Emergency Shutdown System for LNG Carriers

Simulation Tech Inc

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STI

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Contents

Introduction

- ✓ Importance of Natural Gas (NG) continuously increases especially for the cleanliness during combustion.
- ✓ Transportation of the Natural Gas is the key issue in the value chain of NG supply.
- ✓ Pipe lines are suitable for short distances and Liquefied Natural Gas (LNG) is made for a long-distance transportation.
- ✓ LNG carriers have been used for a long-distance transportation from loading terminals and to unloading terminals.
- ✓ Safety in the LNG handling system is the most important issue during loading, transportation, and unloading.
- ✓ Emergency Shutdown (ESD) Systems for LNG carriers are designed and installed onboard LNG carriers to for Fire safety and to maintain the integrity of the cargo system.
- ✓ ESD systems are mandatory for LNG Carriers and any types of ships handling LNG onboard, like LNG SRV, FSRU, LNG bunkering ships, etc.
- ✓ STI has been delivering ESD systems for LNG ships and their variations since 2001.
- ✓ Over 200 LNG ships afloat are equipped with the ESD system from STI.

Introduction

✓ STI has been supporting the LNG shipping industry for over 20 years and will continue the services from
- System design
- Fabrication and Tests
- Commissioning
- After sales services
- System upgrades and modification

✓ From the varieties of projects, STI has gained lots of knowledge about the LNG systems, and ready to provide any kind of customization services from the Generic ESD system.

✓ ESD System design from STI is based on the guidelines from
- SIGTTO
- New IGC Code
- Regulations from various classification societies
- Requirements from ship owners and shipyards designers

Generic System

✓ ESD system links between LNG carriers and LNG terminals to exchange critical information especially for the safety

✓ There are 5 main connections between LNG carriers and LNG terminals (although not all of them are used everywhere)
- Pneumatic Connection
- Fiber Optic Connection
- Electric Connection
- Hot line telephone
- VHF

✓ When the ESD signal is triggered either from ship or shore,
ESD system initiates the ESD process to the related systems of IAS, VRC, SSL, etc.

✓ ESD System from STI has several main components that are interconnected to other systems onboard.
- Pneumatic link system
- Field components of Fusible plug and Emergency push buttons
- Main control panel interfacing with other systems

Generic ESD System

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✓ There are 5 main connections between LNG carriers and LNG terminals (although not all of them are used everywhere)
- Pneumatic Connection
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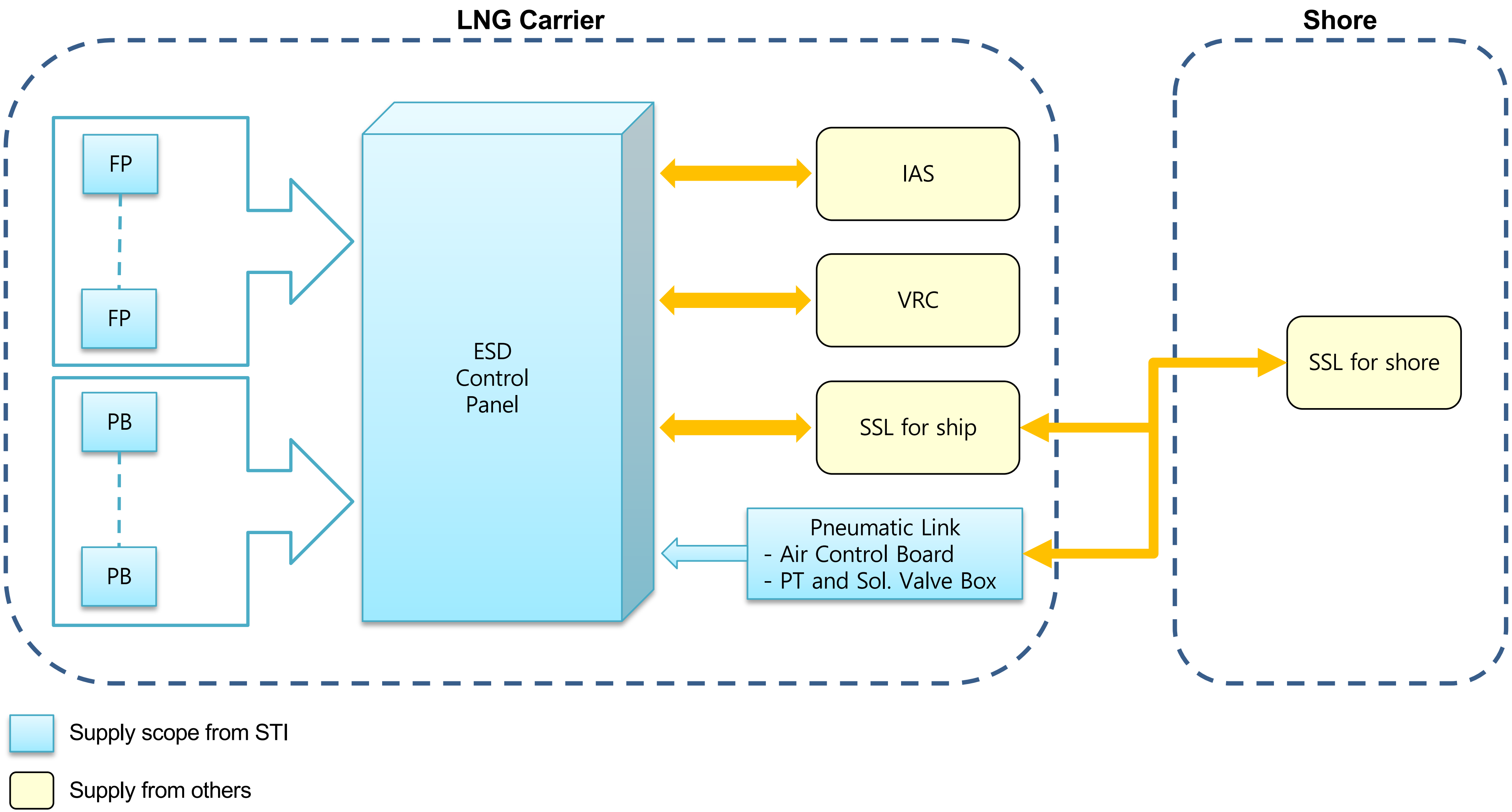
- Electric Connection
- Hot line telephone
- VHF

✓ When the ESD signal is triggered either from ship or shore, ESD system initiates the ESD process to the related systems of
- IAS (Integrated Automation System),
- VRC (Valve Remote Control System),
- SSL (Ship Shore Link System).

✓ ESD System from STI has several main components that are interconnected to other systems onboard.
- Pneumatic link system
- Field components of Fusible plug (FP) and Emergency push buttons (PB)
- Main control panel interfacing with other systems
- Tank protection system to protect from Low Pressure (TPS I), Over Level (TPS II) or Over Pressure (TPS III)

Generic ESD System



System Customization

- ✓ STI has been delivering ESD system for a variety of variations in the system configuration
- ✓ LNG carriers have been evolving for energy saving, saving cargo, and applications.
  All the variations require new set of safety requirements specified as “Cause & Effect Charts”.
  STI has been customizing the ESD system to suit various requirements from the clients,
  during design stage, commissioning, and even after delivery.
- ✓ Over 20 years of experience and booking keeping, STI is ready to respond ever changing requirements from clients.
- ✓ All the designs and fabrications are as per class requirements and other requirements specific to projects.

