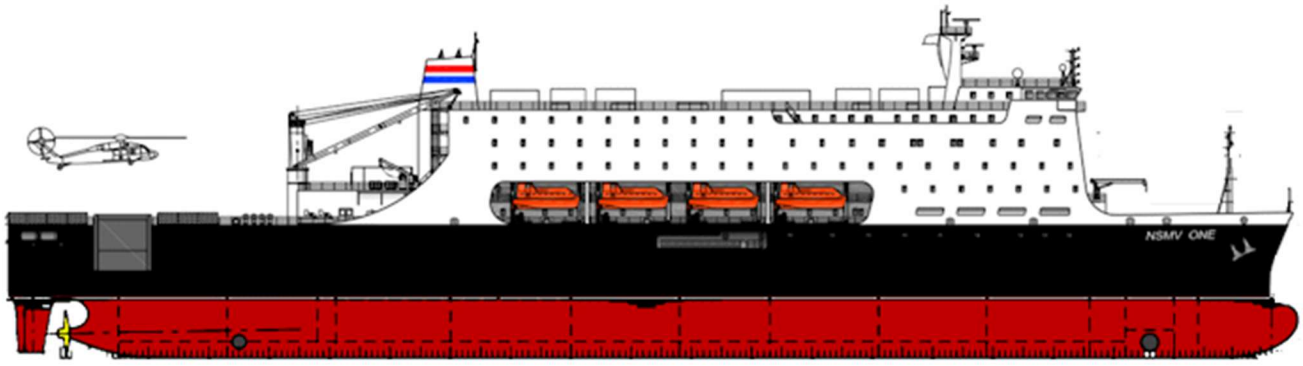
SEA TERM 2025

Cadet Marine Engineering Qualification Program



Oilers Qualification Examination

STUDY GUIDE

Massachusetts Maritime Academy

Buzzards Bay, Massachusetts

October 2024

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Massachusetts Maritime Academy
Cadet Marine Engineering Qualification Program

Introduction

The Engineering Qualification Program was established in 1983 as a result of the tragic fire aboard MMA training ship Bay State. The purpose of the program is to ensure that the Engineering student in the Marine Engineering Program attains an increased level of shipboard engineering expertise each year while at the Academy, that each student learn to understand and operate the training ship machinery efficiently and safely and that the student demonstrate a satisfactory level of basic knowledge about the training ship prior to graduation. Satisfactory completion of the total program will increase each student's immediate shipboard usefulness and professional capability and result in an enhanced sense of operational safety.

Every Marine Engineering Cadet must pass the Cadet Engineers Qualification Examination prior to receiving academic credit and sea time for his or her last training cruise whether she/he is on the TS Patriot State, a commercial ship, or another training ship.

The purpose of this program is to insure that each Marine Engineering student is attaining an increased level of shipboard qualification each year while at the Academy. There are four qualification levels:

1. Fourth Class Wipers Exam. The Fourth-Class Wipers Exam will be administered during the Engineering Systems and Safety course EN-1112 and must be successfully completed before a student is allowed on Sea Term or aboard the training ship alone. The exam will be administered via Blackboard in mid-November. All 4C Cadets are required to take the Safety Exam, regardless of major.
2. Fireman Qualification Exam. The Fireman Qualification Exam will be administered during the cadet's first sea term cruise and must be successfully completed before the Oiler Qualification Exam can be taken. Successful completion of the Fireman's Exam is a pre-requisite for EN-2111: Auxiliary Machines II.
3. Oiler Qualification Exam. The Oiler Qualification Exam will be administered once or twice before the cadet's second cruise in mid-November (and / or early December) and will also be administered on multiple times during sea term. Both the Oiler's Qualification Exam and the Fireman Qualification Exam must be successfully completed before the Cadet Engineer's Qualification Exam can be attempted. Both the Fireman and Oiler Exams must be satisfactorily passed before a cadet can ship commercially during his or her Third-Class or Second-Class year. Successful completion of the Oiler's Exam is required to academically pass Sea Term II (EN-2231). All 3C Marine Engineering Cadets must take the Oiler's Exam in the Fall semester of their 3C year.
4. Cadet Engineers Qualification Exam. The Cadet Engineers (CE) Qualification Exam will be offered once or twice before the cadet's senior sea term in mid-November (and / or early December) and will also be administered during sea term. All 1C Marine Engineering Cadets must take the CE Exam in the Fall semester of their 1C year. The CE Exam must be satisfactorily passed to receive academic credit and sea time for the fourth and final sea term.

These qualification exams also satisfy STCW Objective OICNW-A7.1 *Adequate knowledge of the English language* as a requirement for licensing as a United States Coast Guard Merchant Marine Officer.

Use the IMO Standard Marine Communication Phrases and use English in written and oral form	A7.1 *English language* Adequate knowledge of the English language to enable the officer to use charts and other nautical publications, to understand meteorological information and messages concerning ship's safety and operation, to communicate with other ships, coast stations and VTS centres and to perform the officer's duties also with a multilingual crew, including the ability to use and understand the IMO Standard Marine Communication Phrases (IMO SMCP)

Please note that a cadet must graduate within 18 months of passing the Cadet Engineer's exam or else the cadet will be required to be reexamined and successfully pass the CE Exam a second time.

Exam Format

Unlike the Coast Guard exam, all exams will consist of essay type questions. Well-written responses describing systems, their location and equipment details are required to successfully pass the exam. The Marine Engineering department may hold one review session (to be announced) for all cadets prior to the exam date. Questions may also include sketches or calculations to supplement knowledge.

