Close(In Galley)
12.1194.	12.1195.	12.1196.NCC-123223+L08	12.1197.B DK Galley Extract Fan Damper Close
12.1198.	12.1199.	12.1200.NCC-123211+L08	12.1201.Galley AHU Supply Damper Close
12.1202.	12.1203.	12.1204.XC-123103+L08	12.1205.Stop Galley Supply Fan
12.1206.	12.1207.	12.1208.XC-123103A+L08	12.1209.Stop Galley Exh Fan
12.1210.	12.1211.	12.1212.NCC-123296+L09	12.1213.Accom Stair Ways Nat Exhaust Damper Close
12.1214.	12.1215.	12.1216.XC-123110A+L10	12.1217.Stop Lift M/C Space Exh Fan
12.1218.	12.1219.	12.1220.NCC-123271+L10	12.1221.Lift Shaft Space Nat. Supply Damper Close

12.10	12.10	12.1032.Tag	12.1033.C&E Description
12.1222.	12.1223.	12.1224.NCC-123232+L10	12.1225.Lift Shaft Space Exh Damper Close
12.1226.	12.1227.	12.1228.NCC-123297+L11	12.1229.Close El. Trunk Nat EXH Damper
12.1230.	12.1231.	12.1232.NCC-123298+L12	12.1233.Pipe & El. Trunk Nat. Exh Dampr Close
12.1234.	12.1235.	12.1236.NCC-123285+L15	12.1237.E Dk Main Supply Damper Close
12.1238.	12.1239.	12.1240.NCC-123286+L15	12.1241.E Dk Main Return Damper Close
12.1242.	12.1243.	12.1244.NCC-123250+L15	12.1245.Nav. Inst. Rm Supply Damper Close
12.1246.	12.1247.	12.1248.NCC-123251+L15	12.1249.Nav. Inst. Rm Exhaust Damper Close
12.1250.	12.1251.	12.1252.NCC-123292+L15	12.1253.E-Deck Sanitary Exh Damper Close(P)

12.10	12.10	12.1032.Tag	12.1033.C&E Description
12.1254.	12.1255.	12.1256.NCC-123285+L16	12.1257.E Dk Main Supply Damper Close
12.1258.	12.1259.	12.1260.NCC-123286+L16	12.1261.E Dk Main Return Damper Close
12.1262.	12.1263.	12.1264.NCC-123281+L16	12.1265.DP Backup Rm Supply Damper Close
12.1266.	12.1267.	12.1268.NCC-123280+L16	12.1269.DP Backup Rm Exhaust Damper Close
12.1270.	12.1271.	12.1272.NCC-123293+L16	12.1273.E-Deck Sanitary Exh Damper Close(S)
12.1274.	12.1275.	12.1276.NCC-123261+M01	12.1277.Lift Pulley Space Supply Damper Close
12.1278.	12.1279.	12.1280.NCC-123262+M01	12.1281.AHU Room Exh Damper Close
12.1282.	12.1283.	12.1284.NCC-123201+M01	12.1285.AHU Rm Fresh Air Intake Damper Close

12.10	12.10	12.1032.Tag	12.1033.C&E Description
12.1286.	12.1287.	12.1288.NCC-123203+M01	12.1289.Air Con Return/Exh Damper Close
12.1290.	12.1291.	12.1292.NCC-123214+M01	12.1293.A DK Galley AHU Fresh Air Intake Damper Close
12.1294.	12.1295.	12.1296.NCC-123283+N01	12.1297.Nav Dk Main Air Con Supply Damper Close
12.1298.	12.1299.	12.1300.NCC-123284+N01	12.1301.Nav Dk Main Air Con Return Damper Close
12.1302.	12.1303.	12.1304.NCC-123236+N02	12.1305.W/H Main Air Con Supply Damper Close
12.1306.	12.1307.	12.1308.NCC-123234+N02	12.1309.W/H Exh Damper Close Port Side
12.1310.	12.1311.	12.1312.NCC-123235+N02	12.1313.W/H Exh Damper Close Stbd Side
12.1314.	12.1315.	12.1316.NCC-123204+S01	12.1317.Upp Dk Main Supply Damper Close

12.10	12.10	12.1032.Tag	12.1033.C&E Description
12.1318.	12.1319.	12.1320.NCC-123205+S01	12.1321.Upp Dk Main Return Damper Close
12.1322.	12.1323.	12.1324.XC-123102+S01	12.1325.Stop Dry Provision Exh Fan
12.1326.	12.1327.	12.1328.NCC-123207+S01	12.1329.Dry Provision Exh Damper Close
12.1330.	12.1331.	12.1332.NCC-123279+S03	12.1333.Close Emcy Gen Rm Supply Damper
12.1334.	12.1335.	12.1336.XC-123107+S03	12.1337.Stop Emcy Generator Room Vent Fan

12.1337.1. Fire Zones

Fire Zone Code	Description	Loop:	Fire Central:	Node no
A01	FWD Port HPR Compartment			71
A02	FWD STBD HPR Compartment			71
A03	AFT Port HPR Compartment			71
A04	AFT STBD HPR Compartment			71
B01	Bulk Tank Area	Loop 9	FC2	71
C01	Incinerator Room	Loop 8	FC2	73
E01	Port Engine Room	Loop 6	FC1	73
E02	Cent Engine Room	Loop 7	FC2	73
E03	STBD Engine Room	Loop 8	FC2	73
E11	Port Purifier Room	Loop 6	FC1	73
E12	STBD Purifier Room	Loop 8	FC2	73
E21	Engine Control Room	Loop 7	FC2	73
E31	MSB Room (Port)	Loop 6	FC1	73
E32	MSB Room (Cent)	Loop 7	FC2	73
E33	MSB Room (STBD)	Loop 8	FC2	73
F01	Bosun Store	Loop 5	FC1	71
G01	Paint and Chemical Store	Loop 6	FC1	71
G02	Oxygen and Acetylene Room	Loop 6	FC1	72
H01	Helicopter Deck	Loop 1	FC1	73
H02	Battery Room – I	Loop 1	FC1	71
H03	Battery Room – II	Loop 1	FC1	71
H04	Electrical Equipment Room	Loop 1	FC1	71

Fire Zone Code	Description	Loop:	Fire Central:	Node no
H05	Safety Equipment Room	Loop 1	FC1	71
H06	Heli Lounge / Training Room / Movie Room	Loop 1	FC1	71
J01	Agitator Room	Loop 9	FC2	71
K01	FWD Port Secondary Escape Way	Loop 6	FC1	71
K02	FWD STBD Secondary Escape Way	Loop 8	FC2	71
K03	AFT Port Secondary Escape Way	Loop 6	FC1	71
K04	AFT STBD Secondary Escape Way	Loop 8	FC2	71
L01	Accommodation Deck (1st Deck)	Loop 4	FC1	71
L02	Accommodation Deck (Upper Deck)	Loop 4	FC1	71
L03	Accommodation Deck (A-Deck)	Loop 3	FC1	71
L04	Accommodation Deck (B-Deck)	Loop 3	FC1	72
L05	Accommodation Deck (C-Deck)	Loop 2	FC1	72
L06	Accommodation Deck (D-Deck)	Loop 2	FC1	72
L07	Accommodation Deck (E-Deck)	Loop 1	FC1	72
L08	Galley	Loop 3 & 4	FC1	71
L09	Accommodation Stair Ways	Loop 1, 2, 3 & 4	FC1	71
L10	Accommodation Lift Trunk & Machinery Room	Loop 1	FC1	71
L11	Accommodation Electrical Cable Trunk (P)	Loop 1, 2, 3 & 4	FC1	71
L12	Accommodation Electrical Cable Trunk (S)	Loop 1, 2, 3 & 4	FC1	71
L13	Accommodation Electrical Cable Trunk E-Deck	Loop 1	FC1	72
L14	Accommodation P/D Trunk	Loop 1, 2, 3 & 4	FC1	72