Services from STI

- ✓ Our service covers from preliminary design review to after delivery requests.

Design ❯ Fabrication ❯ Commissioning ❯ Warranty ❯ Lifetime

Design
- ✓ Design review
- ✓ Review of specifications
- ✓ Design approval

Fabrication
- ✓ FAT
- ✓ Integrated FAT

Commissioning
- ✓ Quay commissioning
- ✓ Sea trial
- ✓ Gas trial
- ✓ Crew training

Warranty
- ✓ Spare parts supply

Lifetime
- ✓ System check
- ✓ System upgrade
- ✓ System modification

Reference List (as of May 2021)

No.	Yard	H.No	Series	Onwer	Scope
1	SHI	**1406**	-	EXMAR	Total System
2	SHI	**1425**	-	AP MOLLER	Total System
3	SHI	**1428**		BRITISH GAS	Total System
4	SHI	**1440**		3J PROJECT	Total System
5	SHI	**1502**		MISC	Total System
6	SHI	**1441**	1440 Series	RASGAS	Total System
7	DSME	**2227**		KONGSBERG	Pneumatic System
8	DSME	**2228**	2227 Series	KONGSBERG	Pneumatic System
9	SHI	**1442**	1440 Series	3J PROJECT	Total System
10	DSME	**2226**	2227 Base	Golar LNG	Pneumatic System
11	SHI	**1536**	1440 Base	OMAN	Total System
12	SHI	**1503**	1502 Series	MISC	Total System
13	SHI	**1553**	1428 Base	BRITISH GAS	Total System
14	DSME	**2234**	2226 Series	Golar LNG	Pneumatic System
15	DSME	**2235**	2227 Base	Kristen Navigation	Pneumatic System
16	SHI	**1554**	1553 Series	BRITISH GAS	Total System
17	SHI	**1562**	1425 Base	AP MOLLER	Total System
18	SHI	**1589**	1502 Series	MISC	Total System
19	SHI	**1573**	1536 Series	OMAN	Total System
20	SHI	**1555**	1553 Series	BRITISH GAS	Total System

Reference List (as of May 2021)

No.	Yard	H.No	Series	Onwer	Scope
21	SHI	**1590**	1502 Series	MISC	Total System
22	SHI	**1594**	1440 Base	4J PROJECT	Total System
23	SHI	**1585**	1553 Base	BRITISH GAS	Total System
24	SHI	**1586**	1585 Series	BRITISH GAS	Total System
25	SHI	**1587**	1585 Series	BRITISH GAS	Total System
26	SHI	**1591**	1502 Series	MISC	Total System
27	SHI	**1588**	1585 Series	BRITISH GAS	Total System
28	DSME	**2229**	2227 Base	BERGESEN	Pneumatic System
29	DSME	**2230**	2229 Series	BERGESEN	Pneumatic System
30	DSME	**2231**	2229 Series	BERGESEN	Pneumatic System
31	DSME	**2232**	2229 Series	BERGESEN	Pneumatic System
32	DSME	**2243**	2235 Series	Kristen Navigation	Pneumatic System
33	DSME	**2244**	2226 Series	Kristen Navigation	Pneumatic System
34	SHI	**1607**	1425 Base	AP MOLLER	Total System
35	SHI	**1608**	1607 Series	AP MOLLER	Total System
36	SHI	**1625**	1607 Series	AP MOLLER	Total System
37	SHI	**1626**	1607 Series	AP MOLLER	Total System
38	SHI	**1619**	1440 Base	K-LINE PROJECT	Total System
39	SHI	**1620**	1619 Series	K-LINE PROJECT	Total System
40	SHI	**1634**	1619 Series	K-LINE PROJECT	Total System

Reference List (as of May 2021)

No.	Yard	H.No	Series	Onwer	Scope
41	SHI	**1643**	1440 Base	TEEKAY PROJECT	Total System
42	HHI	**1862**		NYK/JAPAN	Total System
43	SHI	**1644**	1643 Series	TEEKAY PROJECT	Total System
44	HHI	**1863**	1862 Series	NYK/JAPAN	Total System
45	SHI	**1645**	1643 Series	TEEKAY PROJECT	Total System
46	SHI	**1646**	1643 Series	TEEKAY PROJECT	Total System
47	HHI	**1875**	1862 Series	NYK/JAPAN	Total System
48	HHI	**1876**		MOL/JAPAN	Total System
49	~~HHI~~	~~**1903**~~		Canceled	ESDS
50	SHI	**1675**	1643 Base	QGTC PROJECT	Total System
51	HSHI	**S324**	1876series	NEFERTITI SHIPPING	Total System
52	SHI	**1696**	1675 Base	QGTC PROJECT	Total System
53	HHIC	**N192**		KOGAS PROJECT	Total System
54	SHI	**1676**	1675 Series	QGTC PROJECT	Total System
55	SHI	**1677**	1675 Series	QGTC PROJECT	Total System
56	SHI	**1694**	1675 Series	QGTC PROJECT	Total System
57	HHI	**1908**	1862 Base	QGTC PROJECT	Total System
58	SHI	**1695**	1675 Series	QGTC PROJECT	Total System
59	HHI	**1909**	1908 Series	QGTC PROJECT	Total System
60	SHI	**1686**	1619 Base	ILTC PROJECT	Total System

Reference List (as of May 2021)

No.	Yard	H.No	Series	Onwer	Scope
61	SHI	**1697**	1675 Series	QGTC PROJECT	Total System
62	SHI	**1688**	1607 Base	LEIF HOEGH	Total System
63	SHI	**1632**	1607 Series	AP MOLLER	Total System
64	SHI	**1633**	1607 Series	AP MOLLER	Total System
65	HHI	**1910**	1908 Series	QGTC PROJECT	Total System
66	DSME	**2258**	2229 base	BW GAS	Total System
67	DSME	**2259**	2229 base	BW GAS	Total System
68	SHI	**1726**	1675 Base	QGTC PROJECT	Total System
69	SHI	**1751**	1726 Series	QGTC PROJECT	Total System
70	SHI	**1752**	1726 Series	QGTC PROJECT	Total System
71	SHI	**1745**	1607 base	BG	Total System
72	HHIC	**N193**		STX PAN OCEAN PROJECT	Total System
73	SHI	**1689**	1607 Base	LEIF HOEGH	Total System
74	SHI	**1753**	1726 Series	QGTC PROJECT	Total System
75	SHI	**1754**	1726 Series	QGTC PROJECT	Total System
76	SHI	**1641**	2258 base	GASLOG LNG	Total System
77	SHI	**1858**	1745 add. Proj.	BG	Total System
78	STX	**S3008**	2258 base	ELCANO	Total System
79	SHI	**1746**	1607 base	BG	Total System
80	SHI	**1642**	2258 base	GASLOG LNG	Total System