Questions for all qualification exams are based upon engineering systems and basic engine room operations onboard the training ship *T. S. Patriot State*. It is highly recommended that cadets spend time tracing out systems on the *Patriot State* if vessel access is available. It is also recommended that cadets use the vessel machinery operating manual as a study guide. All questions and answers refer to the current operation of the *Patriot State*.

Grading: A minimum passing grade of 70% has been established. Your exam grade will be one component in determining your final sea term grade. Cadets may take the exam more than once to improve their grade.

Your grade for the Oiler Exam is a component of your overall sea term grade, and will be a weighted average depending on the number of attempts required by the student to pass the test. For example, a student passing the Oiler Exam on the first attempt with a score of 75 will receive a higher weighted grade determined by the class average for the first attempt. If the student passes the exam on the first attempt, there will be no need to re-take the exam for a higher grade. This would essentially be scale weighted to a "A" grade for a second attempt, and therefore additional attempts are not necessary when passing on the first attempt. Students who are required to take the exam 3 or 4 times will incur a lower weighted average and result in an overall lower score for the Oiler exam as part of his or her sea term grade.

In grading exams, the engineering department faculty is trying to determine whether the cadet's written answer demonstrates basic understanding of the subject question or, in the

case of a practical demonstration, "does the cadet understand the subject equipment and can he or she safely operate it."

Written answers or procedures for any exam question which constitutes a gross safety violation(s) will result in automatic failure for the that question. The likelihood of passing the exam in this case is greatly diminished.

Qualification exams are meant to establish the minimum level of competency necessary prior to cadets standing watches at his or her grade level. It is expected that he or she will then expand and develop his or her capabilities and competencies.

Purpose of the Oiler Examination

The purpose of the Oiler Qualification Examination is to verify the Cadets' skills necessary to properly assume the duties of Engineering Officer in charge of an Engineering Watch.

Engineering cadets must pass the Oiler's exam in order to receive academic credit and sea time for their third class cruise, both of which are required to sit for the USCG Third Assistant Engineer License.

The information in this study guide identifies the subject material covered on the Oiler exam. The exam will consist of ten questions *similar* to the questions mentioned in this study guide. Questions will be graded on factors including technical accuracy, completeness, spelling and grammar, neatness, etc. The following questions *may or may not appear exactly as written* on the CE's exam and are provided herein as a guide only. The subject matter mentioned in this guide should provide each cadet the basis for the material each cadet is expected to know.

As a reference, specific questions contain a reference to a particular

Oiler Duties While on Watch

The Oiler is the eyes and ears of the Watch Engineer. The Engineer typically remains in the ECR (Engine Control Room) while the vessel is underway and is limited in his or her ability to inspect and monitor all aspects of the plant.

The Senior Oiler should know and personally verify all the information on the Engine Monitoring system. Proper watch standing for all Oilers shall include but not be limited to:

- Checking the condition of all operating machinery in the engine room, the auxiliary machinery rooms, and outside of the engine room, i.e. refrigeration equipment, UPS, emergency diesel, batteries, steering gear, etc.
- Monitoring the condition and operation of the Main Generator Engines.
- Knowing which equipment is running so it can be restarted quickly if power is lost temporarily.
- Checking all oil levels, knowing how to add oil, and knowing where the spare oil is kept and what oil is used for each piece of equipment.
- Knowing the operating temperatures and pressures of the equipment throughout the plant under normal operating conditions.
- Knowing the safe maximum and minimum temperatures and pressures for machinery.
- Knowing how to feel a motor for temperature and vibration.
- Checking all bilges for water, other liquid, or debris.
- Knowing how to line up and pump all the ships' bilge's using all the various bilge pumps.
- Knowing how to change over and clean strainers.

- Maintaining an orderly space by cleaning up oil or water spills from machinery and decks and picking up loose gear or trash.
- Knowing how to check and record the various water levels in the potable tanks and other fresh water system tanks.
- Knowing how to check the ship's air compressors and air receivers.

Systems and Associated Equipment

The Oiler is responsible for the operation of the following systems and equipment. For the Oiler's exam, the Cadet shall know the purpose and fundamental operational requirements of the machinery associated with the following systems:

Main Generator Engines
Low Temperature Fresh Water Cooling System
High Temperature Fresh Water Cooling System
Lubricating Oil Service System
Potable Water System
Fuel Oil Service System
Compressed Air System
Bilge System
Sewage and MSD System
Oily Water Separator
Engine Room Sea Water Service System
Auxiliary Room Sea Water Service System
Electrical Distribution System

Oiler's Scope of Knowledge & Exam Questions

This section contains a list of sample questions that may be similar to the questions posed in the Oiler Exam. Examination questions are specific to the *NSMV Patriot Sate*. Reference Given are to the current (2024) Patriot State Machinery Operating Manual

	Operating Manual Reference	
	SECTION	PAGE
Main Generator Engines and Engine Operation		
• Classify the main generator engines onboard the *Patriot State*. Include the number of engines, and pertinent specifications.	1	3
• List and describe the types of engine alarms associated with the Main Generator Engines (MGE) onboard *Patriot State*.	2.2	8
• Detail the starting procedure for the main generator engines onboard *Patriot State*. Include checks that are required before starting an engine.	2.2	13
• Describe at least four (4) of the associated systems that support and or supply the main generator engines onboard *Patriot State*.	2.2	3-4
Low Temperature Fresh Water Cooling System		
• Describe the Low Temperature Fresh Water Cooling System and list at least 6 consumers that it provides to onboard *Patriot State*.	2.4	4,6,8
• How many low temperature fresh water cooling pumps are located in each engine room? How many of these pumps are operating at a time? What types of pumps are these?	2.4	3
• What type of heat exchangers are utilized to reject heat from the fresh water cooling system? Make a sketch of these types of heat exchangers.	2.4	3

