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	PROGETTO / IMPIANTO FSRU Ravenna e Collegamento alla Rete Nazionale Gasdotti		Rev. 0

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EMERGENZA GAS
INCREMENTO DI CAPACITÀ DI RIGASSIFICAZIONE (DL 17.05.2022, n. 50)
FSRU Ravenna e Collegamento alla Rete Nazionale Gasdotti

Rapporto Preliminare di Sicurezza
per la fase di Nulla Osta di Fattibilità (NOF)
ai sensi del D.Lgs. 105/15

ALLEGATO C.7.10
Matrice Causa-Effetti e Dettagli Sistema di Controllo FSRU

0	Emissione per permessi	A. Visigoti	A. Romano	G. Romano	06/07/2022
Rev.	Descrizione	Elaborato	Verificato	Approvato	Data

Illustration 4.14.1a Control Flow for ESD and Tank Protection System (DFDE Mode)

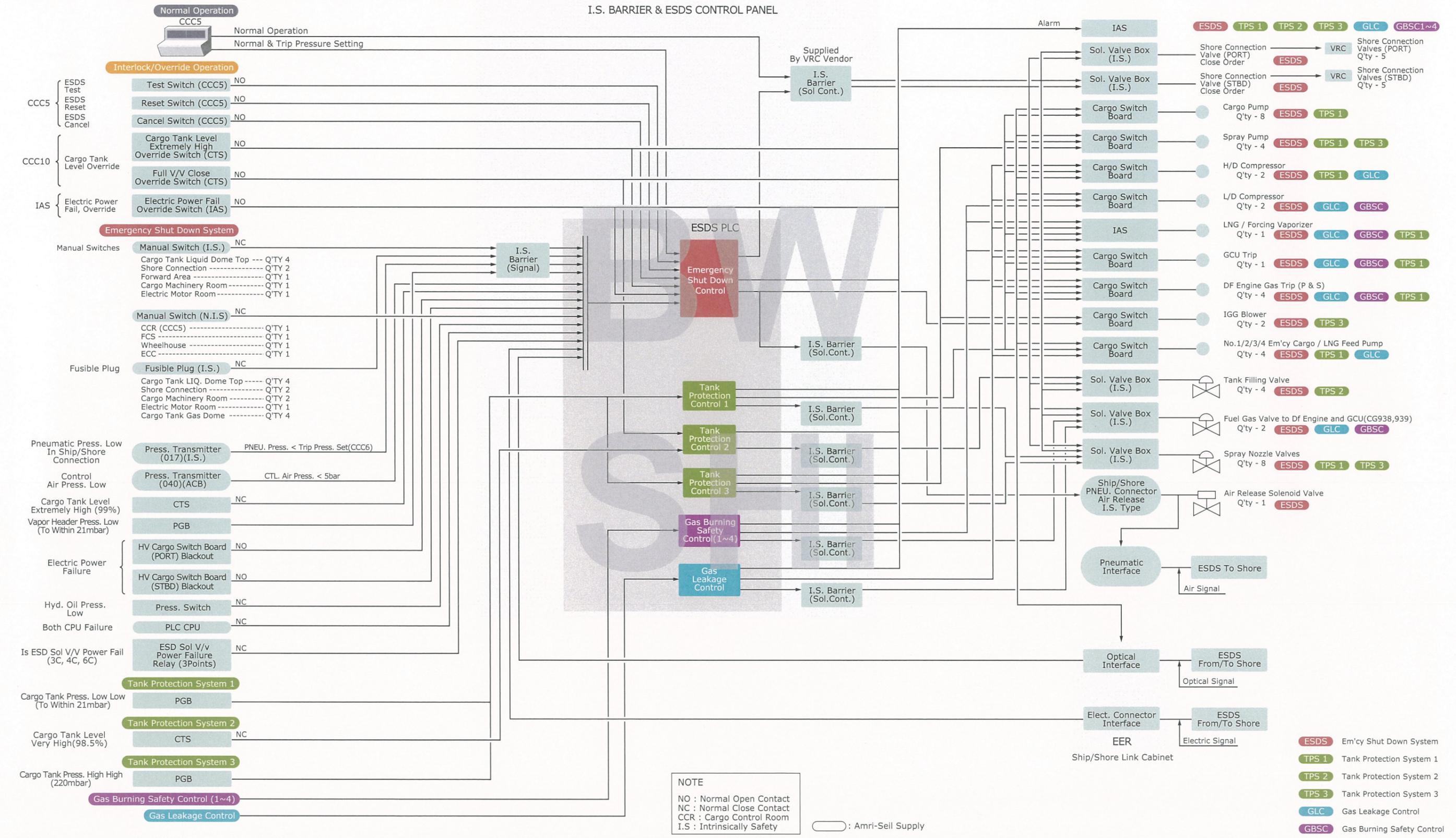


Illustration 4.14.1c ESDS Screen Shot

EMERGENCY SHUTDOWN SYSTEM

Cause Of ESD Trip

- ESD Total Alarm
- Hydr Oil Press Low
- 1 Cargo Tank level Extream High
- 2 Cargo Tank level Extream High
- 3 Cargo Tank level Extream High
- 4 Cargo Tank level Extream High
- Vapor HDR Press LL
- CTL Air Pressure Low < 5bar
- IS ESD Sol VV Power Fail (3C)
- IS ESD Sol VV Power Fail (4C)
- IS ESD Sol VV Power Fail (8C)
- IS ESD Sol VV Power Fail(8C)
- ELECTRIC POWER FAIL (CSBD 1/2)

Manual Push Button Station(No Delay)

- ESD Manual Activated

Thermo Fusible Plugs

- ESD Fusible Plug Activated

Shore Activated ESD

- SHORE TO SHIP LNG ESD
- SHORE TO SHIP CNG ESD
- ESD Pneumatic Press Low Alarm

CTL Air Pressure(PT040)

