



KONGSBERG

Overview

Kongsberg Maritime Safety system (ESD and F&G)

<i>Project:</i>		Deepwater Horizon (RBS8D)			
<i>Product:</i>		KM Safety system			
<i>Synopsis:</i>		This document is a short introduction in order to get an overview over a KM Safety system.			
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1 SAFETY SYSTEM

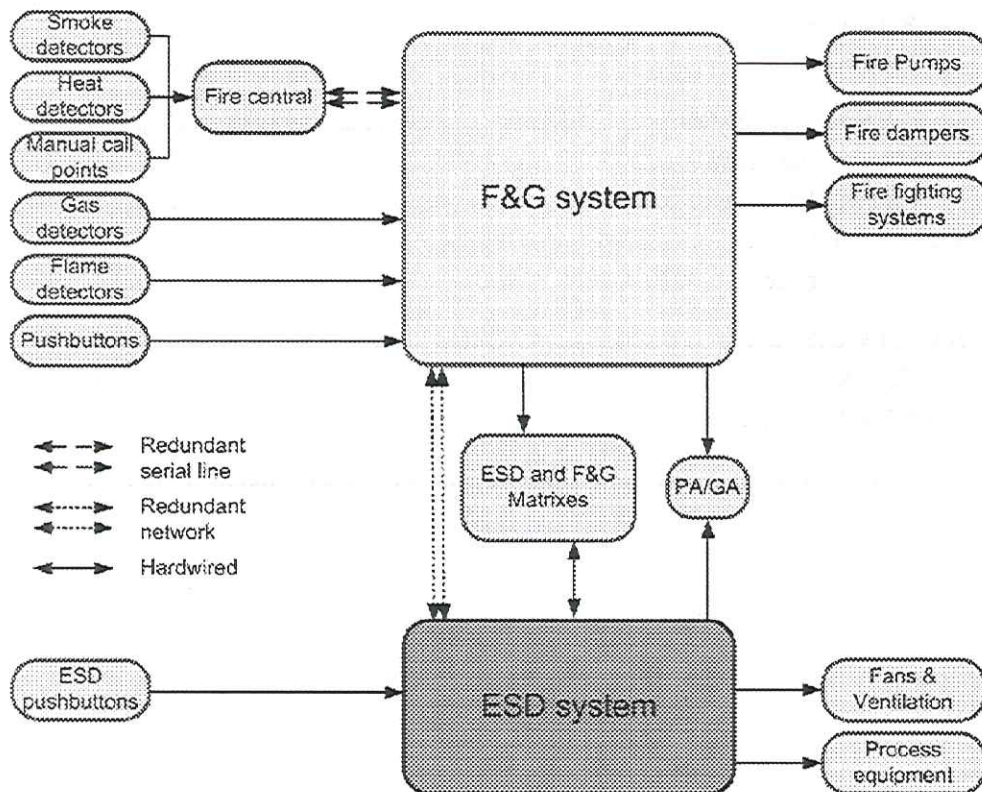
1.1 KM Safety system

The safety system delivered by Kongsberg Maritime (KM) is a functional safety system, represented by the safety instrumented system.

The KM Safety system consists of two independent systems:

- Emergency ShutDown System (ESD).
- Fire & Gas Detection and Protection system (F&G).

The ESD and F&G Systems are interfaced according to the figure below:



1.2 ESD system description

The ESD system is the top level safety system.

The ESD system processes input signals from matrix panel (manual activation) and the F&G system. These input signals activate the different shutdown levels.

The ESD system is divided into several ESD levels, with a C&E for each level.

- ESD 1: Engine rooms
- ESD 2: Propulsion
- ESD 3: HVAC
- ESD 4: Drill floor

1.3 F&G system description

The main objective of the Fire & Gas System is to:

- Monitor and alarm the F&G status from fire and gas detectors.
- Alert personnel and initiate protective actions automatically or manually upon operator's activation.

The F&G system is divided into fire areas, with a C&E for each area.

1.4 System architecture

The KM Safety system consists of both hardware (HW) and software (SW) components.