Reference List (as of May 2021)

No.	Yard	H.No	Series	Onwer	Scope
81	SHI	**1859**	1745 add. Proj.	BG	Total System
82	Kejin	**2008-2519**		-	LPG ESDS
83	Kejin	**2008-2520**		-	LPG ESDS
84	DSME	**2273**		BRUNEI	Total System
85	DSME	**2277**		BRUNEI	Total System
86	DSME	**2280**		SONANGOL	Total System
87	Kejin	**2008-2521**		-	LPG ESDS
88	Kejin	**2008-2522**		-	LPG ESDS
89	DSME	**2281**		SONANGOL	Total System
90	DSME	**2282**		SONANGOL	Total System
91	SHI	**1810**		ANGOLA	Total System
92	SHI	**1811**		ANGOLA	Total System
93	SHI	**1812**		ANGOLA	Total System
94	SHI	**1813**		ANGOLA	Total System
95	SHI	**2031**	1688 Base	Golar FSRU	Total System
96	SHI	**2021**		Golar LNG	Total System
97	SHI	**1946**		GasLog LNG	Pneumatic System
98	SHI	**1947**		GasLog LNG	Pneumatic System
99	SHI	**2016**		GasLog LNG	Pneumatic System
100	SHI	**2017**		GasLog LNG	Pneumatic System

Reference List (as of May 2021)

No.	Yard	H.No	Series	Onwer	Scope
101	SHI	**2041**		GasLog LNG	Pneumatic System
102	SHI	**2042**		GasLog LNG	Pneumatic System
103	SHI	**2043**		GasLog LNG	Pneumatic System
104	SHI	**2044**		GasLog LNG	Pneumatic System
105	SHI	**2022**		Golar LNG	Total System
106	SHI	**2023**		Golar LNG	Total System
107	SHI	**2026**		Golar LNG	Total System
108	SHI	**2027**		Golar LNG	Total System
109	SHI	**2055**		Golar LNG	Total System
110	DSME	**2288**		Maran LNG	Pneumatic System
111	DSME	**2291**		Maran LNG	Pneumatic System
112	DSME	**2292**		Maran LNG	Pneumatic System
113	DSME	**2295**		Maran LNG	Pneumatic System
114	DSME	**2296**		Maran LNG	Pneumatic System
115	SHI	**2045**		Thenamaris	Total System
116	SHI	**2046**		Thenamaris	Total System
117	SHI	**2049**		Thenamaris	Total System
118	SHI	**2024**	2031 Base	Golar FSRU	Total System
119	HHI	**2548**		Hoegh LNG	Pneumatic System
120	HHI	**2549**		Hoegh LNG	Pneumatic System

Reference List (as of May 2021)

No.	Yard	H.No	Series	Onwer	Scope
121	HHI	**2550**		Hoegh LNG	Pneumatic System
122	HHI	**2551**		Hoegh LNG	Pneumatic System
123	HHI	**2552**		Hoegh LNG	Pneumatic System
124	DSME	**2297**		CADIFF	Pneumatic System
125	DSME	**2298**		CADIFF	Pneumatic System
126	DSME	**2400**		CADIFF	Pneumatic System
127	DSME	**2401**		CADIFF	Pneumatic System
128	DSME	**2405**		CADIFF	Pneumatic System
129	DSME	**2406**		CADIFF	Pneumatic System
130	HSHI	**S624**		MaranGas	Pneumatic System
131	HSHI	**S625**		MaranGas	Pneumatic System
132	HSHI	**S626**		MaranGas	Pneumatic System
133	HSHI	**S627**		MaranGas	Pneumatic System
134	SHI	**2047**		Golar LNG	Total System
135	SHI	**2048**		Golar LNG	Total System
136	SHI	**1920**		CHEVRON LNG	Pneumatic System
137	SHI	**1921**		CHEVRON LNG	Pneumatic System
138	SHI	**1941**		CHEVRON LNG	Pneumatic System
139	SHI	**1942**		CHEVRON LNG	Pneumatic System
140	KHI	**22N 1712**		Kawasaki	Total System

Reference List (as of May 2021)

No.	Yard	H.No	Series	Onwer	Scope
141	HHI	**2606**		BGC	Pneumatic System
142	HHI	**2607**		BGC	Pneumatic System
143	SHI	**2056**	2024 Base	Golar FSRU	Total System
144	HSHI	**S658**		Golar LNG	Pneumatic System
145	HSHI	**S659**		Golar LNG	Pneumatic System
146	HHI	**2571**		BW-Maritime	Pneumatic System
147	HHI	**2572**		BW-Maritime	Pneumatic System
148	SHI	**2074**	2031 Base	BW-Singapore	Total System
149	SHI	**2072**	1688 Base	GasLog LNG	Total System
150	SHI	**2073**	1688 Base	GasLog LNG	Total System
151	SHI	**2102**	1688 Base	GasLog LNG	Total System
152	SHI	**2103**	1688 Base	GasLog LNG	Total System
153	HSHI	**S688**		MaranGas	Pneumatic System
154	HSHI	**S689**		MaranGas	Pneumatic System
155	HSHI	**S690**		MaranGas	Pneumatic System
156	HSHI	**S691**		MaranGas	Pneumatic System
157	HSHI	**S734**		MaranGas	Pneumatic System
158	HSHI	**S735**		MaranGas	Pneumatic System
159	DSME	**2407**		Teekay LNG	Pneumatic System
160	DSME	**2408**		Teekay LNG	Pneumatic System

Reference List (as of May 2021)

No.	Yard	H.No	Series	Onwer	Scope
161	DSME	**2411**		Teekay LNG	Pneumatic System
162	DSME	**2412**		Teekay LNG	Pneumatic System
163	DSME	**2413**		Teekay LNG	Pneumatic System
164	DSME	**2414**		Teekay LNG	Pneumatic System
165	DSME	**2415**		Teekay LNG	Pneumatic System
166	DSME	**2416**		Teekay LNG	Pneumatic System
167	DSME	**2417**		Teekay LNG	Pneumatic System
168	HHI	**2636**		BGT	Pneumatic System
169	HHI	**2637**		BGT	Pneumatic System
170	SHI	**2118**		BW-Singapore	Total System
171	HHI	**2612**		TSAKOS	Pneumatic System
172	HHI	**2729**		MISC	Total System
173	HHI	**2730**		MISC	Total System
174	HHI	**2731**		MISC	Total System
175	HHI	**2732**		MISC	Total System
176	HHI	**2735**		MISC	Total System
177	HHI	**2733**		-	Pneumatic System
178	HHI	**2734**		-	Pneumatic System
179	SHI	**2069**		CHEVRON LNG	Pneumatic System
180	HHI	**2854**		GAZPROM LNG FSRU	Pneumatic System