ELECTRIC POWER FAIL OVERRIDE

DFDE P&S Gas Trip Reset

Home Page

SHIP SHORE LINK SYSTEM

- Ship Shore Link System Abnormal
- Ship Shore Link System Inhibit Ind

REGAS SYSTEM

- Fusible Plug Activated For Regas Plant
- Regas Plant EMCY Stop
- NG Sendout ESD VV Closed

Tank Protection TPS1

- 1 Cargo Tank Press Low Low(TPS1)
- 2 Cargo Tank Press Low Low(TPS1)
- 3 Cargo Tank Press Low Low(TPS1)
- 4 Cargo Tank Press Low Low(TPS1)

Tank Protection TPS2

- 1 Cargo Tank Level Very High(TPS2)
- 2 Cargo Tank Level Very High(TPS2)
- 3 Cargo Tank Level Very High(TPS2)
- 4 Cargo Tank Level Very High(TPS2)

Tank Protection TPS3

- 1 Cargo Tank Press High High(TPS3)
- 2 Cargo Tank Press High High(TPS3)
- 3 Cargo Tank Press High High(TPS3)
- 4 Cargo Tank Press High High(TPS3)

Important Alarms (Not ESD)

- PC CPU Fail Alarm (Both CPU Fail->ESD)
- 3C Sol VV Box Hyd Press
- 4C Sol VV Box Hyd Press
- 6C Sol VV Box Hyd Press
- 8C Sol VV Box Hyd Press

ESD Override

- ESD Total Alarm Override
- Electrical Power Fail ESD Override
- Shore To SHIP ESD Override
- Pneumatic Press Low ESD Override
- 1C TK Level EH ESD Override
- 2C TK Level EH ESD Override
- 3C TK Level EH ESD Override
- 4C TK Level EH ESD Override
- 1C TK level VH(FILL VV Close) Override
- 2C TK level VH(FILL VV Close) Override
- 3C TK level VH(FILL VV Close) Override
- 4C TK level VH(FILL VV Close) Override

Gas Burning Safety Control

- Gas Burning Safety Controller 1 Activated P DFDE
- Gas Burning Safety Controller 2 Activated S DFDE
- Gas Burning Safety Controller 3 Activated P&S DFDE
- Gas Burning Safety Controller 4 Activated GCU

Gas Leakage Control

- Gas Leakage Controller Activated IN EMR Or CMR
- Port DFDE RM Or GVU RM Gas Leakage
- Stbd DFDE RM Or GVU RM GAS Leakage
- GCU AREA GAS Leakage

Misc Alarms

- Master Gas VV(CG938(DFDE))
- Master Gas VV (CG938(GCU))
- Port DFDE Fuel Gas Valve (CG946) Trip
- Stbd DFDE Fuel Gas Valve (CG947) Trip
- LNG / Forcing Vaporizer Stop
- NO 2 & NO 3 EIR Supply Fans Stop(P&S)
- Port GVU RM Or NO 3 EIR Fans Stop
- Stbd GVU RM Or NO 2 EIR Fans Stop
- GCU GVU RM EXT Fans Stop
- BOG Temp HMLL For CG939(GCU)
- BOG Temp HMLL For CG938(DFDE)
- LD Comp. Stop & Master Gas VV Close(WH)
- LD Comp. Stop & Master Gas VV Close(CCC)
- LD Comp. Stop & Master Gas VV Close(ECC)
- LD Comp. Stop & Master Gas VV Close(FCS)
- Normal Source Power Fail
- UPS Source Power Fail
- UPS abnormal alarm

Illustration 4.14.1d Cause and Effect Chart (DFDE Mode_1/2)