1.4.1 Software

The SW is called AIM, and is used as a basis for all KM's safety and control systems.

The safety system includes function modules designed specific for the safety functions.

The function modules are used for building the project specific cause & effect (C&E) logic.

1.4.2 Hardware

The system hardware includes these components:

- Process Controller Unit (PCU).
 - This controller is used by all KM safety and control systems.
 - The safety systems use two PCU's in a redundant set-up.
- I/O cards:
 - I/O card designed for use in a safety system:
 - Reads digital and analogue inputs.
 - Sets digital outputs.
 - The ESD system uses redundant I/O cards.
 - The F&G system uses single I/O cards.

1.4.3 Redundancy

The KM safety system is designed as a 1oo2 redundant system.

The KM 1oo2 architecture consists of two elements connected in parallel:

- Both PCU read the same input card, they contain the same software, and will perform the same actions.
- Both PCU are able to perform a shutdown independently of each other, 1oo2 voted.
- If one of the two elements fails (PCU or I/O card), the element is isolated, and the other element will keep control.
- If both elements fail (PCU or I/O card), then the output will go to the failsafe state.

Fail safe is defined to be the most safe state for the output.

- Drilling projects uses Normally DeEnergised (NDE) outputs.
- NDE outputs will not activate the outputs in a fail safe situation.

2 SAFETY PHILOSOFY

The safety philosophy for a KM project is defined by the customer.

Drilling units have typical this philosophy:

- ESD system is divided into several levels.
 - The different levels are individual, and one level will not activate the others.
 - Actions are set manually from the matrix.
 - The operator will evaluate the situation, and take the necessary actions.
 - Automatic actions from the F&G system based on confirmed fire or gas detection in some specific areas, defined in the C&E.
 - Actions set by the ESD system is:
 - Stop ventilation fans.
 - Stop engines and other equipments.
- F&G system is used for detection and alarm.
 - Actions set by the F&G system is:
 - Public Alarms (PA).
 - Alarm and buzzer in the matrix panel.
 - Alarms and buzzer on the Operation Stations (OS).
 - Close Fire dampers.
 - Start fire fighting, like fire water pumps and foam pumps.
- All outputs are chosen to be NDE, where the fail-safe setting is “no action”.

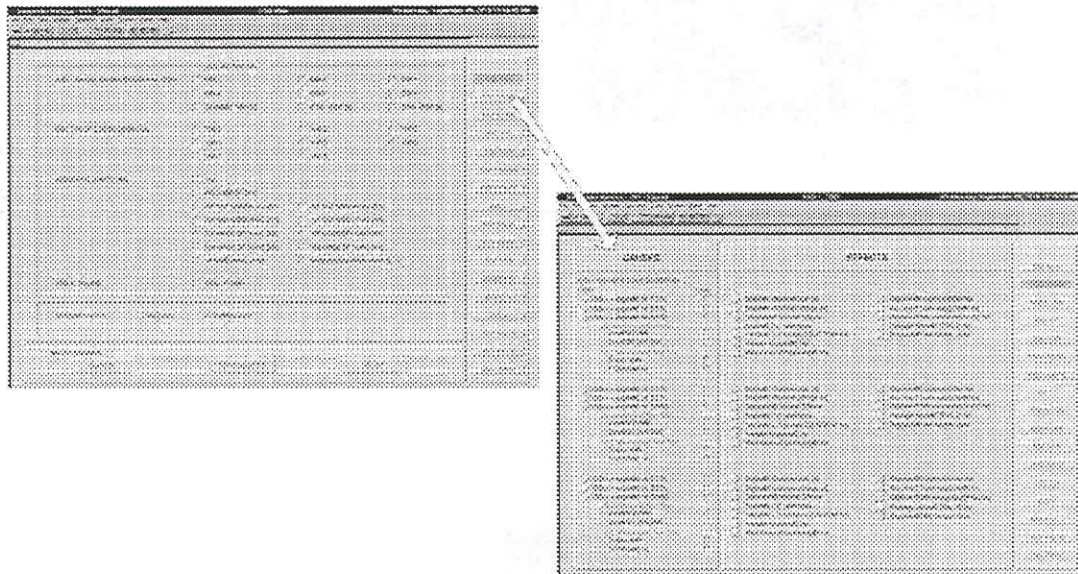
3 SAFETY IMAGES

The KM Safety system includes several images. The images can be shown on all operator stations on the Bridge, Engine Control Room and in the Drillers Shack.