	Operating Manual Reference	
	SECTION	PAGE
High Temperature Fresh Water Cooling System		
• What is the purpose of the high temperature fresh water cooling system? What does this system absorb heat from specifically and where can it reject this heat to?	2.4	13
• Why is an expansion tank utilized in the high temperature and low temperature fresh water cooling systems onboard *Patriot State*?	2.4	3
• Besides the main generator engines, identify and describe two other pieces of equipment that the high temperature fresh water cooling system supplies onboard the *Patriot State*.	2.4	13
Sea Water Systems (Engine Room and Auxiliary Room)		
• How many sea chests are there on *Patriot State* that are utilized for sea water cooling systems? Where is each located and what are each of the designated in each space?	2.3	2,4, 10,14
• List the quantity, type, and capacity of the main seawater cooling pumps in each engine room onboard *Patriot State*.	2.3	3
• List the quantity, type, and capacity of the auxiliary seawater cooling pumps in each auxiliary room onboard *Patriot State*.	2.3	11,15
• Detail at least 6 consumers in the sea water cooling system for the auxiliary machinery rooms and indicate which piece of equipment is associated with each auxiliary room.	2.3	10,14
• Is seawater cooling utilized in either of the motor rooms onboard Patriot State? Explain why or why not?	2.3	19
• What is the MGPS system associated with the sea water cooling system? Explain the principle of operation of the MGPS.	2.3	20

Operating Manual Reference	
SECTION	PAGE

Fuel Systems and Fuel Handling Equipment

- What type of fuel is utilized onboard Patriot State? Explain how this fuel differs from that utilized on previous Massachusetts Maritime Training Ships. — 2.6 | 3
- Detail the flow of fuel from the MGO service tank to the main generator engine injectors and include all relevant equipment that the fuel must pass through. — 2.6 | 2
- What is the purpose of the fuel oil separator system onboard Patriot State? Where does this system originate and where is the discharge of the system. Is this system located in both engine rooms? — 2.6 | 7
- How many fuel oil storage tanks are located onboard Patriot State? Where are they located? — 6.4 | 2
- What is the approximate pressure delivered to the fuel injectors of the main generator engines onboard *Patriot State*? How is this accomplished and what is the name commonly given to this type of engine fuel delivery system. — 2.2 | 4

Lubricating Oil Systems

- Detail several distinct pieces of equipment that utilize a forced lubrication system onboard Patriot State? — 2.7 | 3,7
- How is cooling provided for the lubricating oil for the main generator engines on *Patriot State?* Is the cooling provided considered to be "high temperature" or "low temperature"? — 2.7 | 3
- Explain the purpose of the propulsion motor lubricating oil system? Is this system integrated with the generator engine lubricating oil system? — 2.7 | 7

	Operating Manual Reference	
	SECTION	PAGE
Potable Water System		
• Indicate the two pieces of equipment that are used to generate fresh water onboard *Patriot State*. Include the basic operating principle for each and where they are located onboard the vessel.	6.1	3,7
• What is the distilled / technical water system utilized for in the engine room of the *Patriot State*? Where is the distilled water tank located and where is the distilled water tank filled from?	6.1	13
• Explain the function of the fresh water hydrophore tank and how it works. Make a sketch to support your answer.	6.1	22
• Explain how potable water is treated onboard *Patriot State*. What equipment is associated and what essential function does each piece perform?	6.1	15
• Where is potable fresh water stored onboard *Patriot State*? How many tanks are utilized and where are they located?	6.1	20
• How is potable water heated and distributed on Patriot State? Describe the domestic hot water system in detail.	6.1	17
Compressed Air System		
• Differentiate the starting air system, control air system, and service air system onboard Patriot State. Give examples of what each system is used for.	2.5	3,7,11
• Classify the compressors used for the starting air system. Provide as much technical information as possible.	2.5	3
• Classify the compressors used for the control air system. Provide as much technical information as possible.	2.5	7
• Classify the compressors used for the control air system. Provide as much technical information as possible.	2.5	11

	Operating Manual Reference	
	SECTION	PAGE
Bilge System		
• Describe the various bilge suctions in the machinery spaces onboard *Patriot State*. How many bilge suctions are there in each engine room?	6.3	3-4
• What are the housekeeping pumps utilized for in the engine rooms of the *Patriot State*? What types of pumps are they?	6.3	3
• Where are the emergency bilge suctions located in each engine room onboard *Patriot State* and what pumps are they each associated with?	2.3	2,4
• Describe the various tanks associated with the engine room bilge system onboard *Patriot State* and what each one is used for.	6.3	2-3
• Describe the stepwise procedure to pump the #1 engine room aft bilge well to the bilge primary tank on *Patriot State*.	6.3	3
• Describe the spaces associated with the forward bilge system onboard *Patriot State*. What locations does this bilge system serve and where does this water go when the bilges are pumped?	6.3	7
Sewage & MSD System		
• How is gray water separated from black water onboard Patriot State? Where is grey water collected and where does gray water join into the shipboard sewage system for processing?	6.2	3-4
• Explain the principle of operation for the vacuum collection units associated with the black water system onboard *Patriot State*.	6.2	9
• Explain the MSD treatment process in detail for the Patriot State. What equipment is associated in this process?	6.2	15-17