Category		Cause	TB No. (I/O Add.)	Result	Set Value	Status	Effect (TB No. [Relay No.])	Activated Group
LNGC DFDE Mode	Test	LNGC MODE (CCCS MODE SWITCH)	1-59,60(I:01/29)			OFF		
		ESD Test	2-15,16(I:02/07)			ON		
	ESD reset	ESD Reset	2-17,18(I:02/08)			ON		
		No.3C Accumulator	5-53,54(I:05/26)		90 barg	ON		
		No.4C Accumulator	5-55,56(I:05/27)		90 barg	ON		
		No.5C Accumulator	5-57,58(I:05/28)		90 barg	ON		
	Inhibit*1	No.8C Accumulator	5-59,60(I:05/29)		90 barg	ON		
		ESD Inhibit	2-19,20(I:02/09)			ON		
	Manual switch	#1 Liquid Dome	IS-1-18 (I:02/13)			OFF		
		#2 Liquid Dome						
#3 Liquid Dome								
#4 Liquid Dome								
FWD_END OF TRUNK DECK								
Shore Conn PORT								
Shore Conn STBD								
Cargo Machinery Room								
Elec Motor Room								
CCC (Cargo Control console)		2-1,2(I:02/00)			OFF			
Fusible plug	ECC (Engine Control console)	1-53,54(I:01/26)		OFF				
	Wheel House	2-21,22(I:02/10)		OFF				
	F.C.S	2-23,24(I:02/11)		OFF				
	High Pressure manifold PORT	IS-39-42		OFF				
	High Pressure manifold SWBD	(I:01/24)		OFF				
	#1 Liquid Dome	IS-21-32 (I:02/14)			OFF			
	#2 Liquid Dome							
	#3 Liquid Dome							
	#4 Liquid Dome							
	#1 Gas Dome							
#2 Gas Dome								
#3 Gas Dome								
#4 Gas Dome								
Shore Conn PORT								
Shore Conn STBD								
S/S link	Cargo Machinery Room 1	IS-33-38 (I:01/25)			OFF			
	Cargo Machinery Room 2							
	Electric Motor Room							
	Regas Plant Condenser		IS-41-48		OFF			
	Regas Train 1 OR 2 OR 3 (Anyone)		(I:01/20)		OFF			
	NG sendout HP manifold Port OR Stbd (Anyone)		IS-49-54(I:02/31)		OFF			
	ESD SIG. FOR LNG		1-35,36(I:01/17)		OFF			
	ESD SIG. FOR CNG		1-33,34(I:01/16)		OFF			
	Tank Level *3		#1 Cargo Tank (EH 99%)	2-31,32(I:02/15)		99%	OFF	
			#2 Cargo Tank (EH 99%)	2-33,34(I:02/16)		99%	OFF	
#3 Cargo Tank (EH 99%)		2-35,36(I:02/17)		99%	OFF			
#4 Cargo Tank (EH 99%)		2-37,38(I:02/18)		99%	OFF			
Override *2	#1 Cargo Tank (EH 99%) ESDS Override	2-47,48(I:02/23)		OFF				
	#2 Cargo Tank (EH 99%) ESDS Override	2-49,50(I:02/24)		OFF				
	#3 Cargo Tank (EH 99%) ESDS Override	2-51,52(I:02/25)		OFF				
	#4 Cargo Tank (EH 99%) ESDS Override	2-53,54(I:02/26)		OFF				
Press. low	Hydraulic Oil Pressure <i>Low</i> (voting 2oo3)	3-21,22(I:03/10)		90 barg voting(2oo3)	OFF			
	Hydraulic Oil Pressure <i>Low</i> (voting 2oo3)	1-43,44(I:01/21)			OFF			
	Hydraulic Oil Pressure <i>Low</i> (voting 2oo3)	1-45,46(I:01/22)			OFF			
	Vapor Header Pressure Low <i>Low</i> (voting 2oo3)	IS-69,70(AI:12/04)		3 mbarg (voting 2oo3)	<3mbarg			
	Vapor Header Pressure Low <i>Low</i> (voting 2oo3)	IS-71,72(AI:12/05)						
	Vapor Header Pressure Low <i>Low</i> (voting 2oo3)	IS-73,74(AI:12/06)						
Power fail	Control Air Pressure <i>Low</i> (voting 2oo3)	11-5,6(AI:11/02)		5 barg	<5barg			
	Control Air Pressure <i>Low</i> (voting 2oo3)	11-1-1,2(AI:11/03)						
	Control Air Pressure <i>Low</i> (voting 2oo3)	11-1-3,4(AI:11/04)						
	Pneumatic Pressure Low	IS-59,60(AI:11/01)		< P ₂				
	No.1 6.6 KV CARGO SWBD	3-61,62(I:03/30)		ON				
	No.2 6.6 KV CARGO SWBD	3-63,64(I:03/31)		ON				
Override *2	IS ESD Sol V/V Power Fail(3C)	5-45,46(I:05/22)		OFF				
	IS ESD Sol V/V Power Fail(4C)	5-47,48(I:05/23)		OFF				
	IS ESD Sol V/V Power Fail(6C)	5-49,50(I:05/24)		OFF				
	IS ESD Sol V/V Power Fail(8C)			OFF				
ESD	Electric Power Fail Override	3-35,36(I:03/17)		ON				
	#1 Cargo Tank Cargo Pump #1, 2 Stop (7-33,34,34,74(2016))			ESD,TPS1				
	#2 Cargo Tank Cargo Pump #1, 2 Stop (7-31,32,71,72(2016))			ESD,TPS1				
	#3 Cargo Tank Cargo Pump #1, 2 Stop (7-27,28,67,68(2013))			ESD,TPS1				
	#4 Cargo Tank Cargo Pump #1, 2 Stop (7-25,26,65,66(2012))			ESD,TPS1				
	#1 Cargo Tank Spray Pump Stop (7-37,38(2018))			ESD,TPS1,TPS3				
	#2 Cargo Tank Spray Pump Stop (7-47,48(2021))			ESD,TPS1,TPS3				
	#3 Cargo Tank Spray Pump Stop (7-39,40(2019))			ESD,TPS1,TPS3				
	#4 Cargo Tank Spray Pump Stop (7-49,50(2024))			ESD,TPS1,TPS3				
	No. 1, 2 H/D Comp. Stop (7-29,30,69,70(2014))			ESD,TPS1,GLC				
No. 1, 2 L/D Comp. Stop (7-35,36,75,76(2017))			ESD,TPS1,GBSC3,4,GLC					