3.1 ESD Images

ESD includes:

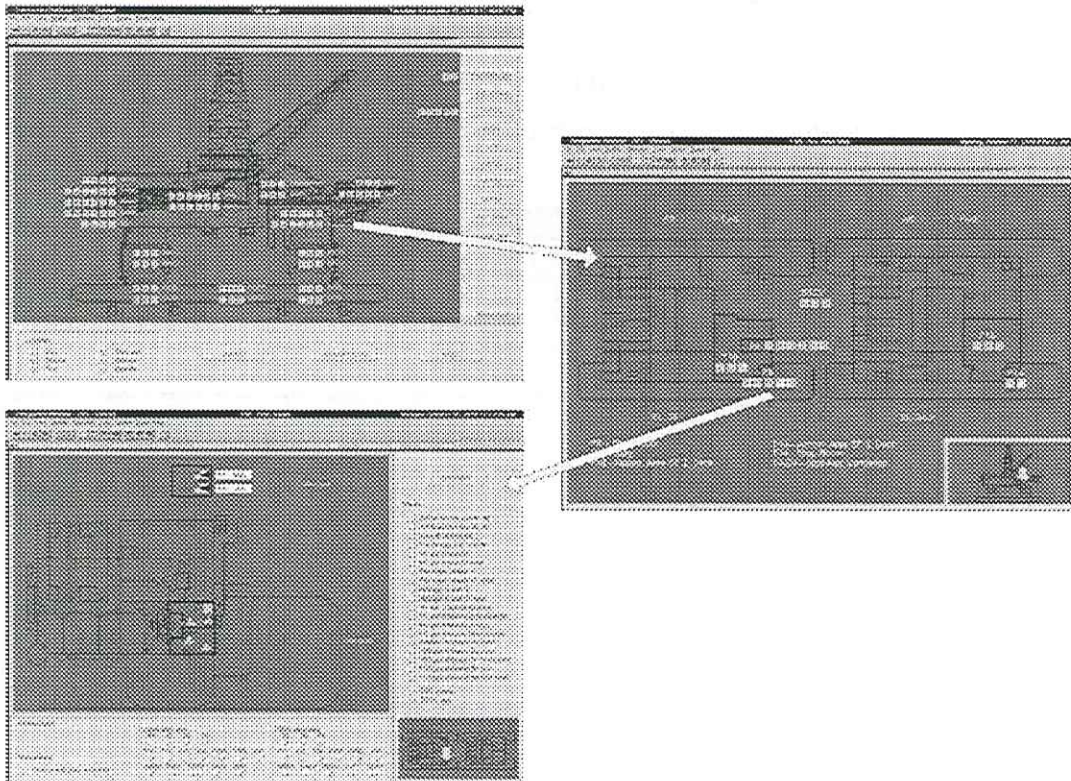
- One main image for all the ESD levels, with status indication.
- One image for each ESD level, with cause & effects.



3.2 F&G Images

F&G includes:

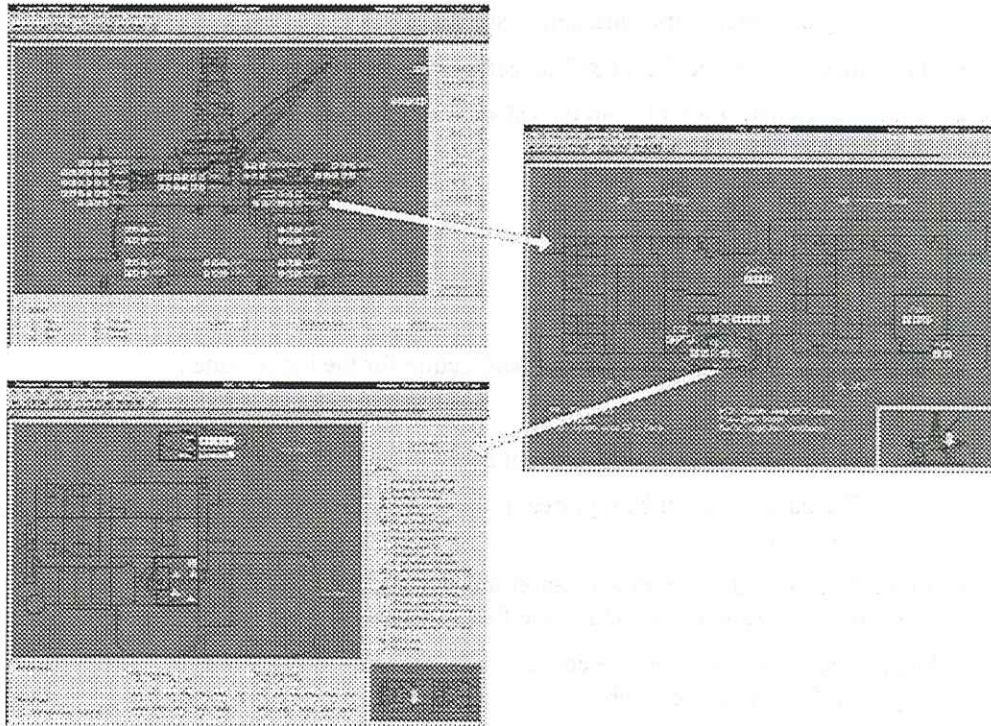
- F&G main image, showing the entire drill rig with status indication for each deck.
- F&G deck image, showing each deck with status indication for each fire area.
- Fire area image, detailed image for each fire area with detectors and effects.



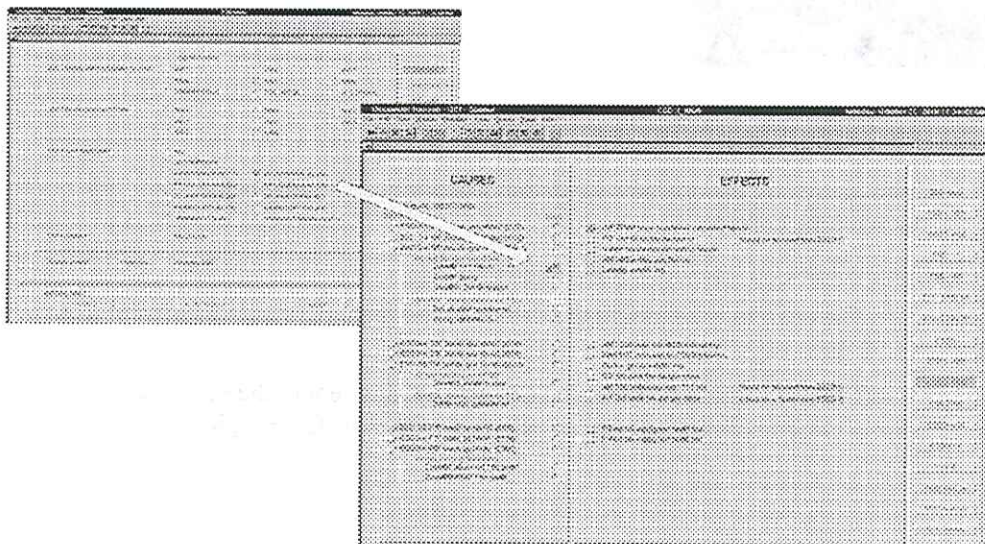
4 SAFETY OPERATION

4.1 Follow an gas alarm

The status indicators in the F&G image will tell the operator where the gas detection is.



The gas detection in this area will activate effects in ESD:



4.2 Test and Maintenance functions

In order to perform test and maintenance of the system there are dedicated functions built in to the system. These functions are intended to be used only for a short period of time until the problem has been solved or the test is completed.