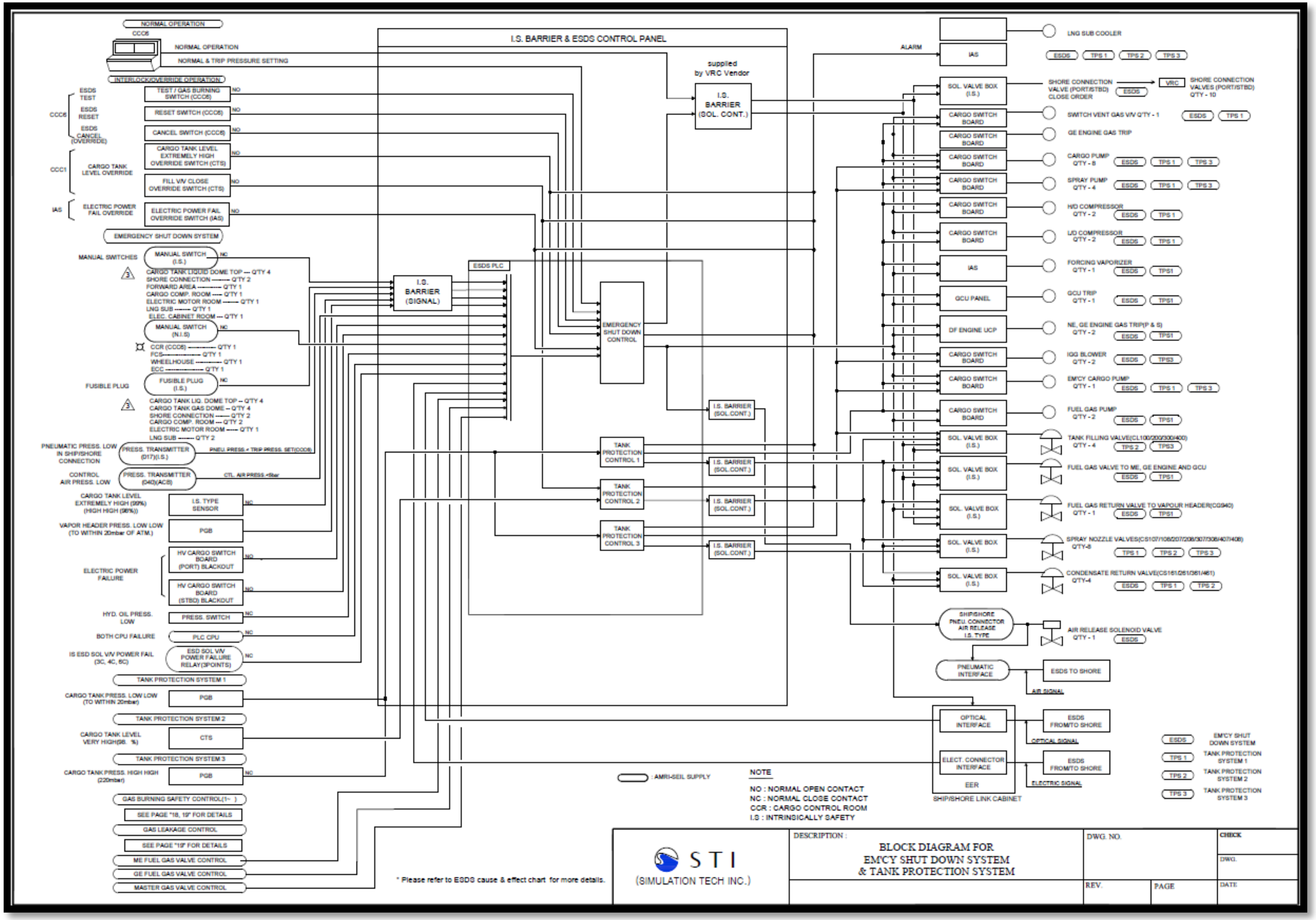
Reference List (as of May 2021)

No.	Yard	H.No	Series	Onwer	Scope
181	HHI	**2865**		Hoegh LNG	Pneumatic System
182	HHI	**2800**		EURO GAS LNG	Pneumatic System
183	HHI	**2801**		EURO GAS LNG	Pneumatic System
184	DSME	**2435**		BW GAS	Pneumatic System
185	DSME	**2436**		BW GAS	Pneumatic System
186	DSME	**2464**		CHANDRIS LNGC	Pneumatic System
187	DSME	**2453**		Teekay LNG	Pneumatic System
188	DSME	**2454**		Teekay LNG	Pneumatic System
189	DSME	**2455**		Teekay LNG	Pneumatic System
190	SHI	**2130**		GasLog LNG	Total System
191	SHI	**2131**		GasLog LNG	Total System
192	HHI	**2189**		Golar LNG	Pneumatic System
193	DSME	**2460**		-	Pneumatic System
194	DSME	**2462**		-	Total System
195	SHI	**2212**		GasLog LNG	Total System
196	SHI	**2274**		GasLog LNG	Total System
197	SHI	**2213**		GasLog LNG	Total System
198	SHI	**2262**		GasLog LNG	Total System
199	HHI	**2937**		SK LNG	Pneumatic System
200	HHI	**2938**		SK LNG	Pneumatic System

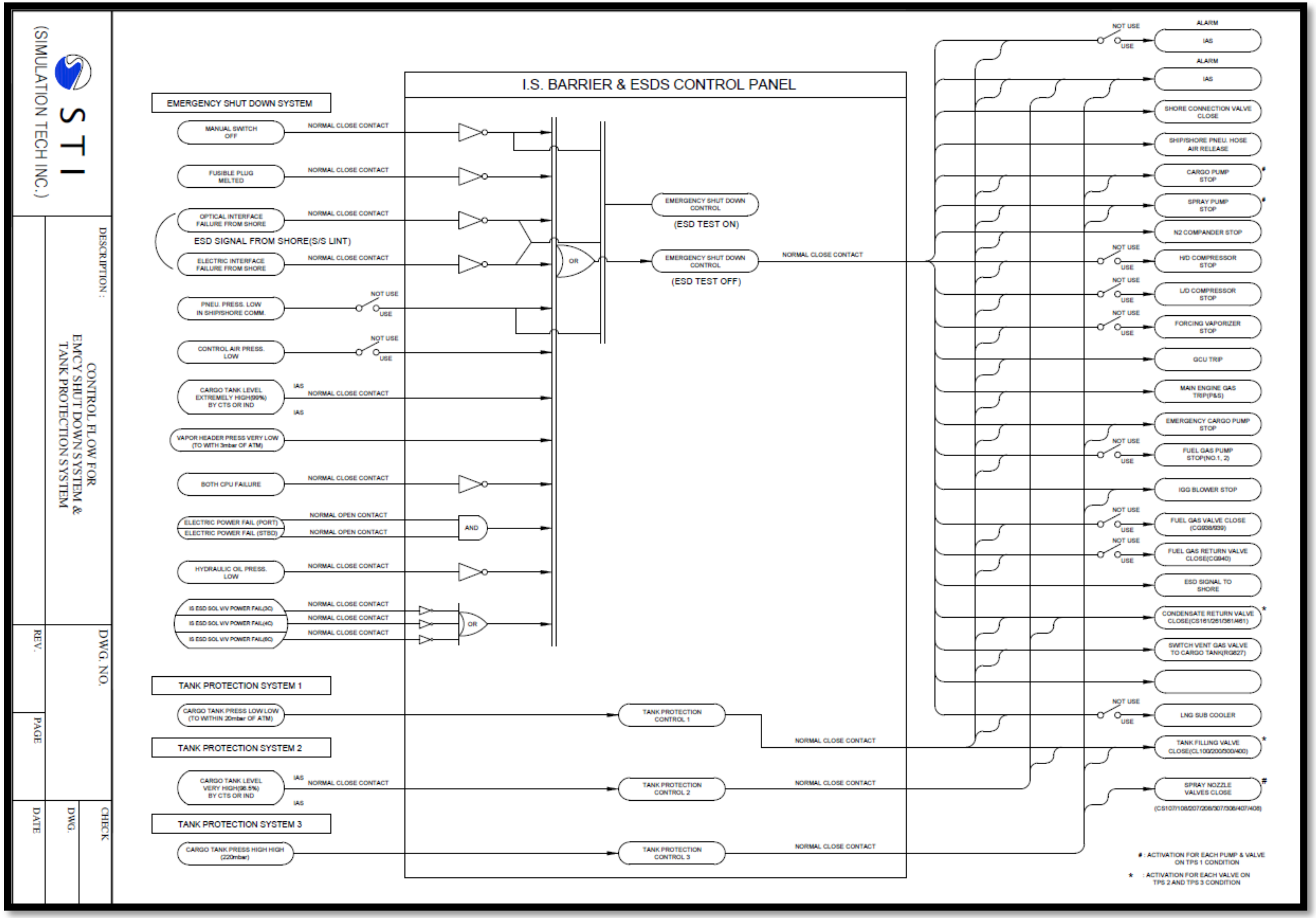
Reference List (as of May 2021)