Oily Water Separator

	Operating Manual Reference	
	SECTION	PAGE
• Classify the oily water separator onboard *Patriot State* and give a detailed description of its principle of operation.	6.3	9
• Explain the principle of coalescence as it applies to the oily water separator. How does coalescence take place in the Heli-Sep OWS onboard *Patriot State*?	6.3	9
• Detail the procedure to start and run the oily water separator onboard the *Patriot State*. Include all pre-checks and precautionary steps to be made.	6.3	11
• Explain the function of the bilge alarm monitor associated with the Oily Water Separator and describe its function.	6.3	9
• What are the functions of the various solenoid valves associated with the oily water separator?	6.3	8
• Produce a cross-sectional diagram of the Heli-Sep oily water separator onboard Patriot State. Label the following in your diagram: polishing pack, separating media, oil sensing probe, process pump, spirolator membranes, feed pump, oil content monitor.	6.3	10

Electrical Distribution and Electrical Propulsion System

	Operating Manual Reference	
	SECTION	PAGE
• Explain how the mechanical energy developed in the main generator engine is transformed into electrical energy for the shipboard electrical distribution system onboard *Patriot State*.	3	3
• What are the various voltages of the different switchboards on the Patriot State. Give 2-3 examples of equipment that would be supplied from each of these switchboards.	3	2,4
• Explain the propulsion motor arrangement and configuration onboard *Patriot State.* Can these motors be operated simultaneously? What are the requirements for running of these propulsion motors?	4	21
• What is the Rexpeller on the *Patriot State*? Explain how this piece of equipment operates and detail its features.	4	23
• How is speed of the electrical propulsion motors controlled onboard Patriot State?	4	15
• Why is access to the high voltage (HV) rooms onboard Patriot State restricted. Explain the dangers in detail using a technical description.	3	3

Unit Conversions

• Convert a given value from one unit to another as prescribed in the referenced section. This may include: *length, area, volume, capacity, mass, force, pressure, power, moments, light intensity, or temperature.*	1	20

Vessel Safety Systems and Safety Equipment

This section of the study guide includes pertinent information adapted from the TS Patriot State SOLAS (Safety of Life at Sea) Manual. You should become thoroughly familiar with the information in the section to ensure preparedness for emergency situations. Qualification Exam Questions will be based on the information contained in this section.

The main objective of the SOLAS Convention is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety. Flag States are responsible for ensuring that ships under their flag comply with its requirements, and a number of certificates are prescribed in the Convention as proof that this has been done. Control provisions also allow Contracting Governments to inspect ships of other Contracting States if there are clear grounds for believing that the ship and its equipment do not substantially comply with the requirements of the Convention - this procedure is known as port State control. The current SOLAS Convention includes Articles setting out general obligations, amendment procedure and so on, followed by an Annex divided into 14 Chapters.

Emergency Signals

Shipboard Emergency Signals are promulgated by the Master of the Training Ship in . The below listed signals will be sounded in the event of a drill or actual emergency on board the Training Vessel. For drill purposes during Orientation only, the ship's whistle will not be sounded.

Fire and Collision: A Continuous blast on the ships whistle and sounding of the general alarm bells for a period of at least ten (10) seconds.

Abandon Ship: More than six (6) short blasts and one (1) long blast on the ship's whistle and the same signal on the general alarm bells.

Man Overboard: Three (3) prolonged blasts on the ship's whistle and the same signal on the general alarm bells.

Dismissal from Fire and Collision Stations: Three (3) short blasts on the ships whistle and the same signal on the general alarm bells.

Emergency Stations

There are 9 emergency stations onboard the TS Patriot State. The emergency stations have been selected as the places from where each emergency team can best prepare to deal with the emergency and carry out their duties. Proximity of equipment such as firefighting equipment, breathing apparatus, emergency control devices, medical supplies, and associated equipment are available for quick intervention by the designated teams when required.

A muster must be taken by each group to establish if there are any missing persons. Once completed, a report must be issued to the overall Command Group located on the bridge/safety center.

The locations of the emergency stations are as follows:

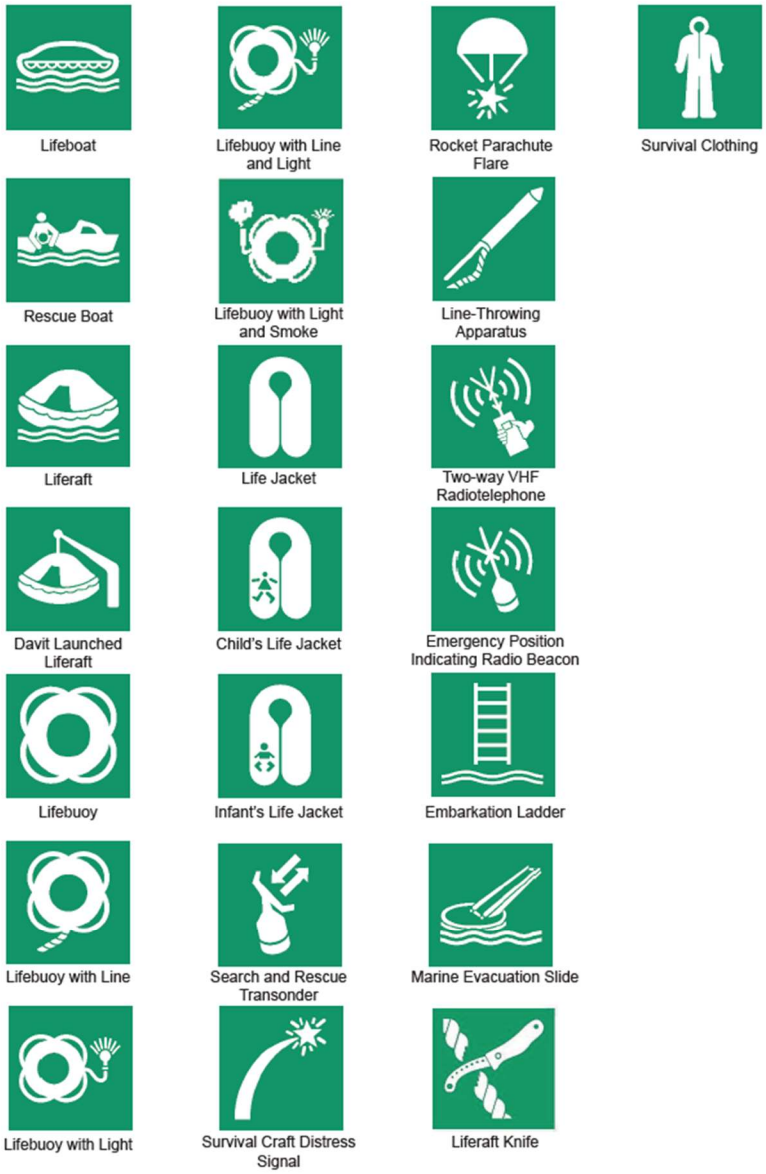
Team	Area	Location
Bridge	Bridge	05 Dk, forward
Bridge Safety Center	Bridge Safety Center	05 Dk, starboard Side Forward
ECR 1	ECR 1	04 Dk, Port Side, Engine Room 1
ECR 2	ECR 2	04 Dk, Port side, Engine Room 2
Rapid Response	EGL 1	Second Dk, Port side, aft Cadet Mess
Clear Berthing Spaces (F&E, MOB)	EGL 1	Second Dk, Port side, aft Cadet Mess
EGL 1	EGL 1	Second Dk, Port side, aft Cadet Mess
EGL 3	EGL 3	Main Dk, Starboard side, FWD of Officers' Lounge
EGL 4	EGL 4	3rd Dk Classrooms, Athwartships Passage

IMO Safety Signage

You will likely encounter the following signage throughout the vessel. You should become familiar with all signage and what each of the following icons indicate.

Means of Escape Signage

Lifesaving Signage



Emergency Stops

In an emergency situation, it may be necessary to quickly shut down certain items of equipment in order to address, or alleviate, the conditions or to prevent any escalation of the emergency situation. Operators perform shutdown actions via emergency stop panels fitted at various locations throughout the vessel.

There is a total of 15 different equipment/ventilation fan groups that can be shut down in an emergency and each group is stopped by pushing the corresponding group button on the emergency shutdown panels.

There are many locations around the vessel from which these groups can be shut down, however there are only two locations from which **all** groups can be shut down and they are as follows:

- Wheelhouse safety center - 05 level.
- Training bridge safety center - 04 level.

Emergency Stop Group	Location of Emergency Stop
ES-1A - Stop for Engine Room (ER) 1 fans and ER1 air conditioning: • VFD panel for ER1 supply ventilation fan 2. • VFD panel for ER1 supply/exhaust ventilation fan 1. • CP for FCU-05,07.	Wheelhouse safety center. Training bridge safety center. ER1 entrance (port). ER1 entrance (starboard). Emergency Gear Locker (EGL) 2.
ES-1B - Stop for ER2 ventilation fans and ER2 air conditioning: • VFD panel for ER2 supply ventilation fan 2. • VFD panel for ER2 supply/exhaust ventilation fan 1. • CP for FCU-06,08.	Wheelhouse safety center. Training bridge safety center. ER2 entrance (port). ER2 entrance (starboard). Emergency Gear Locker (EGL) 2.
ES-2A - Stop for ER1 MGO pumps: • No.1 MGO transfer pump. • No.1 MGO separator, No.1 MGO separator feed pump. • No.2 MGO separator, No.2 MGO separator feed pump. • No.1 sludge pump.	Wheelhouse safety center. Training bridge safety center. ER1 entrance (port). ER1 entrance (starboard). Emergency Gear Locker (EGL) 2.
ES-2B - Stop for ER2 MGO pumps: • No.2 MGO transfer pump. • No.3 MGO separator, No.3 MGO separator feed pump. • No.4 MGO separator, No.4 MGO separator feed pump. • No.2 sludge pump.	Wheelhouse safety center. Training bridge safety center. ER2 entrance (port). ER2 entrance (starboard). Emergency Gear Locker (EGL) 2.
ES-3A - Stop for ER1 Lubricating Oil (LO) pumps, motor room 1 LO pumps and Frequency Converter Room (FCR) 1 LO pumps: • No.1 LO transfer pump. • Starter for No.1 GE preheater and GE LO priming pump. • Starter for No.2 GE preheater and GE LO priming pump. • PM2 No.1/2 D.E jacking pump and N.D.E jacking pump. • Local Group Starter Panel (LGSP) 5 (Sec.3).	Wheelhouse safety center. Training bridge safety center. ER1 entrance (port). ER1 entrance (starboard). Emergency Gear Locker (EGL) 2.
ES-3B - Stop for ER2 LO pumps, motor room 2 LO pumps and FCR2 LO pumps: • No.2 LO transfer pump. • Starter for No.3 GE preheater and GE LO priming pump. • Starter for No.4 GE preheater and GE LO priming pump. • PM1 No.1/2 D.E jacking pump and N.D.E jacking pump. • LGSP-6 (Sec.3).	Wheelhouse safety center. Training bridge safety center. ER2 entrance (port). ER2 entrance (starboard). Emergency Gear Locker (EGL) 2.
ES-4A - Stop for accommodation fans for Fire Zone (FZ) 1: • Deck training and carpentry shop exhaust ventilation fan. • CP for FCU-04.	Wheelhouse safety center. Training bridge safety center.