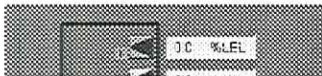
The software logic includes input and output signals.

- The input signals come from F&G detectors and ESD buttons in the matrix.
- The output signals are sent from the safety system to equipment like fire dampers and fans.

4.2.1 Inhibit

Input signal is inhibited:

- Inhibit function will disable the safeguard action for the input signal.
- Example:
 - The inhibit function will prevent a gas alarm to be sent to the C&E logic.
 - The gas alarm will be reported in the system, but no effects/outputs will be activated.
- An inhibited signal in alarm will report the alarm to the OS, and the alarm will be visualised in the alarm list and in the F&G images.
- An inhibited signal will change colour on the software symbol to cyan, with a tagmark "i" next to the symbol.
 - Status indicators in the main images will change colour to cyan.



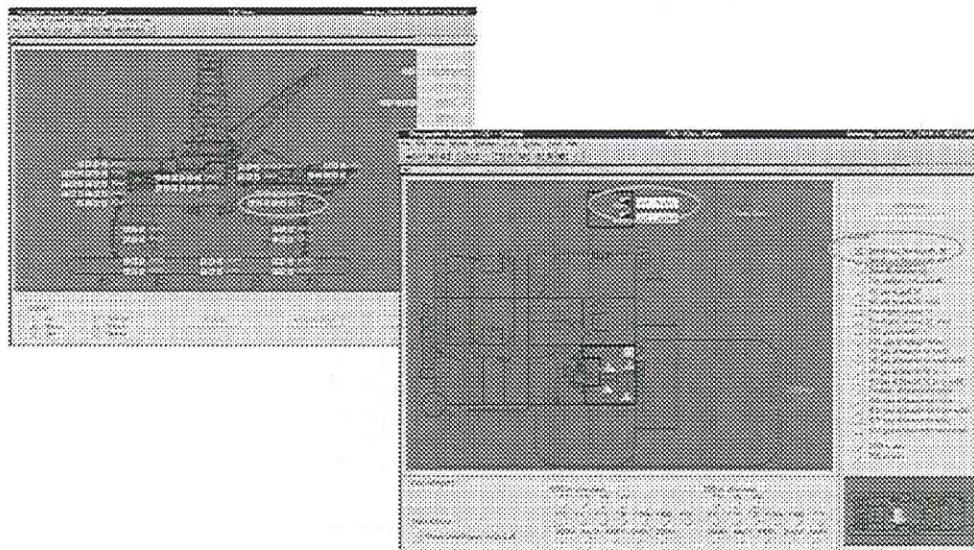
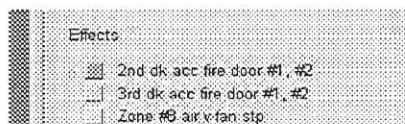
Purpose / use of function:

- Inhibit is used by the operator when the detector need maintenance, is in fault or is not working correct.
- Inhibit is used for test of the input signals.
 - The operator will inhibit the detector, and then test the detector with test gas.
 - The test will indicate that the correct signal is sent to the software, and inhibit will prevent any an activation from the C&E logic.

4.2.2 Override

Output signal is overridden:

- Override function intended to set the output signal to predefined state (de-activated), independent of changes in logic states.
- Override implies that automatic action will not take place on the overridden output.
- The override function will stop the software module from sending the shutdown signal further in the logic, and an overridden effect will not activate the output I/O signal.
- An overridden signal will change colour on the software symbol to cyan, with a tagmark "o" next to the symbol.
 - Status indicators in the main images will change colour to cyan.



Purpose / use of function:

- Override is used for test situations.
- The operator may test the C&E logic by activating a detector or by pushing an ESD button.
 - The override function will prevent any activation of I/O.

5 SAFETY C&E

The C&E is defined by the customer.

5.1 ESD C&E

This C&E is an extract of the entire ESD C&E.

This part includes the ESD level 3-4:

- Manual activation of the ESD level from the ESD matrix.
- Automatic action from F&G, based on the F&G C&E.