Fire Zone Code	Description	Loop:	Fire Central:	Node no
L15	Navigation Instrument room	Loop 1	FC1	71
L16	DP Backup Room	Loop 1	FC1	71
M01	AHU Room	Loop 3 & 5	FC1	71
M02	Fwd Aux. Mach Room	Loop 5	FC1	71
M03	Hydraulic Power Pack Room	Loop 8	FC2	71
M04	Funnel casing Port & STBD	Loop 6 & 8	FC1 & FC2	72
N01	Navigation Deck	Loop 1	FC1	71
N02	Wheelhouse	Loop 1	FC1	71
O01	General Store	Loop 5	FC1	72
O02	Rope Store	Loop 6	FC1	71
P01	Ballast Pump Room	Loop 7	FC2	71
S01	Fire Control Station	Loop 4	FC1	71
S02	Water Mist / Inergen Room	Loop 4	FC1	71
S03	Emergency Generator Room	Loop 12	FC2	73
T01	Center Bow Thruster Room	Loop 5	FC1	73
T02	Port Bow Thruster Room	Loop 5	FC1	73
T03	STBD Bow Thruster Room	Loop 5	FC1	73
T04	Port Stern Thruster Room	Loop 6	FC1	73
T05	STBD Stern Thruster Room	Loop 8	FC2	73
T06	Center Stern Thruster Room	Loop 7	FC2	73
WD	Weather Deck			71
D31	Drill Floor & Derrick	Loop 11	FC2	72
D32	Driller's Cabin / LER/TDCR	Loop 11	FC2	72
D34	Riser storage general area	Loop 11	FC2	72
D35	BOP/Moonpool area	Loop 9 & 11	FC2	72
D36	Drillpipe / Casing storage area	Loop 9	FC2	72

Fire Zone Code	Description	Loop:	Fire Central:	Node no
D37A	Sub sea Workshop EL 30420	Loop 11	FC2	72
D37B	APV Room EL 27260	Loop 11	FC2	72
D37C	BOP Equipment Room EL 23000	Loop 11	FC2	72
D37D	Main HPU Room EL23000	Loop 11	FC2	72
D38	Mud Lab	Loop 9	FC2	72
D39	Shale shaker area	Loop 11	FC2	72
D40	Drilling Swgr room	Loop 9 & 10	FC2	72
D41	Sack storage area	Loop 9 & 10	FC2	72
D42	Cementer room	Loop 9 & 10	FC2	72
D43	Extended well test area	Loop 11	FC2	72
D46	Mud tank area	Loop 9	FC2	72
D47	Mud pump area	Loop 9	FC2	72
D48	Workshop & Stores	Loop 9	FC2	72
D49	Drilling welding workshop	Loop 11	FC2	72
D50	HVAC Plantroom	Loop 9	FC2	72
D51	Cutting Transport area	Loop 11	FC2	72
D52	UPS Room A	Loop 11	FC2	72
D53	UPS Room B	Loop 11	FC2	72
D54	Rubber Good Store	Loop 11	FC2	72
D55	Mud Control Room	Loop 10	FC2	72
D56	Shale Shaker Operator Room	Loop 11	FC2	72
D57	Pod Test Room	Loop 11	FC2	72
D58	Office/Coffee Shop/ET Room & Workshop	Loop 9	FC2	72
HZ	Hazardous Area PS71			71
HZ72	Hazardous Area PS72			72

Fire Zone Code	Description	Loop:	Fire Central:	Node no
HZ73	Hazardous Area PS73			73

Table 12-1: Fire Zones

12.1337.2. Fire central com fault logic and indication

The fire central set-up on this project is 2 fire central panels, one BS and one BC, delivered by Autronica, and 3 F&G nodes. The fire central panels are configured with Autro-Net, which allows the fire central panels to exchange statuses of the detectors between each other. The communication between the fire central panels and the F&G nodes are as follows:

RCU71 / 171 - FC1 (BS)

RCU72 / 172 – FC2 (BC)

RCU73 / 173 – FC1 (BS)

Some detectors in FC1 are configured in PS72, and will need FC2 to transfer the status from FC1. The same is valid for PS71/FC2 and PS73/FC2 also.

If a fire central panel is not communicating with the PS, it will be alarmed on the sfc_fc module, and the sfc_dl and sfc_pt modules will get the status 'follow fault' which will not be alarmed to prevent a rush of alarms, but will indicate that the module is not communicating with a '!' on the tagmark and red color.

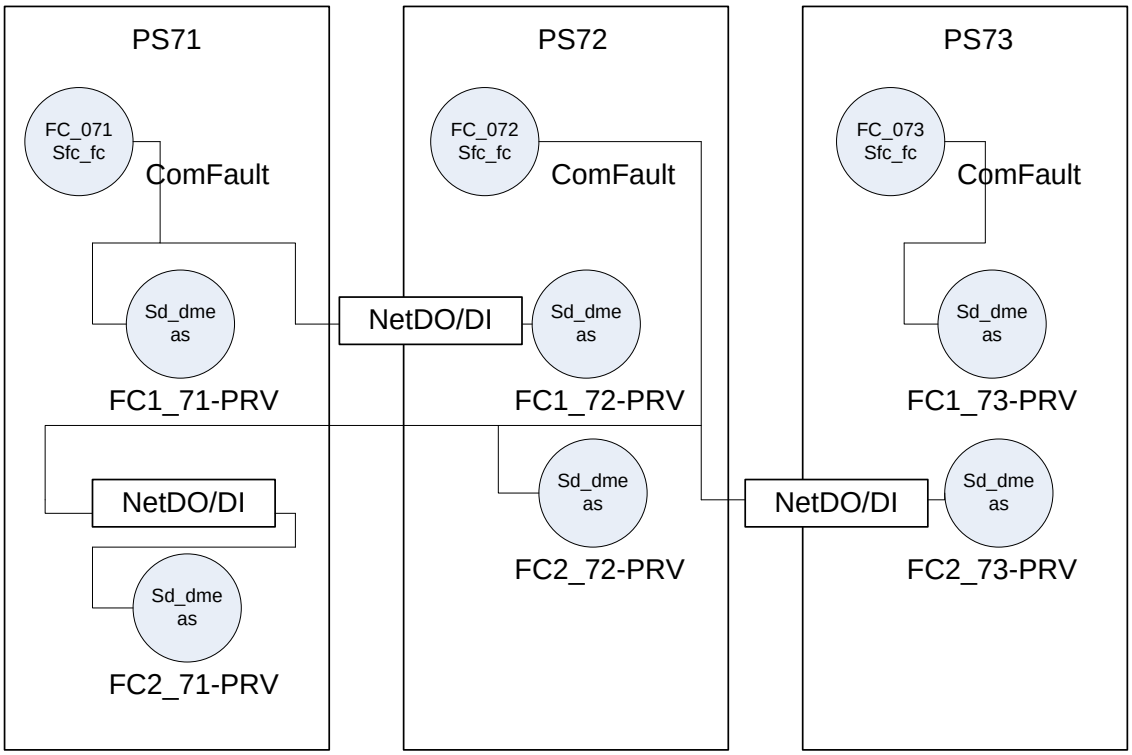
To make it easier for the operator to see which areas and FZ's are affected by a fire central panel not communicating, we have used the following solution:

Each F&G node needs one sd_dmeas module collecting the status of the ComFault status of each FC (1 & 2). There are on module group for each fire central panel, including one sd_dmeas module for each PS:

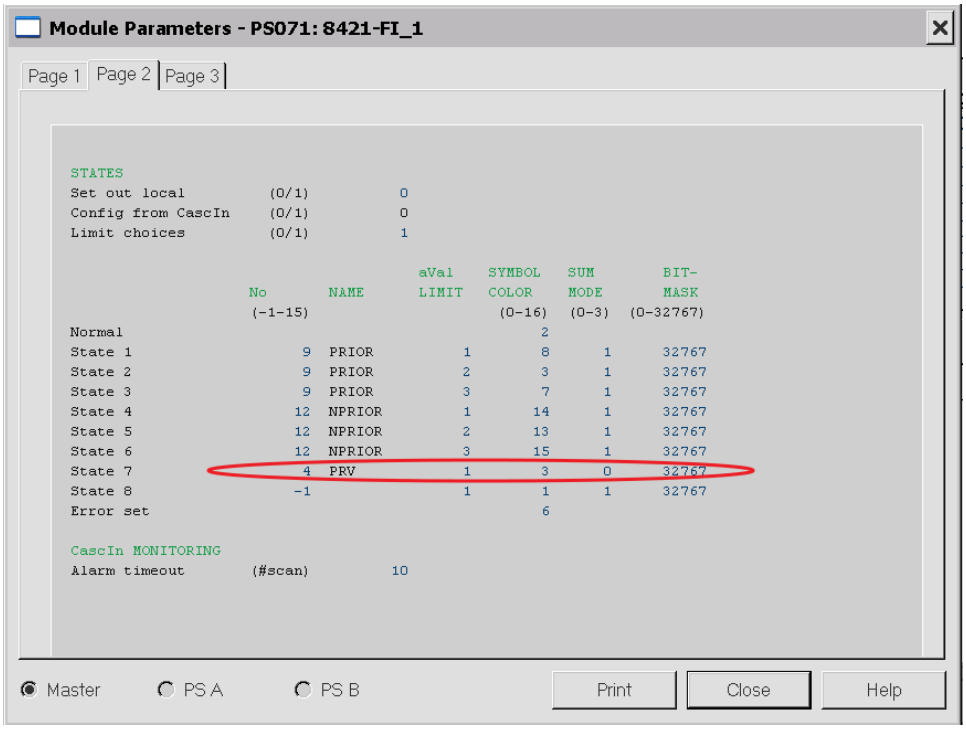
FC1-Comfault, including the modules: FC1_71-PRV, FC1_72-PRV & FC1_73-PRV.

FC2-Comfault, including the modules: FC2_71-PRV, FC2_72-PRV & FC2_73-PRV.

See the drawing on the next page.



Each of the modgrp_st modules for Fire and Manual Call Points have added a line in parameter page 2 for showing the PRV value from the sd_dmeas modules, indicating that the area is affected by the com fault on the fire central panel.



All modgrp_st modules including detectors from FC1 have the module group FC1-ComFault number, and all modgrp_st modules including detectors from FC2 have the module group FC2-ComFault number. The list in the next section is used to determine which modgrp_st module shall present the com fault status of which FC.

12.1337.3. FZ affected if one fire central is not communicational

Fire Central down:	FZ affected:	Comment:
FC1	E01	
FC1	E11	
FC1	E31	
FC1	F01	
FC1	G01	
FC1	G02	
FC1	H01	
FC1	H02	
FC1	H03	
FC1	H04	
FC1	H05	
FC1	H06	
FC1	K01	
FC1	K03	
FC1	L01	
FC1	L02	
FC1	L03	
FC1	L04	
FC1	L05	
FC1	L06	
FC1	L07	

Fire Central down:	FZ affected:	Comment:
FC1	L08	
FC1	L09	
FC1	L10	
FC1	L11	
FC1	L12	
FC1	L13	
FC1	L14	
FC1	L15	
FC1	L16	
FC1	M02	
FC1	N01	
FC1	N02	
FC1	O01	
FC1	O02	
FC1	S01	
FC1	S02	
FC1	T01	
FC1	T02	
FC1	T03	
FC1	T04	
FC2	B01	
FC2	C01	
FC2	D31	

Fire Central down:	FZ affected:	Comment:
FC2	D32	
FC2	D34	
FC2	D35	
FC2	D36	
FC2	D38	
FC2	D39	
FC2	D3A	
FC2	D3B	
FC2	D3C	
FC2	D3D	
FC2	D40	
FC2	D41	
FC2	D42	
FC2	D43	
FC2	D46	
FC2	D47	
FC2	D48	
FC2	D49	
FC2	D50	
FC2	D51	
FC2	D52	
FC2	D53	
FC2	D54	

Fire Central down:	FZ affected:	Comment:
FC2	D55	
FC2	D56	
FC2	D57	
FC2	D58	
FC2	E02	
FC2	E03	
FC2	E12	
FC2	E21	
FC2	E32	
FC2	E33	
FC2	J01	
FC2	K02	
FC2	K04	
FC2	M03	
FC2	P01	
FC2	S03	
FC2	T05	
FC2	T06	
FC1 & 2	M01	Covered by both FC's
FC1 & 2	M04	Covered by both FC's

12.1338. Fail Safe settings of network connections

From RCU	From Tag	From SW module	Terminal	To RCU	To Tag	To SW module	Fail Safe Setting	Red Vote
73	SW-LFF-Res	manin_d	Out	71	XSW-LFF-Res-71	sd_dmeas	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D31	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D32	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D34	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D35	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D36	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D3A	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D3B	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D3C	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D3D	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D38	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D39	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D40	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D41	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D42	logic	-1 (Freeze)	1

From RCU	From Tag	From SW module	Terminal	To RCU	To Tag	To SW module	Fail Safe Setting	Red Vote
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D43	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D46	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D47	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D48	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D49	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D50	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D51	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D52	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D53	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D54	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D55	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D56	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D57	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-D58	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-L07	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-L04	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-L13	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-L14	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-L06	logic	-1 (Freeze)	1

From RCU	From Tag	From SW module	Terminal	To RCU	To Tag	To SW module	Fail Safe Setting	Red Vote
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-G02	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-M04	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-O01	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	72	FG-ACKOR-L05	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D31	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D32	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D34	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D35	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D36	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D3A	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D3B	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D3C	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D3D	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D38	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D39	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D40	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D41	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D42	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D43	logic	-1 (Freeze)	1