GG Blower Stop (07-45,46,51,52(2022,2025))			ESD,TPS3					
No.1 LNG Feed/Emc'y Pump Stop (10-47,48(5021))			ESD,TPS1					
No.2 LNG Feed/Emc'y Pump Stop (10-51,52(5023))			ESD,TPS1					
No.3 LNG Feed/Emc'y Pump Stop (10-49,50(5022))			ESD,TPS1					
No.4 LNG Feed/Emc'y Pump Stop (10-53,54(5024))			ESD,TPS1					
ESD Sig. FOR LNG (10-43,44(5019))			ESD					
ESD Sig. FOR CNG (10-41,42(5018))			N/A					
Fuel Gas Master Valve Close by 6C ACC. (9-5,6(4002)) *8			ESD,TPS1					
Shore Conn. Valve Close by 4C ACC(9-1,2(4000))			ESD					
Shore Conn. Valve Close by 3C ACC(9-3,4(4001))			ESD					
Pneumatic Air Release Valve SA6(5-57,58(3004))			ESD					
LNG / Forcing vaporizer stop(8-57,58(3028))			ESD,TPS1,GBSC3,GLC					
GPU Trip(7-21,22(2010)) Trip signal pulse 3sec			ESD,TPS1,GBSC4,GLC					
DF engine gas trips(10-27,28,31,32(5012,5014))			ESD,TPS1,GBSC1,3,GLC					
DF engine gas trips(10-19,20,23,24(5009,5011))			ESD,TPS1,GBSC2,3,GLC					
CG938 fuel gas valve to DF engine (P&S) close(10-3,4(5001))			ESD,TPS1,GBSC3,GLC					
CG939 fuel gas valve to GCU close(10-7,8(5003))			ESD,TPS1,GBSC4,GLC					
CG946 fuel gas valve to DF engine (P) close(6-61,62(1030))			ESD,TPS1,GBSC1,3,GLC					
CG947 fuel gas valve to DF engine (S) close(6-63,64(1031))			ESD,TPS1,GBSC2,3,GLC					
#1 Cargo Tank Spray Nozzle Valve 1.2 Close (9-13,14,17,18(4006,4008))			ESD,TPS1,TPS3					
#2 Cargo Tank Spray Nozzle Valve 1.2 Close (9-25,26,29,30(4012,4014))			ESD,TPS1,TPS3					
#3 Cargo Tank Spray Nozzle Valve 1.2 Close (9-37,38,41,42(4018,4020))			ESD,TPS1,TPS3					
#4 Cargo Tank Spray Nozzle Valve 1.2 Close (9-53,54,57,58(4026,4028))			ESD,TPS1,TPS3					
#1 Cargo Tank Fill Valve Close (9-10(4004))			ESD,TPS2					
#2 Cargo Tank Fill Valve Close (9-21,22(4010))			ESD,TPS2					
#3 Cargo Tank Fill Valve Close (9-33,34(4016))			ESD,TPS2					
#4 Cargo Tank Fill Valve Close (9-49,50(4024))			ESD,TPS2					
REGAS Plant EMCY Stop (10-35,36(5015))			N/A					
REGAS SKID 1 LNG Booster P/P A Stop (10-67,68(5025))			N/A					
REGAS SKID 1 LNG Booster P/P B Stop (10-79,80(5028))			N/A					
REGAS SKID 2 LNG Booster P/P A Stop (10-69,70(5026))			N/A					
REGAS SKID 2 LNG Booster P/P B Stop (10-81,82(5029))			N/A					
REGAS SKID 3 LNG Booster P/P A Stop (10-71,72(5027))			N/A					
REGAS SKID 3 LNG Booster P/P B Stop (10-83,84(5030))			N/A					
CG660 NG SENDOUT ESD Valve Close (9-61,62(4030))			N/A					
ESD Total Alarm (7-53,54 (2026))			NE					
Electric Power Fail Override (6-41,42(1020))			NE					
ESD Manual Activated (7-7,8(2003))			NE					
ESD Fusible Plug Activated (7-9,10(2004))			NE					
ESD SIG. FOR LNG (07-11,12(2005))			NE					
ESD SIG. FOR CNG (07-13,14(2006))			NE					
#1-#4 Tank Level Ext. High Alarm (99%) (6-19-26(1009-1012)) *3			NE					
#1-#4 Tank Level Ext. High Override (99%) (6-45-72(CR108-CR111))			NE					
ESD HYDR. OIL PRESS. LOW (7-19,20(2009))			NE					
Vapour header press. Low low(7-55,56(2027)) voting 2 oo 3			NE					
ESD Control Air Press. Low (6-35,36(1017))			NE					
ESD Pneumatic Interface (7-15,16(2007))			NE					
CG660 NG SENDOUT ESD Valve Closed (6-63,64(1031))			NE					
#1-#4 cargo tank press. LL (7-57-64(2028-2031))			NE					
#1-#4 cargo tank press. HH (6-27-34(1013-1016))			NE					
#1-#4 Cargo Tank Level Very High Alarm (98.5%) (6-11-18(1005-1008))			NE					
#1-#4 Cargo Tank Level Very High Override (98.5%) (6-73-80(CR112-CR115))			NE					
ESD P.C.C.P.U ALARM (7-5,6(2002)) *5			NE					
ESD Normal Source Power Failure (6-81,82)			NE					
ESD UPS Source Power Failure (6-83,84)			NE					
GBSC1 activated(10-9,10(5004))			NE					
GBSC2 activated(10-11,12(5005))			NE					
GBSC3 activated(10-13,14(5006))			NE					
GBSC4 activated(10-15,16(5007))			NE					
GLC activated(10-17,18(5008))			NE					
3C Each sol. v/v power fail(08-53,54(3026))			NE					
4C Each sol. v/v power fail(08-55,56(3029))			NE					
6C Each sol. v/v power fail(08-59,60(3029))			NE					
8C Each sol. v/v power fail(08-61,62(3030))			NE					
ESD Fusible Plug Activated for regas plant(06-51,52(1025))			NE					