No.	Yard	H.No	Series	Onwer	Scope
201	HHI	**2939**		SK LNG	Pneumatic System
202	DSME	**2498**		MOL/JAPAN	Pneumatic System
203	DSME	**2499**		MOL/JAPAN	Pneumatic System
204	HSHI	**8029**		NYK/JAPAN	Pneumatic System
205	HSHI	**8030**		NYK/JAPAN	Pneumatic System
206	HSHI	**8031**		NYK/JAPAN	Pneumatic System
207	HSHI	**8032**		NYK/JAPAN	Pneumatic System
208	SHI	**2300**		GasLog LNG	Total System
209	SHI	**2301**		GasLog LNG	Total System
210	SHI	**2304**		GasLog LNG	Total System
211	SHI	**2305**		GasLog LNG	Total System
212	SHI	**2311**		GasLog LNG	Total System
213	SHI	**2312**		GasLog LNG	Total System
214	SHI	**2332**		GasLog LNG	Total System
215	HSHI	**S970**		NYK/JAPAN	Pneumatic System
216	HSHI	**S971**		NYK/JAPAN	Pneumatic System
217	HHI	**3145**		SK LNG	Pneumatic System
218	DSME	**2505**		-	Pneumatic System
219	HSHI	**8033**		NYK/JAPAN	Pneumatic System
220	DSME	**2512**		MOL/JAPAN	Pneumatic System
221	DSME	**2513**		MOL/JAPAN	Pneumatic System