From RCU	From Tag	From SW module	Terminal	To RCU	To Tag	To SW module	Fail Safe Setting	Red Vote
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D46	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D47	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D48	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D49	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D50	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D51	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D52	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D53	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D54	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D55	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D56	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D57	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-D58	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-L07	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-L04	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-L13	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-L14	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-L06	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-G02	logic	-1 (Freeze)	1

From RCU	From Tag	From SW module	Terminal	To RCU	To Tag	To SW module	Fail Safe Setting	Red Vote
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-M04	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-O01	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	72	FG-RESOR-L05	logic	-1 (Freeze)	1
71	FG-GLOB-RES	manin_d	Out	72	global_reset_72	global_reset	-1 (Freeze)	1
71	FG-MUTE-FCP	manin_d	Out	72	FC_072	sfc_fc	-1 (Freeze)	1
71	FG-HVAC-OVR	manin_d	Out	72	FG-HVAC-L04	logic	-1 (Freeze)	1
71	FG-HVAC-OVR	manin_d	Out	72	FG-HVAC-L05	logic	-1 (Freeze)	1
71	FG-HVAC-OVR	manin_d	Out	72	FG-HVAC-L06	logic	-1 (Freeze)	1
71	FG-HVAC-OVR	manin_d	Out	72	FG-HVAC-L07	logic	-1 (Freeze)	1
71	FG-GLOB-RES	manin_d	Out	73	global_reset_73	global_reset	-1 (Freeze)	1
71	FG-MUTE-FCP	manin_d	Out	73	FC_073	sfc_fc	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-E01	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-H01	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-E11	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-E02	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-E03	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-E12	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-E21	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-E31	logic	-1 (Freeze)	1

From RCU	From Tag	From SW module	Terminal	To RCU	To Tag	To SW module	Fail Safe Setting	Red Vote
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-E32	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-E33	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-C01	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-S03	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-T01	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-T02	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-T03	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-T04	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-T05	logic	-1 (Freeze)	1
71	FG-ACK-ALL	manin_d	Out	73	FG-ACKOR-T06	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-E01	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-H01	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-E11	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-E02	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-E03	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-E12	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-E21	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-E31	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-E32	logic	-1 (Freeze)	1

From RCU	From Tag	From SW module	Terminal	To RCU	To Tag	To SW module	Fail Safe Setting	Red Vote
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-E33	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-C01	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-S03	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-T01	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-T02	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-T03	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-T04	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-T05	logic	-1 (Freeze)	1
71	FG-RES-ALL	manin_d	Out	73	FG-RESOR-T06	logic	-1 (Freeze)	1
71	FG-HVAC-OVR	manin_d	Out	73	FG-HVAC-S03	logic	-1 (Freeze)	1
71	FG-ACKOR-M02	logic	LogOut	73	FAH-091551	sd_dmeas	-1 (Freeze)	1
71	WC_PS71	algrp_st	AlarmStat	73	WC_OR	logic	-1 (Freeze)	1
72	FG-ACKOR-D40	logic	LogOut	73	HS-126433	sd_dmeas	-1 (Freeze)	1
72	FG-ACKOR-D40	logic	LogOut	73	HS-126311	sd_dmeas	-1 (Freeze)	1
72	FG-ACKOR-D40	logic	LogOut	73	VZO-126433	sd_dmeas	-1 (Freeze)	1
72	FG-ACKOR-D40	logic	LogOut	73	HS-126311A	sd_dmeas	-1 (Freeze)	1
72	FG-ACKOR-D42	logic	LogOut	73	HS-126432	sd_dmeas	-1 (Freeze)	1
72	FG-ACKOR-D42	logic	LogOut	73	HS-126316	sd_dmeas	-1 (Freeze)	1
72	FG-ACKOR-D42	logic	LogOut	73	VZO-126432	sd_dmeas	-1 (Freeze)	1

From RCU	From Tag	From SW module	Terminal	To RCU	To Tag	To SW module	Fail Safe Setting	Red Vote
72	FG-ACKOR-D42	logic	LogOut	73	HS-126316A	sd_dmeas	-1 (Freeze)	1
72	WC_PS72	algrp_st	AlarmStat	73	WC_OR	logic	-1 (Freeze)	1

Table 12-2: Fail Safe settings of safety modules, actions NetDO / DI modules.