Illustration 4.14.1f Cause and Effect Chart (FSRU Mode_1/2)

Note

- Categories in Action part mean the following
 - ESD: ESD related action
 - TPS1/2/3: Tank Protection Action Type 1/2/3
 - GBSC : Gas Burning Safety Control
 - GLC : Gas Leakage Control
- Symbol(signal status) and abbreviation
 - : On at activated condition, ● : Off at activated condition
 - NE : Normal Energized, NDE : Normal De-energized
- ESD Cause Time Delay: Time delay to be adjustable
 - Manual Switch: Time delay 0sec.
 - Fusible Plug: Time delay 5sec.
 - S/S Link: Time delay 5sec.
 - Tank Level: Time delay 5sec.
 - Press. Low/High: Time delay 5sec. (except for Hydraulic Oil Press. Low => 10sec.)
 - Power Fail: Time delay 5sec.

Preliminary check list for test

- Cable wiring condition of ESDS local panel.
- Operating condition of VRC, IAS and all Equipments related ESDS.
- Supplied power for ESDS

Category	Cause	TB No. (I/O Add.)	Result	Set Value	Status	Effect (TB No. [Relay No.])	
FSRU Mode	FSRU_MODE (CCCS MODE SWITCH)	1-59,60(I:01/29)			ON		
Test	ESD Test	2-15,16(I:02/07)			ON		
	ESD Reset	2-17,18(I:02/08)			ON		
	ESD reset	No.3C Accumulator	5-55,56(I:05/27)	90 barg	ON		
		No.4C Accumulator	5-57,58(I:05/28)	90 barg	ON		
		No.6C Accumulator	5-59,60(I:05/29)	90 barg	ON		
		No.8C Accumulator	5-53,54(I:05/26)	90 barg	ON		
	Inhibit-1	ESD Inhibit	2-19,20(I:02/09)			ON	
		#1 Liquid Dome	IS-1-18 (I:02/13)			OFF	
		#2 Liquid Dome		OFF			
		#3 Liquid Dome		OFF			
#4 Liquid Dome		OFF					
FWD_END OF TRUNK DECK		OFF					
Shore Conn PORT		OFF					
Shore Conn STBD		OFF					
Cargo Machinery Room		OFF					
Elec Motor Room		OFF					
CCC (Cargo control console)	2-1,2(I:02/00)				OFF		
Manual switch	ECC (Engine control console)	1-53,54(I:01/26)			OFF		
	Wheel House	2-21,22(I:02/10)			OFF		
	F.C.S	2-23,24(I:02/11)			OFF		
	High Pressure manifold PORT	IS-39-42 (I:01/24)			OFF		
	High Pressure manifold STBD				OFF		
	Fusible plug	#1 Liquid Dome	IS-21-32 (I:02/14)			OFF	
		#2 Liquid Dome		OFF			
		#3 Liquid Dome		OFF			
		#4 Liquid Dome		OFF			
		#1 Gas Dome		OFF			
#2 Gas Dome		OFF					
#3 Gas Dome		OFF					
#4 Gas Dome		OFF					
Shore Conn PORT		OFF					
Shore Conn STBD		OFF					
ESD	Cargo Machinery Room 1	IS-33-38 (I:01/25)			OFF		
	Cargo Machinery Room 2		OFF				
	Electric Motor Room		OFF				
	Regas Plant Recondenser		OFF				
	Regas Skid 1 OR 2 OR 3 (Anyone)		IS-43-54(I:01/23)			OFF	
	NG sendout HP manifold Port OR Stbd (Anyone)		OFF				
	ESD SIG. FOR LNG		1-35,36(I:01/17)			OFF	
	ESD SIG. FOR CNG		1-33,34(I:01/16)			OFF	
	S/S link		#1 Cargo Tank (EH 99%)	2-31,32(I:02/15)	99%	OFF	
			#2 Cargo Tank (EH 99%)	2-33,34(I:02/16)	99%	OFF	
#3 Cargo Tank (EH 99%)		2-35,36(I:02/17)	99%	OFF			
#4 Cargo Tank (EH 99%)		2-37,38(I:02/18)	99%	OFF			
Override #2	#1 Cargo Tank (EH 99%) ESDS Override	2-47,48(I:02/23)			OFF		
	#2 Cargo Tank (EH 99%) ESDS Override	2-49,50(I:02/24)			OFF		
	#3 Cargo Tank (EH 99%) ESDS Override	2-51,52(I:02/25)			OFF		
	#4 Cargo Tank (EH 99%) ESDS Override	2-53,54(I:02/26)			OFF		
Pres. low	Hydraulic Oil Pressure Low (voting 2oo3)	3-21,22(I:03/10)	90 barg	voting(2oo3)	OFF		
	Hydraulic Oil Pressure Low (voting 2oo3)	1-43,44(I:01/21)			OFF		
	Hydraulic Oil Pressure Low (voting 2oo3)	1-45,46(I:01/22)			OFF		
	Vapor Header Pressure Low Low (voting 2oo3)	IS-69,70(AI:12/04)			3 mbarG		
	Vapor Header Pressure Low Low (voting 2oo3)	IS-71,72(AI:12/05)			3 mbarG		
	Vapor Header Pressure Low Low (voting 2oo3)	IS-73,74(AI:12/06)			3 mbarG		
	Control Air Pressure Low (voting 2oo3)	11-5,6(AI:11/02)			5 barg		
	Control Air Pressure Low (voting 2oo3)	11-1-1,2(AI:11/03)			5 barg		
	Control Air Pressure Low (voting 2oo3)	11-1-3,4(AI:11/04)			5 barg		
	Pneumatic Pressure Low	IS-59,60(AI:11/01)			< P _{TH}		
Power fail	No.1 6.6 KV CARGO SWBD	3-61,62(I:03/30)			ON		
	No.2 6.6 KV CARGO SWBD	3-63,64(I:03/31)			ON		
	IS ESD Sol V/V Power Fail(3C)	5-47,48(I:05/23)			OFF		
	IS ESD Sol V/V Power Fail(4C)	5-49,50(I:05/24)			OFF		
Override #2	IS ESD Sol V/V Power Fail(6C)	5-51,52(I:05/25)			OFF		
	IS ESD Sol V/V Power Fail(8C)	5-45,46(I:05/22)			OFF		
Override #2	Electric Power Fail Override	3-35,36(I:03/17)			ON		

Illustration 4.14.1g Cause and Effect Chart (FSRU Mode 2/2)