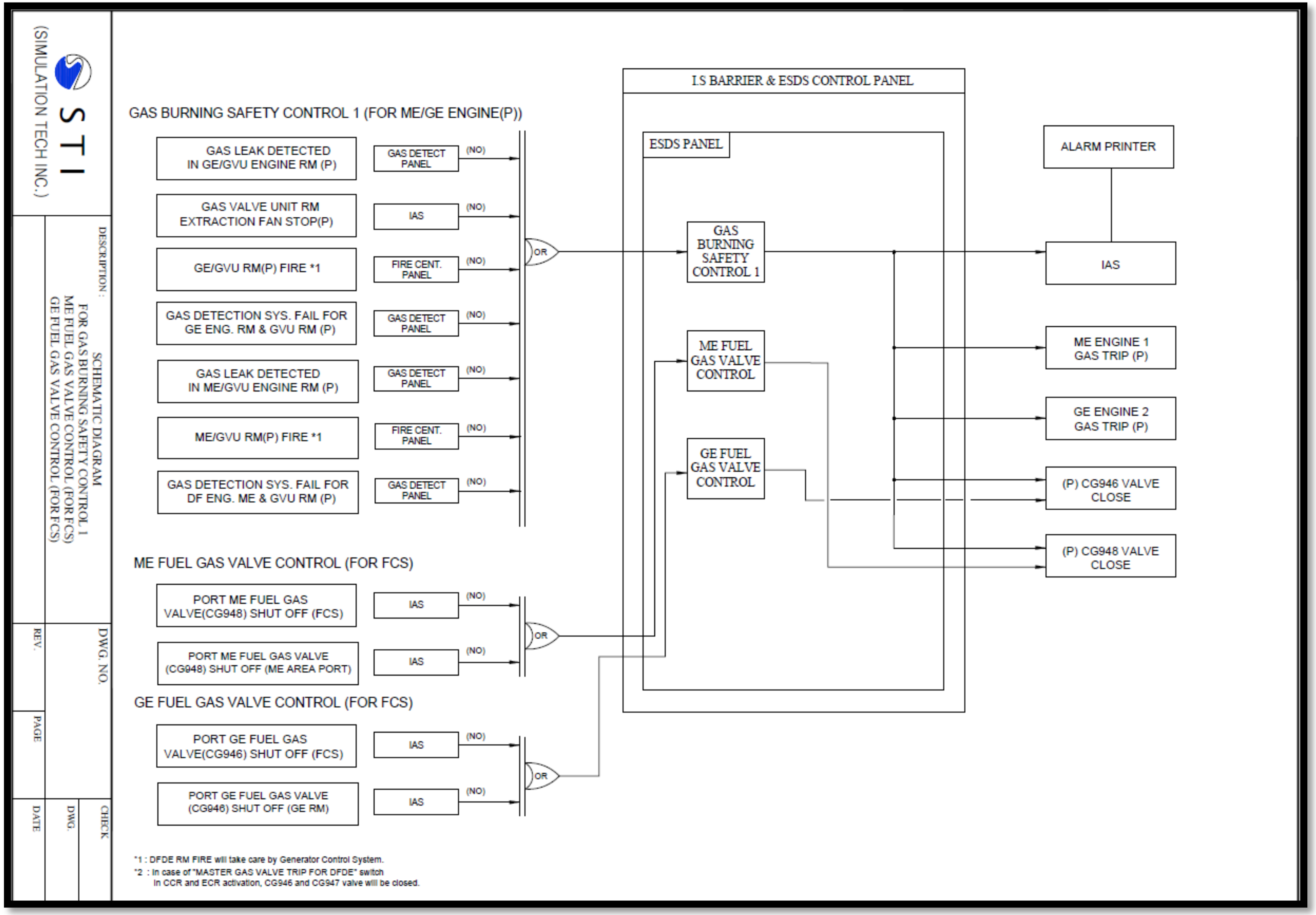
Sample Drawings



Sample Drawings



Sample Drawings



Sample Drawings

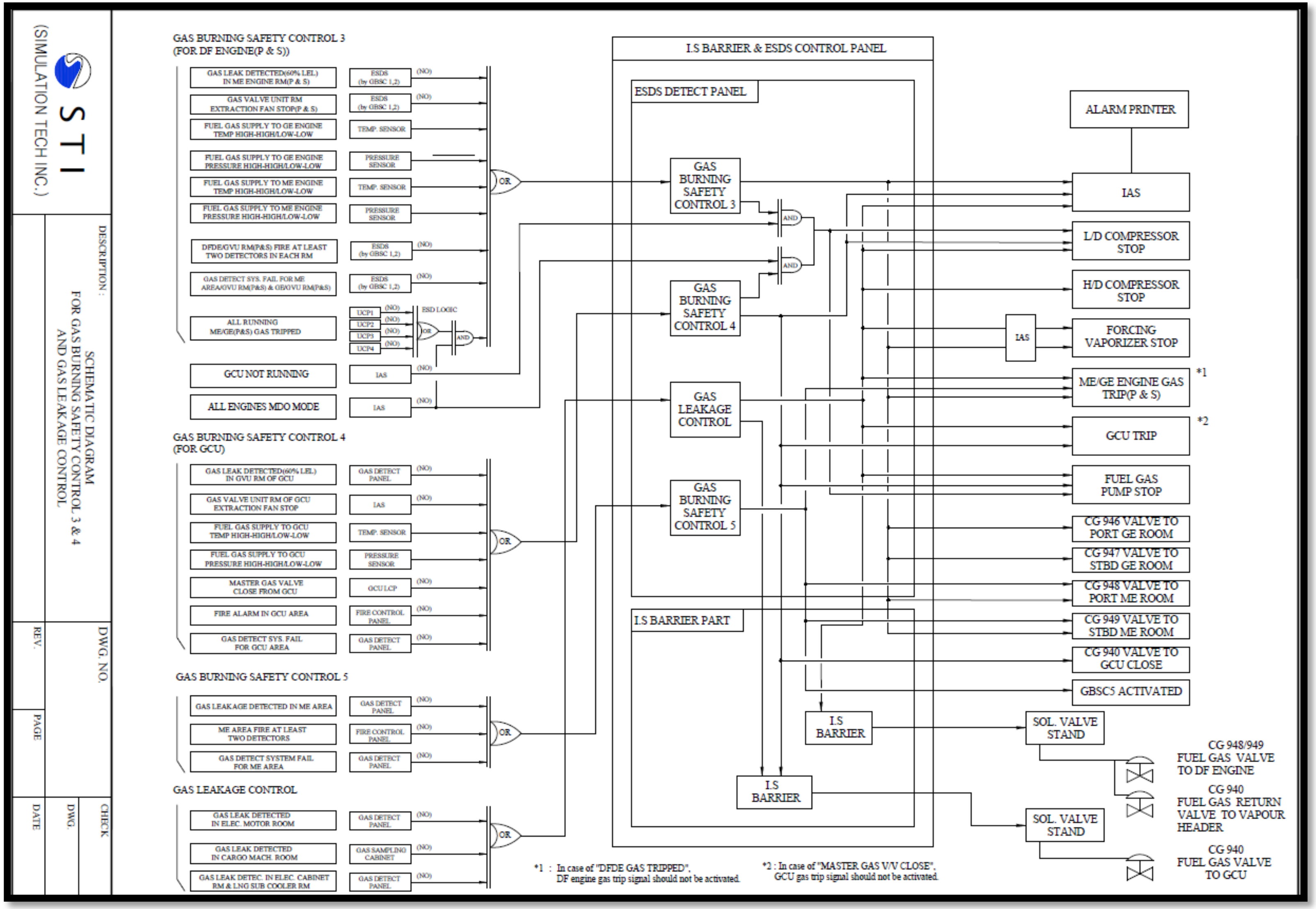
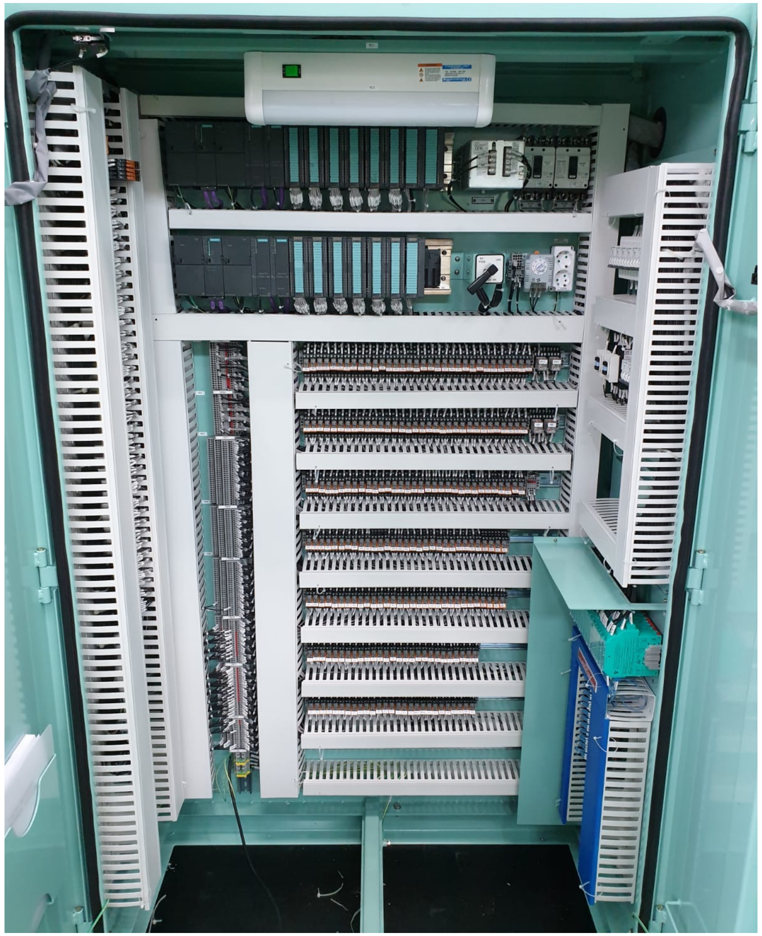


Photo Gallery

Main Control Panel



- Redundancy PLC CPU
- Redundancy Communication I/O Network
- Analog Input Card
- Digital Input Card
- Digital Output Card
- Power Supply, IS Barriers, Relay etc.

Photo Gallery

Push Button Box

The manual push buttons are used by ship personnel to initiate the ESD action for an emergency situation. The manual push buttons are installed at the following locations as a minimum.