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
Sd_out2 connections:								
73	FAH-091551	sd_dmeas	OutStat	71	FG-FF-VOT-M02	fgd_stat2	InStatus1	-1 (Freeze)
73	PAL-126341	sd_dmeas	OutStat	72	FG-IL-VOT-D40	fgd_stat2	InStatus1	-1 (Freeze)
73	PAL-126342	sd_dmeas	OutStat	72	FG-IL-VOT-D40	fgd_stat2	InStatus2	-1 (Freeze)
73	PAL-126343	sd_dmeas	OutStat	72	FG-IL-VOT-D40	fgd_stat2	InStatus3	-1 (Freeze)
73	PAH-126345	sd_dmeas	OutStat	72	FG-IR-VOT-D40	fgd_stat2	InStatus1	-1 (Freeze)
73	VZO-126433	sd_dmeas	OutStat	72	FG-IR-VOT-D40	fgd_stat2	InStatus2	-1 (Freeze)
73	HS-126311	sd_dmeas	OutStat	72	FG-GV-VOT-D40	fgd_stat2	InStatus1	-1 (Freeze)
73	HS-126311A	sd_dmeas	OutStat	72	FG-GV-VOT-D40	fgd_stat2	InStatus2	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
73		sd_dmeas	OutStat	72	FG-IL-VOT-D42	fgd_stat2	InStatus1	-1 (Freeze)
73	PAL-126342	sd_dmeas	OutStat	72	FG-IL-VOT-D42	fgd_stat2	InStatus2	-1 (Freeze)
73	PAL-126343	sd_dmeas	OutStat	72	FG-IL-VOT-D42	fgd_stat2	InStatus3	-1 (Freeze)
73	PAH-126345	sd_dmeas	OutStat	72	FG-IR-VOT-D42	fgd_stat2	InStatus1	-1 (Freeze)
73	VZO-126432	sd_dmeas	OutStat	72	FG-IR-VOT-D42	fgd_stat2	InStatus2	-1 (Freeze)
73	HS-126316	sd_dmeas	OutStat	72	FG-GV-VOT-D42	fgd_stat2	InStatus1	-1 (Freeze)
73	HS-126316A	sd_dmeas	OutStat	72	FG-GV-VOT-D42	fgd_stat2	InStatus2	-1 (Freeze)
73	HS-126433	sd_dmeas	AlStatOut	72	HS-126433-C	sd_in2	AlStatIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
73	HS-126302	sd_dmeas	AlStatOut	72	HS-126302-D40-C	sd_in2	AlStatIn	-1 (Freeze)
73	PAH-126344	sd_dmeas	AlStatOut	72	PAH-12634-D40-C	sd_in2	AlStatIn	-1 (Freeze)
73	HS-126432	sd_dmeas	AlStatOut	72	HS-126432-C	sd_in2	AlStatIn	-1 (Freeze)
73	HS-126302	sd_dmeas	AlStatOut	72	HS-126302-D42-C	sd_in2	AlStatIn	-1 (Freeze)
73	PAH-126344	sd_dmeas	AlStatOut	72	PAH-12634-D42-C	sd_in2	AlStatIn	-1 (Freeze)
NetIOSafe connections:								
72	XC-123166+72	sd_out2	ShutDown	71	XC-123166+72_1	sd_out2	ShutDownIn	1 (Action)
72	XC-092712+72	sd_out2	ShutDown	71	XC-092712+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-092713+72	sd_out2	ShutDown	71	XC-092713+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-093708+72	sd_out2	ShutDown	71	XC-093708+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-093709+72	sd_out2	ShutDown	71	XC-093709+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-091108+72	sd_out2	ShutDown	71	XC-091108+72_1	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
72	XC-091109+72	sd_out2	ShutDown	71	XC-091109+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-092711+72	sd_out2	ShutDown	71	XC-092711+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-093707+72	sd_out2	ShutDown	71	XC-093707+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-091107+72	sd_out2	ShutDown	71	XC-091107+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-126375+72	sd_out2	ShutDown	71	XC-126375+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-091103+72	sd_out2	ShutDown	71	XC-091103+72_1	sd_out2	ShutDownIn	1 (Action)
72	NCC-123286+72	sd_out2	ShutDown	71	NCC-123286+72_1	sd_out2	ShutDownIn	1 (Action)
72	NCC-123285+72	sd_out2	ShutDown	71	NCC-123285+72_1	sd_out2	ShutDownIn	1 (Action)
72	NCC-123218+72	sd_out2	ShutDown	71	NCC-123218+72_1	sd_out2	ShutDownIn	1 (Action)
72	NCC-123217+72	sd_out2	ShutDown	71	NCC-123217+72_1	sd_out2	ShutDownIn	1 (Action)
72	SW-FirePP+72	sd_out2	ShutDown	71	SW-FirePP+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	NCC-123227+72	sd_out2	ShutDown	71	NCC-123227+72_1	sd_out2	ShutDownIn	1 (Action)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
72	NCC-123228+72	sd_out2	ShutDown	71	NCC-123228+72_1	sd_out2	ShutDownIn	1 (Action)
72	XC-126333A+72	sd_out2	ShutDown	71	XC-126333A+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-126332A+72	sd_out2	ShutDown	71	XC-126332A+72_1	sd_out2	ShutDownIn	-1 (Freeze)
81	XC-124541+ES5	sd_out2	ShutDown	71	XC-124541+81_1	sd_out2	ShutDownIn	1 (Action)
81	XC-124541A+ES5	sd_out2	ShutDown	71	XC-124541A+81_1	sd_out2	ShutDownIn	1 (Action)
81	SW-ES3-F01	sd_out2	ShutDown	71	SW-ES3-F01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES3-M02	sd_out2	ShutDown	71	SW-ES3-M02+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES41-M03	sd_out2	ShutDown	71	SW-ES41-M03+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES41-G01	sd_out2	ShutDown	71	SW-ES41-G01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES41-P01	sd_out2	ShutDown	71	SW-ES41-P01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES41-S02	sd_out2	ShutDown	71	SW-ES41-S02+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-A01	sd_out2	ShutDown	71	SW-ES5-A01+81_	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
81	SW-ES5-A02	sd_out2	ShutDown	71	SW-ES5-A02+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-A03	sd_out2	ShutDown	71	SW-ES5-A03+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-A04	sd_out2	ShutDown	71	SW-ES5-A04+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-L12	sd_out2	ShutDown	71	SW-Q1-L12+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-L11	sd_out2	ShutDown	71	SW-Q1-L11+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-L10	sd_out2	ShutDown	71	SW-Q1-L10+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-L01	sd_out2	ShutDown	71	SW-Q1-L01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-L02	sd_out2	ShutDown	71	SW-Q1-L02+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-L03	sd_out2	ShutDown	71	SW-Q1-L03+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-K01	sd_out2	ShutDown	71	SW-Q1-K01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-K03	sd_out2	ShutDown	71	SW-Q1-K03+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-H06	sd_out2	ShutDown	71	SW-Q1-H06+81_	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
81	SW-Q1-H05	sd_out2	ShutDown	71	SW-Q1-H05+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-H04	sd_out2	ShutDown	71	SW-Q1-H04+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-H03	sd_out2	ShutDown	71	SW-Q1-H03+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-H02	sd_out2	ShutDown	71	SW-Q1-H02+81_	sd_out2	ShutDownIn	-1 (Freeze)
72	NCC-123225+72	sd_out2	ShutDown	71	NCC-123225+72_1	sd_out2	ShutDownIn	1 (Action)
72	NCC-123226+72	sd_out2	ShutDown	71	NCC-123226+72_1	sd_out2	ShutDownIn	1 (Action)
72	XC-124541+72	sd_out2	ShutDown	71	XC-124541+72_1	sd_out2	ShutDownIn	1 (Action)
72	XC-124541A+72	sd_out2	ShutDown	71	XC-124541A+72_1	sd_out2	ShutDownIn	1 (Action)
72	SW-HC-HZ72+71	sd_out2	ShutDown	71	SW-HC-HZ72+72_	sd_out2	ShutDownIn	-1 (Freeze)
72	SW-H2S-HZ72+71	sd_out2	ShutDown	71	SW-H2S-HZ72+72_	sd_out2	ShutDownIn	-1 (Freeze)
72	SW-HC-NHAZ+D57	sd_out2	ShutDown	71	SW-HCNHZ-D57-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-HC-NHAZ+D56	sd_out2	ShutDown	71	SW-HCNHZ-D56-D	sd_dmeas	ProMeas	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
72	SW-HC-NHAZ+D55	sd_out2	ShutDown	71	SW-HCNHZ-D55-D	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-HC-NHAZ+D52	sd_out2	ShutDown	71	SW-HCNHZ-D52-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-HC-NHAZ+D50	sd_out2	ShutDown	71	SW-HCNHZ-D50-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-HC-NHAZ+D49	sd_out2	ShutDown	71	SW-HCNHZ-D49-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-HC-NHAZ+D48	sd_out2	ShutDown	71	SW-HCNHZ-D48-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-HC-NHAZ+D47	sd_out2	ShutDown	71	SW-HCNHZ-D47-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-HCNHZ+D34	sd_out2	ShutDown	71	SW-HCNHZ-D34-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-HCNHZ-A+D36	sd_out2	ShutDown	71	SW-HCNHZ-D36-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-HCNHZ-A2+D3A	sd_out2	ShutDown	71	SW-HCNHZ-D3A-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-HCNHZ-A2+D3B	sd_out2	ShutDown	71	SW-HCNHZ-D3B-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-HCNHZ-A2-D3C	sd_out2	ShutDown	71	SW-HCNHZ-D3C-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-HCNHZ-A2+D3D	sd_out2	ShutDown	71	SW-HCNHZ-D3D-DI	sd_dmeas	ProMeas	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