Category		Cause	TB No. (I/O Add.)	Result	Set Value	Status	Effect (TB No. [Relay No.])	Activated Group
<p>Note</p> <p>1. Categories in Action part mean the following</p> <ul style="list-style-type: none"> - ESD: ESD related action - TPS1/2/3: Tank Protection Action Type 1/2/3 - GBSC: Gas Burning Safety Control - GLC: Gas Leakage Control <p>2. Symbol(signal status) and abbreviation</p> <ul style="list-style-type: none"> O: On at activated condition, ●: Off at activated condition NE: Normal Energized, NDE: Normal De-energized <p>3. ESD Cause Time Delay; Time delay to be adjustable</p> <ul style="list-style-type: none"> - Manual Switch: Time delay 0sec. - Fusible Plug: Time delay 5sec. - S/S Link: Time delay 5sec. - Tank Level: Time delay 5sec. - Press. Low/High: Time delay 5sec. (except for Hydraulic Oil Press. Low => 10sec.) - Power Fail: Time delay 5sec. <p>Preliminary check list for test</p> <ol style="list-style-type: none"> 1. Cable wiring condition of ESDS local panel. 2. Operating condition of VRC, IAS and all Equipments related ESDS. 3. Supplied power for ESDS 								
<p>Effect (TB No. [Relay No.])</p> <p>#1 Cargo Tank Cargo Pump #1, 2 Stop (7-33, 34, 73, 74[2016])</p> <p>#2 Cargo Tank Cargo Pump #1, 2 Stop (7-31, 32, 31, 32, 71, 72[2015])</p> <p>#3 Cargo Tank Cargo Pump #1, 2 Stop (7-27, 28, 67, 68[2013])</p> <p>#4 Cargo Tank Cargo Pump #1, 2 Stop (7-26, 26, 65, 66[2012])</p> <p>#1 Cargo Tank Spray Pump Stop (7-37, 38[2018])</p> <p>#2 Cargo Tank Spray Pump Stop (7-47, 48[2023])</p> <p>#3 Cargo Tank Spray Pump Stop (7-39, 40[2019])</p> <p>#4 Cargo Tank Spray Pump Stop (7-49, 50[2024])</p> <p>No. 1, 2 H/D Comp. Stop (7-29, 30, 69, 70[2014])</p> <p>No. 1, 2 L/D Comp. Stop (7-35, 36, 75, 76[2017])</p> <p>GG Blower Stop (07-45, 46, 51, 52[2022, 2025])</p> <p>No. 1 LNG Feed/Emc'y Pump Stop (10-47, 48[5021])</p> <p>No. 2 LNG Feed/Emc'y Pump Stop (10-51, 52[5023])</p> <p>No. 3 LNG Feed/Emc'y Pump Stop (10-49, 50[5022])</p> <p>No. 4 LNG Feed/Emc'y Pump Stop (10-53, 54[5024])</p> <p>ESD Sig. FOR LNG (10-43, 44[5019])</p> <p>ESD Sig. FOR CNG (10-41, 42[5018])</p> <p>Fuel Gas Master Valve Close by 6C ACC. (9-5, 6[4002]) *8</p> <p>Shore Conn. Valve Close by 4C ACC. (9-1, 2[4000])</p> <p>Shore Comm. Valve Close by 3C ACC. (9-3, 4[4001])</p> <p>Pneumatic Air Release Valve SA6(S-57, 58[3004])</p> <p>LNG / Fueling vaporizer stop(6-57, 58[2028])</p> <p>GCU trip(7-21, 22[2010]) Trip signal pulse 3sec</p> <p>DF engine gas trip(P)[10-27, 28, 31, 32[5012, 5014])</p> <p>DF engine gas trip(S)[10-19, 20, 23, 24[5009, 5011])</p> <p>CG938 fuel gas valve to DF engine (P&S) close(10-3, 4[5001])</p> <p>CG939 fuel gas valve to GCU close(10-7, 8[5003])</p> <p>CG946 fuel gas valve to DF engine (P) close(6-61, 62[1030])</p> <p>CG947 fuel gas valve to DF engine (S) close(6-63, 64[1031])</p> <p>#1 Cargo Tank Spray Nozzle Valve 1, 2 Close (9-13, 14, 17, 18[4006, 4008])</p> <p>#2 Cargo Tank Spray Nozzle Valve 1, 2 Close (9-25, 26, 29, 30[4012, 4014])</p> <p>#3 Cargo Tank Spray Nozzle Valve 1, 2 Close (9-37, 38, 41, 42[4018, 4020])</p> <p>#4 Cargo Tank Spray Nozzle Valve 1, 2 Close (9-53, 54, 57, 58[4026, 4028])</p> <p>#1 Cargo Tank Fill Valve Close (9-9, 10[4004])</p> <p>#2 Cargo Tank Fill Valve Close (9-21, 22[4010])</p> <p>#3 Cargo Tank Fill Valve Close (9-33, 34[4016])</p> <p>#4 Cargo Tank Fill Valve Close (9-49, 50[4024])</p> <p>REGAS Plant EM CY Stop (10-35, 36[5015])</p> <p>REGAS SKID 1 LNG Booster P/P A Stop (10-55, 56[5025])</p> <p>REGAS SKID 1 LNG Booster P/P B Stop (10-61, 62[5028])</p> <p>REGAS SKID 2 LNG Booster P/P A Stop (10-57, 58[5026])</p> <p>REGAS SKID 2 LNG Booster P/P B Stop (10-63, 64[5029])</p> <p>REGAS SKID 3 LNG Booster P/P A Stop (10-59, 60[5027])</p> <p>REGAS SKID 3 LNG Booster P/P B Stop (10-65, 66[5030])</p> <p>CG660 NG SENDOUT Valve Close by 8C ACC. (9-43, 44[4021])</p> <p>ESD Total Alarm (7-53, 54[2026])</p> <p>Electric Power Fail Override (6-41, 42[1020])</p> <p>ESD Manual Activated (7-7, 8[2003])</p> <p>ESD Fuelie Plug Activated (7-9, 10[2004])</p> <p>ESD SIG. FOR CNG (07-11, 12[2005])</p> <p>ESD SIG. FOR LNG (07-13, 14[2006])</p> <p>#1-#4 Tank Level Ext. High Alarm (99%) (6-19-26[1009-1012]) *3</p> <p>#1-#4 Tank Level Ext. High Override (99%) (6-65-72[CR108-CR111])</p> <p>ESD HYDR. OIL PRESS. LOW (7-19, 20[2009])</p> <p>Vapour header press. Low low(7-55, 56[2027]) <i>valving 2 oo 3</i></p> <p>ESD Control Air Press. Low (6-35, 36[1017])</p> <p>ESD Pneumatic Interface (7-15, 16[2007])</p> <p>CG660 NG SENDOUT ESD Valve