-IS Zone (With an IS Barrier in the ESDS Cabinet)

. Cargo tank liquid domes

. Shore connection

. Forward area

. Cargo compressor room

-None-IS Zone

. FCS

. CCR Console

. Wheelhouse

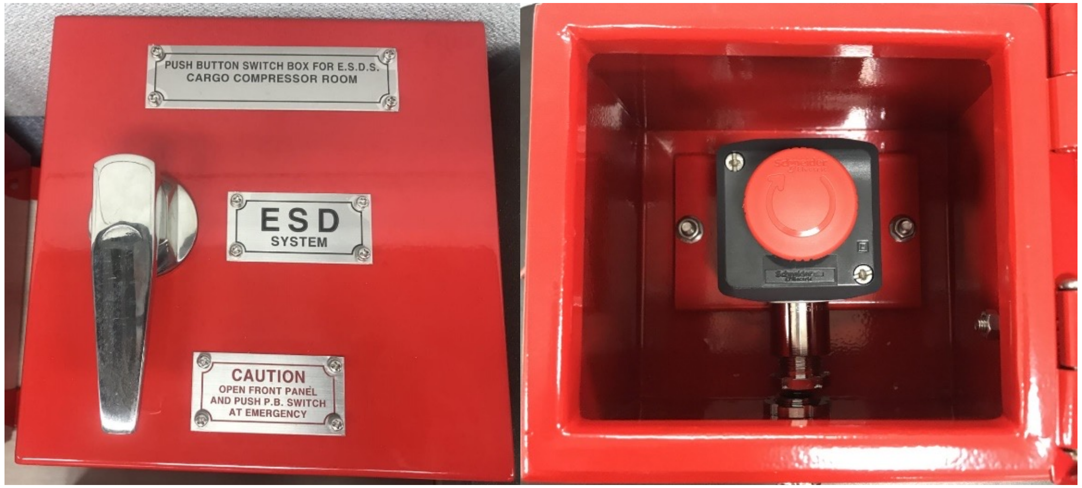


Photo Gallery

Fusible Plug Box

The fusible plugs are used to detect abnormal temperature increase by various causes; fire, explosion, etc. The fusible plug melts and opens the circuit when the surrounding temperature is higher than 98^{o}C, which initiates the ESD condition. The fusible plugs are installed at the following locations as a minimum.

-IS Zone (With an IS Barrier in the ESDS Cabinet)

. Cargo tank liquid domes
. Cargo tank gas domes
. Shore connection
. Cargo compressor room
. Electric motor room

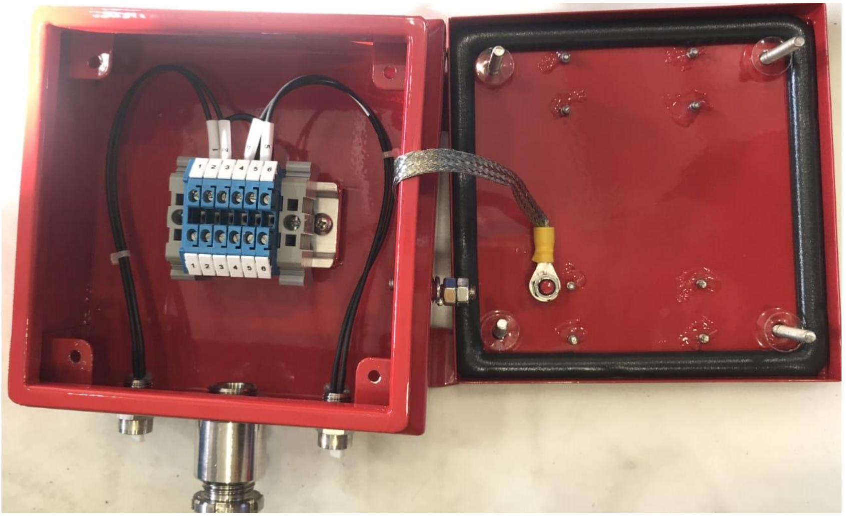


Photo Gallery

Air Control Board

Air control board is used to maintain the air pressure in the pneumatic ESD line at a predefined set point, so-called "Normal Pressure". The pressure in the pneumatic line is measured by two pressure transmitters. One is used by the ESD system as a process variable to control the air pressure. The air pressure is maintained by "On/Off" control using solenoid valves. The other pressure, "Air Supply Pressure Low", is one of the causes of ESD.

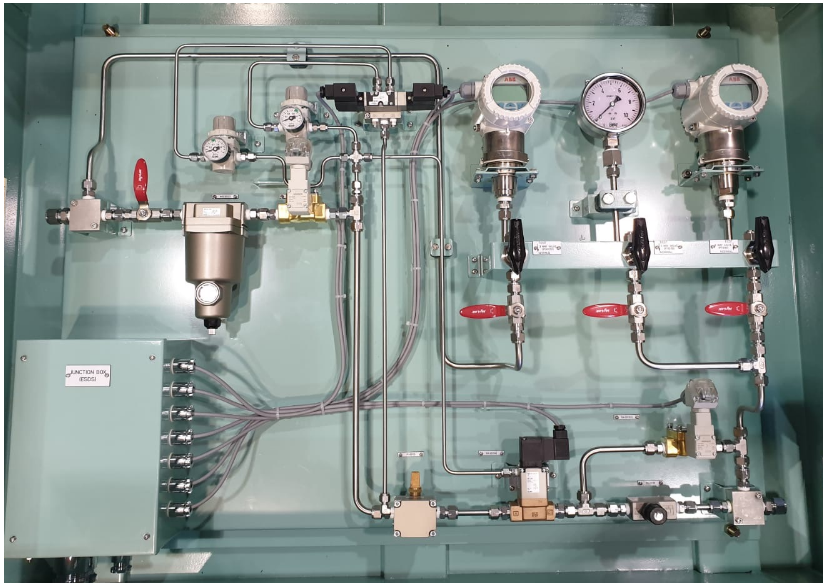


Photo Gallery

Pressure Transmitter Box

The pressure transmitter in the enclosure is used to measure the air pressure of the pneumatic ESD line and the measured pressure is used for triggering of the ESD.