72	SW-C-HC-D41+D41	sd_out2	ShutDown	71	SW-HCNHZ-D41-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-C-HC-D42+D42	sd_out2	ShutDown	71	SW-HCNHZ-D42-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	SW-HCNHZ-D35	sd_out2	ShutDown	71	SW-HCNHZ-D35-DI	sd_dmeas	ProMeas	-1 (Freeze)
73	XC-123166+73	sd_out2	ShutDown	71	XC-123166+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-123127+73	sd_out2	ShutDown	71	XC-123127+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-123121+73	sd_out2	ShutDown	71	XC-123121+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-123120+73	sd_out2	ShutDown	71	XC-123120+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-093709+73	sd_out2	ShutDown	71	XC-093709+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-093708+73	sd_out2	ShutDown	71	XC-093708+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-093707+73	sd_out2	ShutDown	71	XC-093707+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-092713+73	sd_out2	ShutDown	71	XC-092713+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-092712+73	sd_out2	ShutDown	71	XC-092712+73_1	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
73	XC-092711+73	sd_out2	ShutDown	71	XC-092711+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-091600+73	sd_out2	ShutDown	71	XC-091600+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-091109+73	sd_out2	ShutDown	71	XC-091109+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-091108+73	sd_out2	ShutDown	71	XC-091108+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-091107+73	sd_out2	ShutDown	71	XC-091107+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-FirePP+73	sd_out2	ShutDown	71	SW-FirePP+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123305+73	sd_out2	ShutDown	71	NCC-123305+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123147+73	sd_out2	ShutDown	71	XC-123147+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-123132+73	sd_out2	ShutDown	71	XC-123132+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-123131+73	sd_out2	ShutDown	71	XC-123131+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-091601+73	sd_out2	ShutDown	71	XC-091601+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123308+73	sd_out2	ShutDown	71	NCC-123308+73_1	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
73	XC-123141+73	sd_out2	ShutDown	71	XC-123141+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-123140+73	sd_out2	ShutDown	71	XC-123140+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-123138+73	sd_out2	ShutDown	71	XC-123138+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-091602+73	sd_out2	ShutDown	71	XC-091602+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123312+73	sd_out2	ShutDown	71	NCC-123312+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123145+73	sd_out2	ShutDown	71	XC-123145+73_1	sd_out2	ShutDownIn	1 (Action)
73	NCC-123313+73	sd_out2	ShutDown	71	NCC-123313+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-126373+73	sd_out2	ShutDown	71	XC-126373+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-126372+73	sd_out2	ShutDown	71	XC-126372+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-126371+73	sd_out2	ShutDown	71	XC-126371+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123135A+73	sd_out2	ShutDown	71	XC-123135A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123135+73	sd_out2	ShutDown	71	XC-123135+73_1	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
73	NCC-123310A+73	sd_out2	ShutDown	71	NCC-123310A+3_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123310+73	sd_out2	ShutDown	71	NCC-123310+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-126321A+73	sd_out2	ShutDown	71	XC-126321A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123124+73	sd_out2	ShutDown	71	XC-123124+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123316A+73	sd_out2	ShutDown	71	NCC-123316A+3_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123316+73	sd_out2	ShutDown	71	NCC-123316+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-126322A+73	sd_out2	ShutDown	71	XC-126322A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123136+73	sd_out2	ShutDown	71	XC-123136+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123317A+73	sd_out2	ShutDown	71	NCC-123317A+3_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123317+73	sd_out2	ShutDown	71	NCC-123317+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-126323A+73	sd_out2	ShutDown	71	XC-126323A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123144+73	sd_out2	ShutDown	71	XC-123144+73_1	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
73	NCC-123318A+73	sd_out2	ShutDown	71	NCC-123318A+3_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123318+73	sd_out2	ShutDown	71	NCC-123318+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123137+73	sd_out2	ShutDown	71	XC-123137+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-123126+73	sd_out2	ShutDown	71	XC-123126+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-091603+73	sd_out2	ShutDown	71	XC-091603+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123311+73	sd_out2	ShutDown	71	NCC-123311+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-126329A+73	sd_out2	ShutDown	71	XC-126329A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-126374+73	sd_out2	ShutDown	71	XC-126374+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123154+73	sd_out2	ShutDown	71	XC-123154+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-123113+73	sd_out2	ShutDown	71	XC-123113+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123302A+73	sd_out2	ShutDown	71	NCC-123302A+3_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123302+73	sd_out2	ShutDown	71	NCC-123302+73_1	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
73	XC-126328A+73	sd_out2	ShutDown	71	XC-126328A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123155+73	sd_out2	ShutDown	71	XC-123155+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-123115+73	sd_out2	ShutDown	71	XC-123115+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123303A+73	sd_out2	ShutDown	71	NCC-123303A+3_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123303+73	sd_out2	ShutDown	71	NCC-123303+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-126330A+73	sd_out2	ShutDown	71	XC-126330A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123156+73	sd_out2	ShutDown	71	XC-123156+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-123117+73	sd_out2	ShutDown	71	XC-123117+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123304A+73	sd_out2	ShutDown	71	NCC-123304A+3_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123304+73	sd_out2	ShutDown	71	NCC-123304+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-126325A+73	sd_out2	ShutDown	71	XC-126325A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123157+73	sd_out2	ShutDown	71	XC-123157+73_1	sd_out2	ShutDownIn	1 (Action)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