Closed (10-37, 40[5017])</p> <p>#1-#4 cargo tank press. LL (7-57-64[2028-2031])</p> <p>#1-#4 cargo tank press. HH (6-27-34[1013-1016])</p> <p>#1-#4 Cargo Tank Level Very High Alarm (97.1%) (6-11-18[1005-1008])</p> <p>#1-#4 Cargo Tank Level Very High Override (97.1%) (6-73-80[CR112-CR115])</p> <p>ESD P.C.CPU ALARM (7-5, 6[2002])*5</p> <p>ESD Normal Source Power Failure (6-81, 82)</p> <p>ESD UPS Source Power Failure (6-83, 84)</p> <p>GBSC1 activated(10-9, 10[5004])</p> <p>GBSC2 activated(10-11, 12[5005])</p> <p>GBSC3 activated(10-13, 14[5006])</p> <p>GBSC4 activated(10-15, 16[5007])</p> <p>GLC activated(10-17, 18[5008])</p> <p>3C Each sol. v/v power fail(08-53, 54[2026])</p> <p>4C Each sol. v/v power fail(08-55, 56[2027])</p> <p>6C Each sol. v/v power fail(08-59, 60[2029])</p> <p>8C Each sol. v/v power fail(08-61, 62[2030])</p> <p>ESD Fusible Plug Activated for regas plant(06-51, 52[1025])</p>								
<p>FSRU Mode</p>								
TPS1	Tank press. low	#1 Cargo Tank Press. Low Low #2 Cargo Tank Press. Low Low #3 Cargo Tank Press. Low Low #4 Cargo Tank Press. Low Low	S-AI-02/61, 62(AI:12/00) S-AI-03/63, 64(AI:12/01) S-AI-04/65, 66(AI:12/02) S-AI-05/67, 68(AI:12/03)	21 mbarG 21 mbarG 21 mbarG 21 mbarG	<21 mbarG <21 mbarG <21 mbarG <21 mbarG	●	ESD, TPS1	
TPS2	Tank level *3	#1 Cargo Tank (VH 97.1%) #2 Cargo Tank (VH 97.1%) #3 Cargo Tank (VH 97.1%) #4 Cargo Tank (VH 97.1%)	2-39, 40(I:02/19) 2-41, 42(I:02/20) 2-43, 44(I:02/21) 2-45, 46(I:02/22)	97.1% 97.1% 97.1% 97.1%	OFF OFF OFF OFF	●	ESD, TPS1, TPS2	
TPS2	Override *2	#1 Cargo Tank Fill V/V Close Override #2 Cargo Tank Fill V/V Close Override #3 Cargo Tank Fill V/V Close Override #4 Cargo Tank Fill V/V Close Override	2-55, 56(I:02/27) 2-57, 58(I:02/28) 2-59, 60(I:02/29) 2-61, 62(I:02/30)	OFF OFF OFF OFF	OFF OFF OFF OFF	●	ESD, TPS1, TPS2	
TPS3	Tank press. High	#1 Cargo Tank Press. High High #2 Cargo Tank Press. High High #3 Cargo Tank Press. High High #4 Cargo Tank Press. High High	S-AI-02/61, 62(AI:12/00) S-AI-03/63, 64(AI:12/01) S-AI-04/65, 66(AI:12/02) S-AI-05/67, 68(AI:12/03)	670 mbarG 670 mbarG 670 mbarG 670 mbarG	>670 mbarG >670 mbarG >670 mbarG >670 mbarG	●	ESD, TPS1, TPS3	
GBSC1		Gas Leakage Detected in DF engine rm(p) or GUVU rm(p) Anyone 60% LEL - Gas valve unit rm extraction fans both stop(p) or - No.3 E/R supply fan stop(p) DFDE/GUVU rm (P) fire	3-01, 02(I:03/00) 3-23, 24(I:03/11) 3-37, 38(I:03/18)	60% LEL ON ON	ON ON ON	●	ESD, TPS1, GBSC1, GLC	
GBSC2		Gas Leakage Detected in DF engine rm(s) or GUVU rm(s) Anyone 60% LEL - Gas valve unit rm extraction fans both stop(s) or - No.2 E/R supply fan stop(s) DFDE/GUVU rm (S) fire	3-05, 06(I:03/02) 3-25, 26(I:03/12) 3-39, 40(I:03/19)	60% LEL ON ON	ON ON ON	●	ESD, TPS1, GBSC2, 3, GLC	
GBSC3		Gas Leakage Detected in DF engine rm(p&s) or GUVU rm(p&s) Anyone 60% LEL Gas valve unit rm extraction fan stop(p&s) No2 & No3 E/R supply fans both stop (p&s) Fuel gas supply to DF engine temp high-high/low-low DFDE (P&S) gas tripped Master gas valve close(CG938)(CCC) Master gas valve close(CG938)(ECC)	3-01, 02(I:03/00) and 3-05, 06(I:03/02) 3-23, 24(I:03/11) and 3-25, 26(I:03/12) 3-29, 30(I:03/14) 3-33, 34(I:03/16) {(I:05/16)or(I:05/17)} and{(I:05/18)or(I:05/19)} 1-55, 56(I:01/27) 1-61, 62(I:01/30)	ON (AND) ON (AND) ON ON ON ON	ON (AND) ON (AND) ON ON ON ON	●	ESD, TPS1, GBSC3, 4, GLC	
GBSC3 CASE1		GCU not running Gas Leakage Detected in GUVU rm of GCU or GCU area Anyone 60% LEL Gas valve unit rm of GCU extraction fan stop Fuel gas supply to GCU temp high-high/low-low Master gas valve close from GCU *7 Fire alarm in GCU area Master gas valve close(CG939)(CCC) Master gas valve close(CG939)(ECC)	3-15, 16(I:03/7) 3-7, 8(I:03/03) 3-27, 28(I:03/13) 3-31, 32(I:03/15) 3-45, 46(I:03/22) 2-25, 26(I:02/12) 1-57, 58(I:01/28) 1-63, 64(I:01/31)	ON ON ON ON ON ON ON	ON ON ON ON ON ON ON	●	ESD, TPS1, GBSC4, GLC	
GBSC4 CASE1		All DFDE MDO/HFO mode Gas Leak Detec. in Elec. Motor RM Gas Leak Detec. in Cargo Mach. RM	3-13, 14(I:03/06) 3-11, 12(I:03/05) 3-9, 10(I:03/04)	ON 60% LEL 60% LEL	ON ON ON	●	ESD, TPS1, GBSC4, GLC	
NG SENDOUT CONTROL		Gas Leakage around REGAS Plant Gas Sampling System NG Sendout High High Press NG Sendout Low Low Temp	1-41, 42(I:01/20) 3-19, 20(I:03/09) 3-11, 12(I:03/05)	60% LEL 115 barg -5°C	ON ON ON	●	ESD, TPS1, GBSC2, 3, GLC	
PLC FAIL		Both CPU Failure *4 CPU Failure (One of Them) *5				●	ESD, TPS1, GBSC2, 3, GLC	
POWER TEST		Normal Source Power Fail UPS Output Power Fail	6-81, 82(PW1) 6-83, 84(PW2)	AND AND	ON ON	●	ESD, TPS1, GBSC2, 3, GLC	