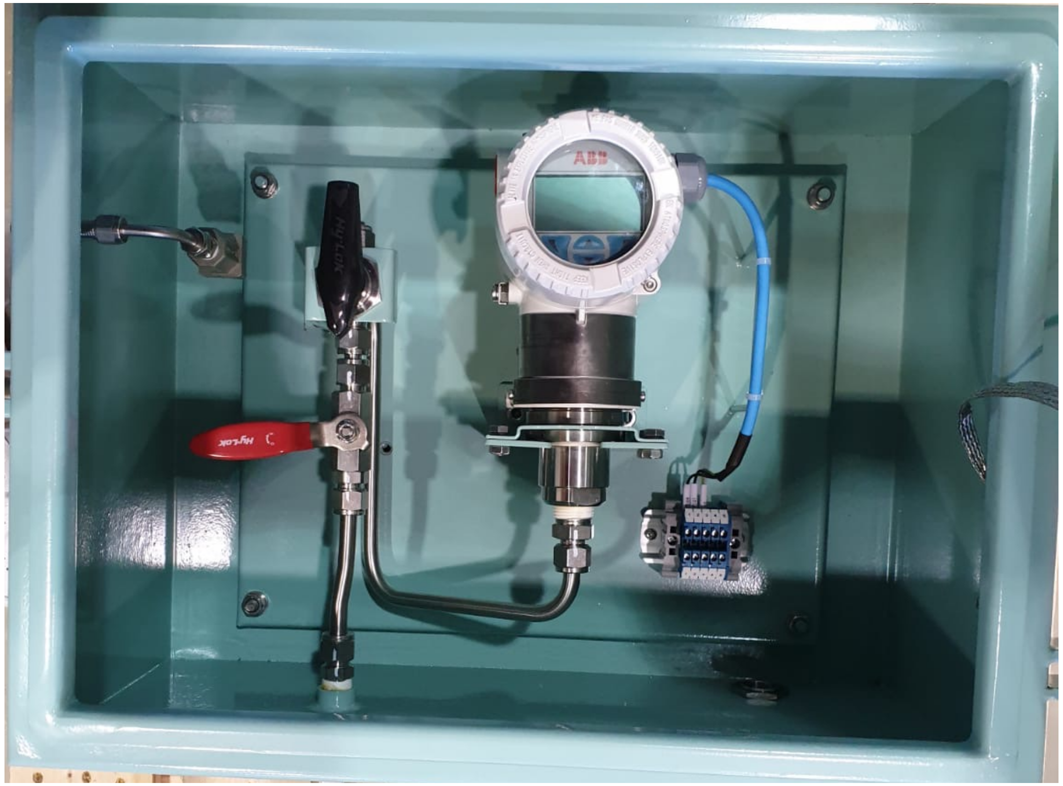


Photo Gallery

Solenoid Valve Box

The solenoid valve in the enclosure releases the air within the pneumatic ESD line at ESD condition, which then triggers an emergency situation to the shore terminal.

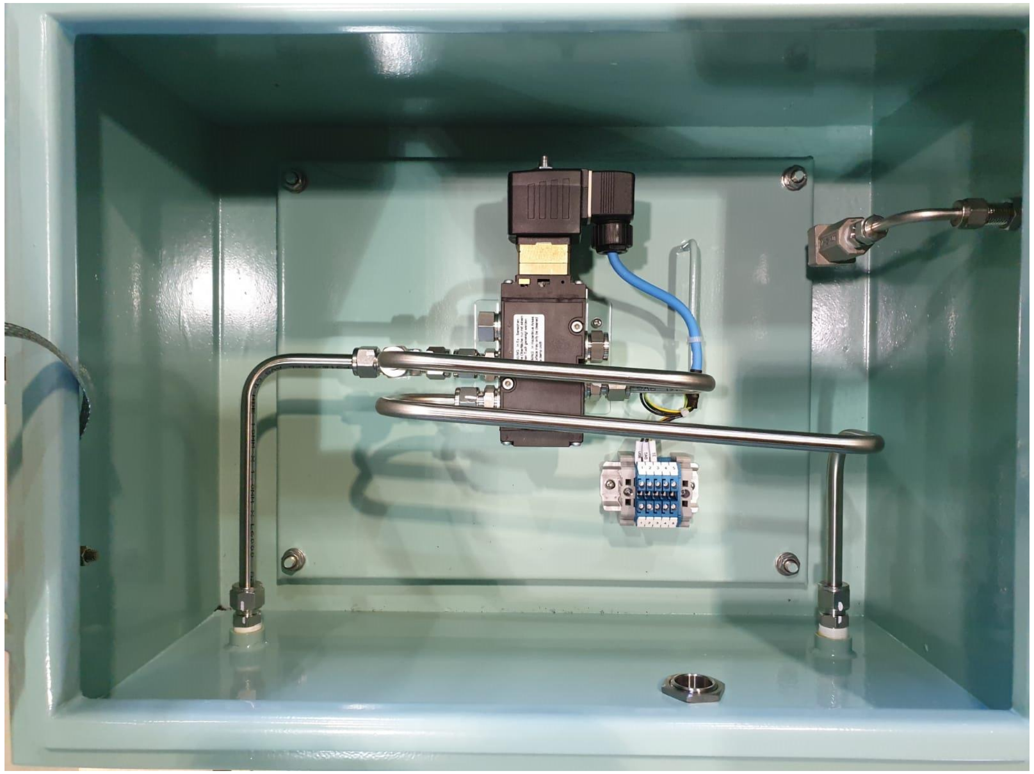


Photo Gallery

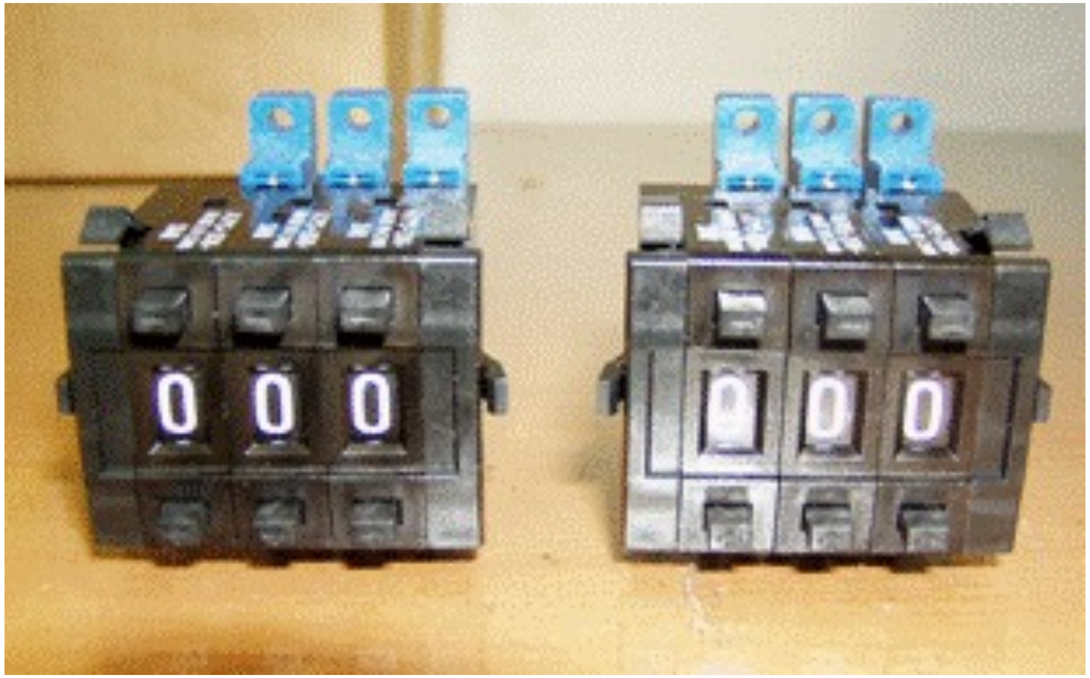
Pressure Transmitter & Solenoid Valve Box

Pressure transmitter box and solenoid valve box, if required, can be manufactured within one enclosure.

Photo Gallery

Pressure Setting Switch

Pressure setting switches are generally installed on an IAS operator console in CCR. These are to set the set points of both the normal pressure and the trip pressure of the pneumatic ESD line depending on the port conditions.



Thank you !

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