73	XC-123122+73	sd_out2	ShutDown	71	XC-123122+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123307A+73	sd_out2	ShutDown	71	NCC-123307A+3_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123307+73	sd_out2	ShutDown	71	NCC-123307+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-126327A+73	sd_out2	ShutDown	71	XC-126327A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123158+73	sd_out2	ShutDown	71	XC-123158+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-123142+73	sd_out2	ShutDown	71	XC-123142+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123314A+73	sd_out2	ShutDown	71	NCC-123314A+3_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123314+73	sd_out2	ShutDown	71	NCC-123314+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-126326A+73	sd_out2	ShutDown	71	XC-126326A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123159+73	sd_out2	ShutDown	71	XC-123159+73_1	sd_out2	ShutDownIn	1 (Action)
73	XC-123133+73	sd_out2	ShutDown	71	XC-123133+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123309A+73	sd_out2	ShutDown	71	NCC-123309A+3_1	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
73	NCC-123309+73	sd_out2	ShutDown	71	NCC-123309+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-126331A+73	sd_out2	ShutDown	71	XC-126331A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123107+73	sd_out2	ShutDown	71	XC-123107+73_1	sd_out2	ShutDownIn	1 (Action)
73	NCC-123279+73	sd_out2	ShutDown	71	NCC-123279+73_1	sd_out2	ShutDownIn	1 (Action)
73	NCC-123206+73	sd_out2	ShutDown	71	NCC-123206+73_1	sd_out2	ShutDownIn	1 (Action)
73	NCC-123305A+73	sd_out2	ShutDown	71	NCC123305A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123308A+73	sd_out2	ShutDown	71	NCC123308A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	NCC-123312A+73	sd_out2	ShutDown	71	NCC123312A+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	XC-123125+73	sd_out2	ShutDown	71	XC-123125+73_1	sd_out2	ShutDownIn	1 (Action)
73	NCC-123306+73	sd_out2	ShutDown	71	NCC-123306+73_1	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-H2S-E01+E01	sd_out2	ShutDown	71	SW-H2S-E01-DI1	sd_dmeas	ProMeas	-1 (Freeze)
73	SW-H2S-E02+E02	sd_out2	ShutDown	71	SW-H2S-E02-DI1	sd_dmeas	ProMeas	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
73	SW-H2S-E03+E03	sd_out2	ShutDown	71	SW-H2S-E03-DI1	sd_dmeas	ProMeas	-1 (Freeze)
81	SW-Q1-L08	sd_out2	ShutDown	71	SW-Q1-L08+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-L09	sd_out2	ShutDown	71	SW-Q1-L09+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-L15	sd_out2	ShutDown	71	SW-Q1-L15+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-L16	sd_out2	ShutDown	71	SW-Q1-L16+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-M01	sd_out2	ShutDown	71	SW-Q1-M01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-N01	sd_out2	ShutDown	71	SW-Q1-N01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-N02	sd_out2	ShutDown	71	SW-Q1-N02+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-H02	sd_out2	ShutDown	71	SW-Q2-H02+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-H03	sd_out2	ShutDown	71	SW-Q2-H03+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-H04	sd_out2	ShutDown	71	SW-Q2-H04+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-H05	sd_out2	ShutDown	71	SW-Q2-H05+81_	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
81	SW-Q2-H06	sd_out2	ShutDown	71	SW-Q2-H06+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-K01	sd_out2	ShutDown	71	SW-Q2-K01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-K03	sd_out2	ShutDown	71	SW-Q2-K03+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-L01	sd_out2	ShutDown	71	SW-Q2-L01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-L02	sd_out2	ShutDown	71	SW-Q2-L02+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-L03	sd_out2	ShutDown	71	SW-Q2-L03+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-L015	sd_out2	ShutDown	71	SW-Q2-L015+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-L08	sd_out2	ShutDown	71	SW-Q2-L08+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-L09	sd_out2	ShutDown	71	SW-Q2-L09+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-L10	sd_out2	ShutDown	71	SW-Q2-L10+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-L11	sd_out2	ShutDown	71	SW-Q2-L11+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-L12	sd_out2	ShutDown	71	SW-Q2-L12+81_	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
81	SW-Q2-M01	sd_out2	ShutDown	71	SW-Q2-M01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-N02	sd_out2	ShutDown	71	SW-Q2-N02+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q2-L016	sd_out2	ShutDown	71	SW-Q2-L016+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-K02	sd_out2	ShutDown	71	SW-Q1-K02+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-K04	sd_out2	ShutDown	71	SW-Q1-K04+81_	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-HCNHZ-E1+E01	sd_out2	ShutDown	71	SW-HCNHZ-E1+73	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-HCNHZ-E2+E02	sd_out2	ShutDown	71	SW-HCNHZ-E2+73	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-HCNHZ-E3+E03	sd_out2	ShutDown	71	SW-HCNHZ-E3+73	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-HCNHZ-C1+C01	sd_out2	ShutDown	71	SW-HCNHZ-C1+73	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-HCNHZ-T1+T01	sd_out2	ShutDown	71	SW-HCNHZ-T1+73	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-HCNHZ-T2+T02	sd_out2	ShutDown	71	SW-HCNHZ-T2+73	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-HCNHZ-T3+T03	sd_out2	ShutDown	71	SW-HCNHZ-T3+73	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
73	SW-HCNHZ-T4+T04	sd_out2	ShutDown	71	SW-HCNHZ-T4+73	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-HCNHZ-T5+T05	sd_out2	ShutDown	71	SW-HCNHZ-T5+73	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-HCNHZ-T6+T06	sd_out2	ShutDown	71	SW-HCNHZ-T6+73	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-HCNHZ-S3+S03	sd_out2	ShutDown	71	SW-HCNHZ-S3+73	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-HCNHZE21+E21	sd_out2	ShutDown	71	SW-HCNHZE21+73	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D3B	sd_out2	ShutDown	72	SW-ES5-D3B+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D3C	sd_out2	ShutDown	72	SW-ES5-D3C+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D3D	sd_out2	ShutDown	72	SW-ES5-D3D+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D40	sd_out2	ShutDown	72	SW-ES5-D40+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D41	sd_out2	ShutDown	72	SW-ES5-D41+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D42	sd_out2	ShutDown	72	SW-ES5-D42+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D47	sd_out2	ShutDown	72	SW-ES5-D47+81_	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
81	SW-ES5-D48	sd_out2	ShutDown	72	SW-ES5-D48+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D49	sd_out2	ShutDown	72	SW-ES5-D49+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D50	sd_out2	ShutDown	72	SW-ES5-D50+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D52	sd_out2	ShutDown	72	SW-ES5-D52+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D53	sd_out2	ShutDown	72	SW-ES5-D53+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D54	sd_out2	ShutDown	72	SW-ES5-D54+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D55	sd_out2	ShutDown	72	SW-ES5-D55+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D56	sd_out2	ShutDown	72	SW-ES5-D56+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D57	sd_out2	ShutDown	72	SW-ES5-D57+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D58	sd_out2	ShutDown	72	SW-ES5-D58+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-L06	sd_out2	ShutDown	72	SW-Q1-L06+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES81-D32	sd_out2	ShutDown	72	SW-ES81-D32+81_	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