Project : RBS8D SEMI-SUBMERSIBLE DRILLING VESSEL		SYSTEM or AREA		S-FWD 2ND DECK QUARTER		
Document Title : CAUSE & EFFECT MATRIX for EMCY SHUT DOWN SYSTEM		ESD GROUP		ESD 3-4 (HCC 3)		
Drawing No : HRBS-I69-000-H0025 REV. K		Description		GALLEY SUPPLY VENT FAN VOLT HEAT		
<div>OUTPUT (EFFECT)</div>				#11-42/44/45/46/47/48/49/50 TRIP		
		TAG		LAUNDRY EXH FAN/41/42 TRIP		
ESD-247037				ESD-247110		
INPUT to ESD PANEL (CAUSE)				5-F THERM ROOM SUPPLY VENT FAN VOLT HEAT		
		Output Qty		1 1		
TAG	DESCRIPTION	NO	157	158	159	160
XS-247050	ESD 3-4 S/F 2nd Deck Qtrs HVAC ESD (CCR)	3-4	X	X	X	X
XS-247059	ESD 3-4 S/F 2nd Deck Qtrs HVAC ESD (CCR)	3-4	X	X	X	X
XS-247080	ESD 3-4 S/F 2nd Deck Qtrs HVAC ESD (DWS)	3-4	X	X	X	X
FSL-315002	2ND DECK STBD SPRINKLER RELEASED		X	X	X	X
FSL-315065	GALLEY SPRINKLER RELEASED		X	X	X	
HY-172609	ZONE #9 S-FWD TIR & ELRM VENT FAN STOP					X
HY-172609	ZONE #9 GALLEY VENT FAN STOP		X	X	X	
HY-172610	ZONE #10 2ND DECK S-FWD VENT FAN STOP		X	X	X	

5.2 F&G C&E

This C&E is an extract of the entire F&G C&E.

This part includes the fire area F08:

- Fire detection, smoke and manual alarm.
- Gas detection, combustible and toxic.
- Manual close ventilation.