Emergency Stop Group	Location of Emergency Stop
ES-4B - Stop for accommodation fans for FZ2: • Galley exhaust ventilation fan, scullery exhaust ventilation fan. • Sanitary spaces (02, 03, 04, 05 level) exhaust ventilation fan. • Sanitary spaces (01 level, main, 2nd, 3rd, 4th deck) exhaust ventilation fan. • Sanitary spaces (2nd, 3rd, 4th deck) exhaust ventilation fan. • CP for AHU-01~05,11,12,15. • No.1/2 stairway for FZ2 supply ventilation fan. • CP for refrigeration system of daily room (galley). • Sundry spaces (01, main, 2nd, 3rd and 4th deck) exhaust vent fan. • ST for cadet's laundry fans (21593Q). • ST for crew's laundry fans (61550Q). • ST for officer's laundry fans (81550Q and 71550Q). • TR Panel for IT equipment room.	Wheelhouse safety center. Training bridge safety center.
ES-4C - Stop for accommodation fans for FZ3: • Hospital area exhaust fan. • Sanitary space (02, 03, 04 level) exhaust ventilation fan. • Sanitary space (01 level, main, 2nd, 3rd 4th deck) exhaust ventilation fan. • CP for FCU-01,02, CP for AHU-06~10,14. • No. 3/4 stairway for FZ3 supply ventilation fan. • CP for refrigeration system of freezing, chilled room and lobbies. • Sundry spaces (01, main, 2nd, 3rd and 4th deck) exhaust vent fan. • Stairway (20961P) supply vent fan. • ST for cadet's laundry fans (91110Q, 81110Q, 71110Q). • ST for crew's laundry fans (61080Q). • ST for ship's laundry fans (30861Q). • ST for garbage compactor with plastic garbage room fan. • TR Panel for IT equipment room 2.	Wheelhouse safety center. Training bridge safety center.
ES-4D - Stop for accommodation fans for FZ4: • CP for AHU-16. • Stairway (40702P) supply vent fan. • Toilets exhaust vent fan.	Wheelhouse safety center. Training bridge safety center.
ES-5 - Stop for Ro-Ro fans: • LGSP-11 (for Ro-Ro deck fans).	Wheelhouse safety center. Training bridge safety center.
ES-6A - Stop for Auxiliary Machinery Room (AMR) 1/2 fans: • AMR1 supply fan 1, AMR1 supply fan 2. • AMR2 supply fan 1, AMR2, supply fan 2.	Wheelhouse safety center. Training bridge safety center.

Emergency Stop Group	Location of Emergency Stop
ES-6B - Stop for AMR 3/4 fans: • AMR3 supply fan 1, AMR3 supply fan 2. • AMR4 supply fan 1, AMR4 supply fan 2.	Wheelhouse safety center Training bridge safety center
ES-7A - Stop for motor room 1 fans, motor room 1 air conditioning, FCR1 ventilation fans and FCR1 air conditioning: • No.3 Motor room suuply/exhaust fan, No.4 Motor room supply fan. • PTR2 No.1/2 cooling fan, PM2 No..1/2/3/4 cooling fan. • CP for FCU-10.	Wheelhouse safety center Training bridge safety center ER1 entrance (port) ER1 entrance (starboard) Emergency Gear Locker (EGL) 2
ES-7B - Stop for motor room 2 fans, motor room 2 air conditioning, FCR2 ventilation fans and FCR2 air conditioning: • No.1 Motor room suuply/exhaust fan, No.2 Motor room supply fan. • PTR1 No.1/2 cooling fan, PM2 No..1/2/3/4 cooling fan. • CP for FCU-09.	Wheelhouse safety center Training bridge safety center ER2 entrance (port) ER2 entrance (starboard) Emergency Gear Locker (EGL) 2
ES-G - Stop for Galley equipment: • LPD-13, Galley equipment. • Galley exhaust vent fan.	Galley outside

Fire Lockers

There are a total of 36 fire lockers distributed around the vessel, with many combined together in a single location. They are distributed so that there is a minimum of one in each fire zone. They contain essential fire fighting equipment and apparatus which enables the ship's fire fighting teams to collect the correct gear at a convenient location to tackle various fire related incidents.

The contents of each fire locker comprises the following:

Fire Lockers No.1 to No. 26 (Fireman's Outfit)

Each fire locker contains the following:

- 1 x 1200 liters Self-Contained Breathing Apparatus (SCBA).
- 2 x 1200 liters spare air cylinder.
- 1 x safety lamp.
- 1 x small fire axe with belt.
- 1 x fire suit.
- 1 x rigid helmet.
- 1 x boots.
- 1 x gloves.

Fire Locker 27-28 (Fireman's Outfit)

Each fire locker contains the following:

- 1 x 1200 liters Self Contained Breathing Apparatus (SCBA).
- 2 x 1200 liters spare air cylinder.
- 1 x safety lamp.
- 1 x small fire axe with belt.
- 1 x fire suit.
- 1 x rigid helmet.
- 1 x boots.
- 1 x gloves.
- 4 x portable fire extinguishers (6kg CO2).
- 4 x spare for portable fire extinguishers (6kg CO2).