81	SW-ES82-D32	sd_out2	ShutDown	72	SW-ES82-D32+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-L07	sd_out2	ShutDown	72	SW-Q1-L07+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D38	sd_out2	ShutDown	72	SW-ES5-D38+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES5-D3A	sd_out2	ShutDown	72	SW-ES5-D3A+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-L05	sd_out2	ShutDown	72	SW-Q1-L05+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-L04	sd_out2	ShutDown	72	SW-Q1-L04+81_	sd_out2	ShutDownIn	-1 (Freeze)
71	SW-HC-HZ+PS72	sd_out2	ShutDown	72	SW-HC-HZ+PS+71_	sd_out2	ShutDownIn	-1 (Freeze)
71	SW-H2S-HZ+PS72	sd_out2	ShutDown	72	SW-H2S-HZ+PS+71	sd_out2	ShutDownIn	-1 (Freeze)
71	XC-091542+71	sd_out2	ShutDown	73	XC-091542+71_1	sd_out2	ShutDownIn	-1 (Freeze)
71	XC-091333+71	sd_out2	ShutDown	73	XC-091333+71_1	sd_out2	ShutDownIn	1 (Action)
71	XC-091335+71	sd_out2	ShutDown	73	XC-091335+71_1	sd_out2	ShutDownIn	1 (Action)
71	XC-091331+71	sd_out2	ShutDown	73	XC-091331+71_1	sd_out2	ShutDownIn	1 (Action)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
71	VCO-091521+71	sd_out2	ShutDown	73	VCO-091521+71_1	sd_out2	ShutDownIn	-1 (Freeze)
71	XC-091323+71	sd_out2	ShutDown	73	XC-091323+71_1	sd_out2	ShutDownIn	1 (Action)
71	XC-091325+71	sd_out2	ShutDown	73	XC-091325+71_1	sd_out2	ShutDownIn	1 (Action)
71	VCO-091525+71	sd_out2	ShutDown	73	VCO-091525+71_1	sd_out2	ShutDownIn	-1 (Freeze)
71	SW-H2S-Air+M01	sd_out2	ShutDown	73	SW-H2S+M01+71_	sd_out2	ShutDownIn	-1 (Freeze)
71	SW-HC-HZ+PS73	sd_out2	ShutDown	73	SW-HC-HZ+71_	sd_out2	ShutDownIn	-1 (Freeze)
71	SW-H2S-HZ+PS73	sd_out2	ShutDown	73	SW-H2S-HZ+71_	sd_out2	ShutDownIn	-1 (Freeze)
71	SW-M01-VFD+M01	sd_out2	ShutDown	73	SW-M01-VFD+71_	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-126344+72	sd_out2	ShutDown	73	XC-126344+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	VCO-126301+72	sd_out2	ShutDown	73	VCO-126301+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	VCO-126302+72	sd_out2	ShutDown	73	VCO-126302+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	VCO-126433+72	sd_out2	ShutDown	73	VCO-126433+72_1	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
72	VCO-126311+72	sd_out2	ShutDown	73	VCO-126311+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-126433+72	sd_out2	ShutDown	73	XC-126433+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	VCO-126432+72	sd_out2	ShutDown	73	VCO-126432+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	VCO-126316+72	sd_out2	ShutDown	73	VCO-126316+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-126432+72	sd_out2	ShutDown	73	XC-126432+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	SW-HC-HZ72+73	sd_out2	ShutDown	73	SW-HC-HZ72+72	sd_out2	ShutDownIn	-1 (Freeze)
72	SW-H2S-HZ72+73	sd_out2	ShutDown	73	SW-H2S-HZ72+72	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES11-E01	sd_out2	ShutDown	73	SW-ES11-E01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES11-E11	sd_out2	ShutDown	73	SW-ES11-E11+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES12-E01	sd_out2	ShutDown	73	SW-ES12-E01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES12-E11	sd_out2	ShutDown	73	SW-ES12-E11+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES21-E02	sd_out2	ShutDown	73	SW-ES21-E02+81_	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
81	SW-ES22-E02	sd_out2	ShutDown	73	SW-ES22-E02+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES31-E03	sd_out2	ShutDown	73	SW-ES31-E03+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES31-E12	sd_out2	ShutDown	73	SW-ES31-E12+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES32-E03	sd_out2	ShutDown	73	SW-ES32-E03+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES32-E12	sd_out2	ShutDown	73	SW-ES32-E12+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES3-T01	sd_out2	ShutDown	73	SW-ES3-T01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES3-T02	sd_out2	ShutDown	73	SW-ES3-T02+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES61-S03	sd_out2	ShutDown	73	SW-ES61-S03+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-Q1-S03	sd_out2	ShutDown	73	SW-Q1-S03+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES3-T03	sd_out2	ShutDown	73	SW-ES3-T03+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES41-C01	sd_out2	ShutDown	73	SW-ES41-C01+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES41-T05	sd_out2	ShutDown	73	SW-ES41-T05+81_	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
81	SW-ES41-T04	sd_out2	ShutDown	73	SW-ES41-T04+81_	sd_out2	ShutDownIn	-1 (Freeze)
81	SW-ES41-T06	sd_out2	ShutDown	73	SW-ES41-T06+81_	sd_out2	ShutDownIn	-1 (Freeze)
71	XC-124534+71	sd_out2	ShutDown	81	XC-124534+71_1	sd_out2	ShutDownIn	-1 (Freeze)
71	XC-124525+71	sd_out2	ShutDown	81	XC-124525+71_1	sd_out2	ShutDownIn	-1 (Freeze)
71	XC-124523+71	sd_out2	ShutDown	81	XC-124523+71_1	sd_out2	ShutDownIn	-1 (Freeze)
71	SW-L08-Q2-G+L08	sd_out2	ShutDown	81	SW-L08-Q2-G+71	sd_out2	ShutDownIn	-1 (Freeze)
71	SW-L08-Q2-S+L08	sd_out2	ShutDown	81	SW-L08-Q2-S+71	sd_out2	ShutDownIn	-1 (Freeze)
71	SW-L09-Q2-G+L09	sd_out2	ShutDown	81	SW-L09-Q2-G+71	sd_out2	ShutDownIn	-1 (Freeze)
71	SW-M01-Q2G+M01	sd_out2	ShutDown	81	SW-M01-Q2G+71	sd_out2	ShutDownIn	-1 (Freeze)
71	SW-M01-Q2-S+M01	sd_out2	ShutDown	81	SW-M01-Q2-S+71	sd_out2	ShutDownIn	-1 (Freeze)
71	XC-124545+WD	sd_out2	ShutDown	81	XC-124545+WD+71	sd_out2	ShutDownIn	-1 (Freeze)
71	SW-L08-Q2S2+L08	sd_out2	ShutDown	81	SW-L08-Q2S2+71	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
71	XC-124545A+WD	sd_out2	ShutDown	81	XC-124545A+W+71	sd_out2	ShutDownIn	-1 (Freeze)
71	SW-M01-Q2G2+M01	sd_out2	ShutDown	81	SW-Gas-M01-DI	sd_dmeas	ProMeas	-1 (Freeze)
71	SW-L08-Q2G2+L08	sd_out2	ShutDown	81	SW-Gas-L08-DI	sd_dmeas	ProMeas	-1 (Freeze)
72	XC-135258+72	sd_out2	ShutDown	81	XC-135258+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-135314+72	sd_out2	ShutDown	81	XC-135314+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-135299+72	sd_out2	ShutDown	81	XC-135299+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-135310+72	sd_out2	ShutDown	81	XC-135310+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-135265+72	sd_out2	ShutDown	81	XC-135265+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-135264+72	sd_out2	ShutDown	81	XC-135264+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-135263+72	sd_out2	ShutDown	81	XC-135263+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-135261+72	sd_out2	ShutDown	81	XC-135261+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-135262+72	sd_out2	ShutDown	81	XC-135262+72_1	sd_out2	ShutDownIn	-1 (Freeze)

From RCU	From Tag	From SW module	From Terminal	To RCU	To Tag	To SW module	To Terminal	Fail Safe Setting
72	XC-135278+72	sd_out2	ShutDown	81	XC-135278+72_1	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-135241+D50	sd_out2	ShutDown	81	XC-135241+72_	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-135245+72	sd_out2	ShutDown	81	XC-135245+72_	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-135242+D3A	sd_out2	ShutDown	81	XC-135242+72_	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-135244+D56	sd_out2	ShutDown	81	XC-135244+72_	sd_out2	ShutDownIn	-1 (Freeze)
72	XC-135243+D57	sd_out2	ShutDown	81	XC-135243+72_	sd_out2	ShutDownIn	-1 (Freeze)
72	SW-Act-ES82+D32	sd_out2	ShutDown	81	SW-Act-ES82+72_	sd_out2	ShutDownIn	-1 (Freeze)
73	SW-STEMG-S3+S03	sd_out2	ShutDown	81	SW-STEMG-S3+73	sd_out2	ShutDownIn	-1 (Freeze)

Table 12-3: Fail Safe settings of network modules, sd_out2 & NetIOSafe.