PROJECT : RBSSD SEMI-SUBMERSIBLE DRILLING VESSEL				REV	B	I	C	C	I	C	C	I	C	C	I	K	K	K	H	H	E	E	F	F	F	K	K							
DOCUMENT TITLE : CAUSE & EFFECT MATRIX FOR FIRE/GAS SAFETY SYS.				Time	NOTE 1 : X = Immediate activation, G = Activation when confirmed in area or manual confirmation 1 = Alarm in all areas if alarm not acknowledged within 2 min (single detection such as smoke/thermal/gas)																													
				Date	NOTE 2 Audible alarm for ALL AREA, MACHINERY SPACES/MAIN DECK/SHOPS shall be issued via PA/GA system																													
				NOTE 3 F&G Process station will send/receive information to/from ESD process station.																														
DRAWING NO. : HRBS-169-000-H0025 REV.K				DESCRIPTION																														
INPUT to FIRE/GAS PROCESS STATION				OUTPUT (EFFECT)																														
				TAG	SSS-05-01	SSS-05-02	SSS-05-03	SSS-05-04	SSS-05-05	SSS-05-06	SSS-05-07	SSS-05-08	SSS-05-09	SSS-05-10	SSS-05-11	SSS-05-12	SSS-05-13	SSS-05-14	SSS-05-15	SSS-05-16	SSS-05-17	SSS-05-18	SSS-05-19	SSS-05-20	SSS-05-21	SSS-05-22	SSS-05-23							
				DESCRIPTION	FIRE/GAS SAFETY PANEL	MATRIX PANEL (WSI) - FIRE ALARM	MATRIX PANEL (WSI) - COMBUSTIBLE GAS ALARM	MATRIX PANEL (WSI) - TOXIC GAS ALARM	MATRIX PANEL (WSI) - BUZZER	MATRIX PANEL (CCR) - FIRE ALARM	MATRIX PANEL (CCR) - COMBUSTIBLE GAS ALARM	MATRIX PANEL (CCR) - TOXIC GAS ALARM	MATRIX PANEL (CCR) - BUZZER	MATRIX PANEL (CCR) - FIRE ALARM	MATRIX PANEL (CCR) - COMBUSTIBLE GAS ALARM	MATRIX PANEL (CCR) - TOXIC GAS ALARM	MATRIX PANEL (CCR) - BUZZER	MATRIX PANEL (CCR) - FIRE ALARM	MATRIX PANEL (CCR) - COMBUSTIBLE GAS ALARM	MATRIX PANEL (CCR) - TOXIC GAS ALARM	MATRIX PANEL (CCR) - BUZZER	FIRE ALARM AUDIBLE - ALL AREA NOTE 2	HC (COMB) GAS ALARM AUDIBLE - ALL AREA NOTE 2	HS (TOXIC) GAS ALARM AUDIBLE - ALL AREA NOTE 2	FIRE/GAS ALARM BEACON FOR MACH AREA	HC (COMB) GAS ALARM BEACON FOR MACH AREA	HS (TOXIC) GAS ALARM BEACON FOR MACH AREA	HC (COMB) GAS ALARM BEACON FOR ACCOM AREA	HS (TOXIC) GAS ALARM BEACON FOR ACCOM AREA	3RD DECK ACCOM FIRE DOOR #1&2	3RD DECK ACCOM FIRE DOOR #1&2	DOOR #1 CLOSE IN ZONE #1 (FIRE/LIN 2ND SF)	F&G VIT CLOSE IN ZONE #1 (FIRE/LIN 2ND SF)	ZONE #3 & 5 F&G TRG & RETENTION FAN STOP NOTE 1
Output number				NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23							
REV	TAG	DESCRIPTION		NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23							
S	FIRE & VIT DAMPERS - MANUAL CLOSE																																	
B	FZ-172008	CLOSE ZONE 8 (ELEC. RM 2ND SF)			X																											X	X	
FIRE DETECTIONS IN ZONE #8 (ELEC. ROOM)																																		
I	ASH-172502	2ND DECK STD UTILITY TRUNK	F8	X	X		X	X		X	X		X	X		X	X		X	X														
I	ASH-172503	2ND DECK STD ELECTRICAL ROOM	F8	X	X		X	X		X	X		X	X		X	X		X	X														
I	ASH-172504	2ND DECK STD TRANSFORMER ROOM (219)	F8	X	X		X	X		X	X		X	X		X	X		X	X														
I	ASH-172505	2ND DECK STD TRANSFORMER ROOM (219)	F8	X	X		X	X		X	X		X	X		X	X		X	X														
I	XS-172509	2ND DECK STD TRANSFORMER ROOM (219)	F8	X	X		X	X		X	X		X	X		X	X		X	X														
Gas detection																																		
F	CCD-172313	L MAIN CK STD FWD SUP. VENT FOR TIR RM	F8	X		X	X	X		X	X		X	X		X	X		X	X		1				1								
H				X		X	X	X		X	X		X	X		X	X		X	X		1/0				1/0								
K	TOD-172313	L MAIN CK STD FWD SUP. VENT FOR TIR RM	F8	X		X	X	X		X	X		X	X		X	X		X	X		1/0				1/0								
H				X		X	X	X		X	X		X	X		X	X		X	X		1/0				1/0								

6 REFERENCES

Ref	Document title	Document number
[1]	Delivery files from Deepwater Horizon (RBS8D).	Copied offshore 2009-09-08 (vc6280.rar).
[2]	Hyundai, Cause &Effect ESD, RBS8D.	HRBS-I69-000-H0025, rev K (2000-10-30)
[3]	Hyundai, Cause &Effect F&G, RBS8D.	HRBS-I69-000-H0025, rev K (2001-02-07)
[4]	RB Falcon, Safety Design Philosophy, RBS8D project "Deepwater Horizon".	Rev 2 (2000-08-23)
[5]	RBS8D, FDS for ESD.	171456, rev C (2002-02-20)
[6]	RBS8D, FDS for F&G.	171455, rev C (2001-02-25)

Table 6-1: References.