Fire Locker No.29 (Helicopter Fire Fighting Equipment)

This fire locker contains the following:

- 1 x large fire axe.
- 1 x large crow bar.
- 1 x fire resistant blanket.
- 1 x bolt/wire cutter.
- 1 x first aid kit.
- 1 x red emergency signal lamp.
- 1 x adjustable wrench.
- 1 x grab hook.
- 1 x heavy duty hacksaw with spare blades.
- 1 x life line.
- 1 x side cutting pliers.
- 1 x assorted screw drivers.
- 1 x hardness knife.
- 1 x marshaling batons at night.
- 1 x red emergency signal/torch.
- 1 x ladder

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Fire Lockers No.30 (Spare Charge for Portable Fire Extinguisher)

This fire locker contains the following:

- 7 x spare for portable fire extinguishers (clean agent type).
- 1 x spare for portable fire extinguishers (9.46L Wet K type).

Fire Lockers No.31 - 36 (Spare Charge for Portable Fire Extinguisher)

Each fire locker contains the following:

- 5 x spare for portable fire extinguishers (6kg CO2).
- 10 x spare for portable fire extinguishers (6kg dry chemical).

Watertight Doors

Watertight Sliding Doors
Manufacturer: IMS AS
Model: N280
Type: Electric/Hydraulic Class 3
No. of sets: 9

The primary purpose of the vessels watertight sliding doors, is to maintain the watertight integrity of the vessel whilst allowing the passage of personnel between compartments. They also serve to isolate compartments in the event of a fire.
Each hydraulically operated watertight sliding door is self-contained and comprises the following equipment:

- Electrically driven power pack.
- Hydraulic accumulator.
- Operating cylinders and limit switches.
- Operating handles (open/close).
- Emergency hand pump.
- Junction box for electrical power and control signals.
- Warning bells and lights.

Each door can be operated from the following locations:

- Remotely (closed only) on the mimic panels situated at the bridge control station and on the training bridge.
- Locally opened and closed (via operating handles or manual hand pump situated at each door).
- Remotely (closed only) from the emergency hand pump station situated above the water line in FZ4 corridor starboard

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Note: Doors can only be opened locally. Each door is equipped with a mechanical locking device to ensure that the door will not open in any situation, unless the operation lever locally on the door is operated toward opening direction of door. The mechanical locking device is only activated when the door is closed.

Note: Always wait for the door to completely open before passing through.

WARNING

Never attempt to pass through a watertight door whilst it is moving or the alarms are active. Keep all foreign objects clear of the door tracks.

The sliding watertight doors are positioned in the vessel as follows:

No.	Front (Forward)	Back (Aft)	Deck	Frame
1	Corridor (fwd) 31765P	Store 31820Q	3	176
2	Corridor (fwd FZ2) 21595P	Gymnasium 21760Q	4	159
3	Corridor (aft FZ2) 21595P	Corridor (fwd FZ2) 21415P	4	141
4	Corridor (fwd FZ3) 21235P	Corridor (aft FZ2) 21415P	4	123
5	Corridor (aft FZ3) 21085P	Corridor (fwd FZ3) 21235P	4	108
6	Corridor (aft FZ3) 21085P	Engine Room 1	4	90
7	Engine Room 1	Engine Room 2	4	70
8	Motor Room 1	Engine Room 2	4	51
9	Motor Room 1	Motor Room 2	4	33

Normal Operation

To operate the watertight doors, proceed as follows:
a) Confirm that there are no obstructions that could prevent the door from operating.
b) To open the door, turn the handle 90° towards door opening. To close the door, turn the handle 30° away from the door. The warning light will commence flashing and an audible alarm will sound. These warnings will only stop when the door is fully open or fully closed.

The master mode switch on the bridge mimic panel should always be switched to 'local' control for normal operations. If the mode switch is selected to 'doors closed', releasing the open/close door handle will cause the door to close automatically.

Emergency Operation (Local)

In case of an empty accumulator caused by a power pack failure, proceed as follows:
a) Take the manual pump lever located adjacent to the power pack and fit into the manual pump controller.
b) To close the door, it is only necessary to operate the pump lever.
c) To open the door, put the door handle to the OPEN position and operate the hand pump.

Emergency Operation (Remote)

In case of an empty accumulator, electrical failure and no access to the door, close the relevant door from the emergency hand pump station located above the waterline at FZ4 corridor stbd.
a) Connect the pump lever located beside the pump. Ensure the valve at the bottom of the tank is set to emergency pumping (valve lever vertical).
b) Operate the pump lever until the relevant door light on the indicator panel shows that the door is closed.
If a door has been closed from the remote emergency hand pump station, the oil in the system must be returned to the tank once power has been restored to the door. This operation requires 2 operators.

Watertight Hinged Doors
Manufacturer: ESTech Marine
Type: Quick center closing type
No. of sets: 4

In addition to watertight sliding doors, the vessel is fitted with a number of quick-closing, hinged steel watertight doors, which are also essential for preserving the watertight integrity of the vessel. The hinged watertight doors are positioned in the vessel as follows:

No.	In	Out	Deck	Frame
01	Corridor (aft FZ2)31765P	Corridor (fwd FZ3)31234P	3	122
02	Reception (aft FZ3)30704P	Corridor (fwd FZ4)31234P	3	70
03	Steering gear (aft FZ5)	Companionway to aft mooring deck/RORO cargo space	3	5
04	Corridor (aft FZ3)30701P	Corridor(fwd FZ4)30791P	3	70

Door Opening and Closing

All hinged watertight doors are opened and closed manually. Each door is mounted on a sill to prevent water ingress when open and each door is fitted with a spring loaded door closer.

Door Sealing Arrangement

Watertight integrity is achieved by means of a double sealing arrangement. Firstly a neoprene gasket and secondly ceramic packing, which are fitted into recessed channels around the edge of the door. Locking dogs are used to compress the door against the sealing arrangement to achieve watertight integrity.