Notice

- *1 When ESD Inhibit is selected, ESDS is not operated.
- *2 When Override is activated, ESD or TPS2 is not operated.
- *3 Each tank level alarm(Ext. High or Very High) is generated according to each tank condition.
- *4 When Both CPUs are failed, ESD is activated and all output signals are turned off.
- *5 When one of the redundant CPU is failed, an alarm for the CPU failure is generated and passed to IAS.

* P_{TS}: Trip Pressure Set Point which can be set by "PNEU. SETTING SWITCH (TRIP)" in CCR.

* Revision
Rev.0 Prepared for Approval (July 25, 2013)

Illustration 4.14.2a ESDS Pneumatic System

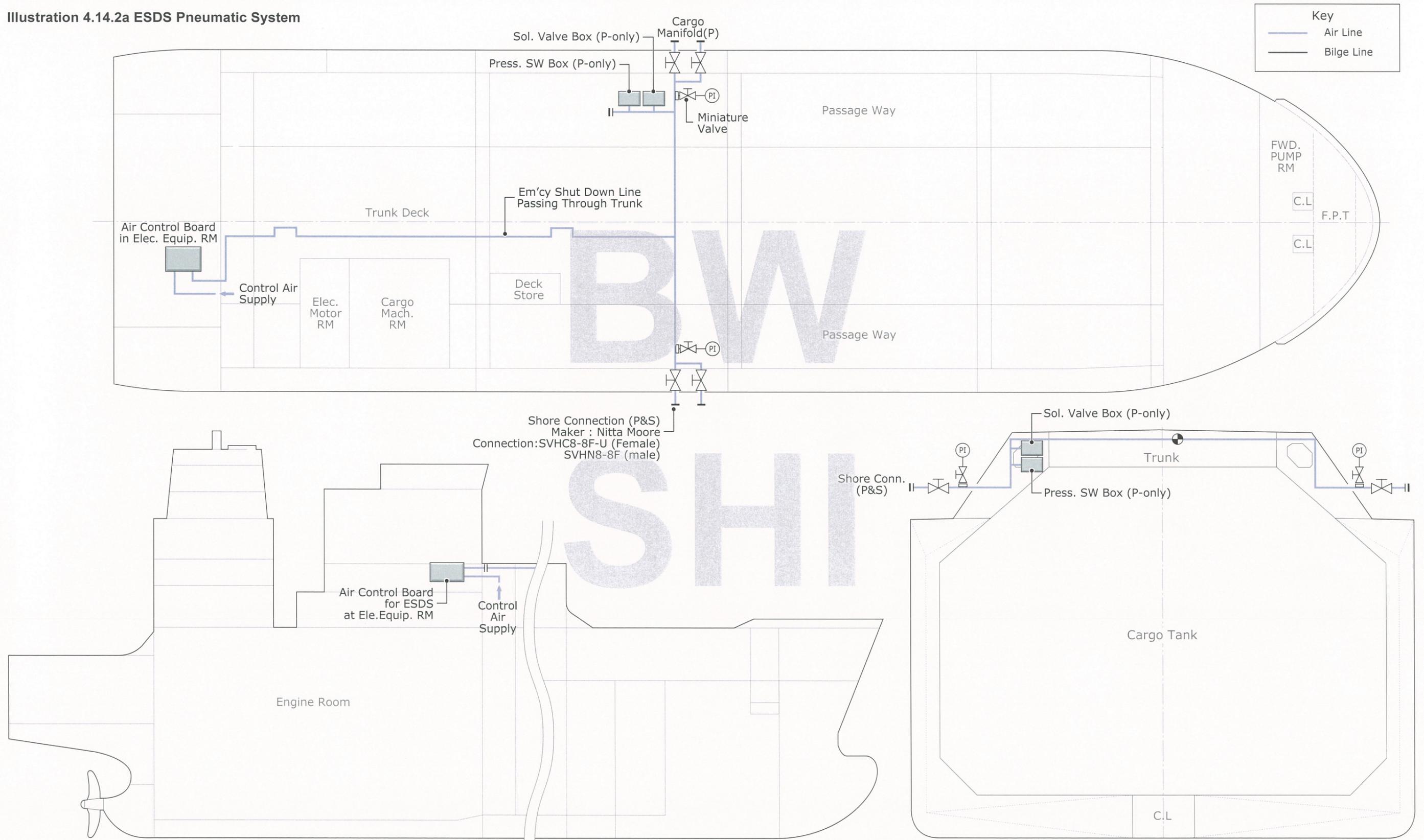


Illustration 4.14.3a Ship-Shore Link