Status Indication

Limit switches are fitted to the hatch frames of all watertight doors to relay the door (open/close) status to the watertight door indication panel in the safety

Quick Closing Valves

To ensure a fast and effective ability to respond to a fire situation, the ship is provided with means to: shut off tanks containing flammable liquids that would normally be open and shut down pumps and other equipment that could cause or maintain a fire.

Oil Storage Tank Quick Closing Valves

Outlet valves from fuel oil and lubricating oil tanks from which oil could flow to feed a fire are equipped with quick-closing valves. These valves are operated from a control box located in the emergency gear locker No.2 located on main deck, port side forward of the engine casing.

The control box is supplied with compressed air at 8.0 bar, from the control air system to a 350 litre storage receiver located inside the control box. This receiver is fitted with drain, relief valve and low pressure alarm connected to the central alarm and monitoring system. A screw down non-return valve is fitted on the inlet line, this valve is normally locked open to ensure that a full charge of compressed air is always available for operation of the valves.

The control box supplies the following 23 quick closing valves, via 3 groups

Group	Valve	Description
Group I	OE001	No.1 MGO service tank to MGE
	OP001	No.1 MGO settling tank to MGO separator
	OP002	No.1 MGO service tank to MGO separator
	OF021	Empty of No.1 MGO settling tank
	OF022	Empty of No.1 MGO service tank
	OF027	MGO Filling/Suction Isolating valve (for forward MGO tanks)
	LF012	No.1 LO storage tank outlet
	LF011	No.1 LO settling tank outlet

Group	Valve	Description
Group II	OE201	No.2 MGO service tank to MGE
	OE202	No.3 MGO service tank to MGE
	OP201	No.2 MGO settling tank to MGO separator
	OP202	No.3 MGO service tank to MGO separator
	OP206	No.3 MGO settling tank to MGO separator
	OP207	No.3 MGO Service tank to MGO separator
	LF212	No.2 LO storage tank outlet
	LF211	No.2 LO settling tank outlet
	OF221	Empty of No.2 MGO settling tank
	OF222	Empty of No.2 MGO service tank
	OF223	Empty of No.3 MGO settling tank
	OF224	Empty of No.3 MGO service tank
	OF225	MGO Fill/suction isolating valve (for MGO tank. 3P/4P)
	OF226	MGO Fill/suction isolating valve (for MGO Tank.3S/4S)
Group III	OI306	Outlet of Sludge Oil Mixing tank.

The oil tank valves are grouped into three systems with one three-way valve operating each group. In normal operation, the supply line to each group of tank valves is closed, but when the valve lever is turned 90°, compressed air is directed to pneumatic cylinders mounted on the side of each valve. Pressure will cause an actuator piston to collapse the bridge of each valve in that group, thus causing the valves to close.
The QCV's are reset by venting the air supply and operating the valve handwheel in a closed direction to reset the bridge mechanism and then by opening the valve in the normal manner.

Main Engine Fuel Inlet Quick Closing Valves

Fuel lines supplying the main engines are also equipped with quick-closing valves, however these valves are not operated from the QCV control box, instead, these valves are supplied with operating air directly from the control air system via pneumatic control panels. These valves are for use when there is a fire or major fuel leak on the engine in question. They may also be used to stop the engine in an emergency when all other methods have failed. Two QCV pneumatic control panels supply air to the QCV's on the fuel systems of No.1 & No.2 MGEs.

Control Panel	Valve	Description
No.1	OE051	No.1 MGE FO supply shut-off valve
	OE052	No.2 MGE FO supply shut-off valve

Control Panel	Valve	Description
No.2	OE251	No.3 MGE FO supply shut-off valve
	OE252	No.4 MGE FO supply shut-off valve

Each control panel is fitted with an isolation valve from the control air system, which is normally left open, whilst 3-way ball valves on the supply lines to each QCV remain closed. Opening the ball valve lever, will allow compressed air to collapse the bridge on the QCV, thus shutting off fuel to the engine. Each control box and control panel is fitted with a glass plate, which is broken in emergency situations to access the 3-way valves. A hammer is provided to break the glass.

To Reset a Quick-Closing Valve

- All QCVs have to be reset manually.
- Reset the remote operating valve lever to its original position - all operating air lines will be vented off.
- Turn the QCV handwheel clockwise, as if closing the valve, until the valve bridge can be reset.
- Turn the tank valve handwheel counter clockwise to open the valve fully.
- Confirm the pressure in the operating air receiver and control air system is normal.

Emergency Generator Engine Fuel Oil Inlet Quick-Closing Valve

The emergency generator engine fuel tank outlet is provided with a quick closing valve (OP301). In an emergency situation, this valve is activated by pulling on a wire connected to the valve bridge. The wire handle is located outside the emergency generator room entrance. Pulling on the wire will trip the valve.

Inergen Full Flooding Fixed Gas Fire Extinguishing System

Inergen is an inert gas which extinguishes Class A, B and C fires rapidly, whilst not damaging equipment, and most importantly not imposing any harmful effects on human life.

Inergen is a proprietary mixture of nitrogen, argon and CO2. It is colorless and odorless and has a normal density of 1.34kg/m3. During the discharge of the system, the oxygen concentration in the space is lowered from the normal 20.9% to between 10% and 13%.

At the same time the CO2 level is increased by approximately 4%. Because of this, the gas affects the breathing, which must be increased to maintain the oxygen flow to the muscles and brain as in a normal atmosphere.
In a total flooding system, the enclosure around the hazard must be tight enough to hold the required percentage of inergen concentration for a period of time to extinguish the fire.

After discharge into a room, the specific gravity of the gas is nearly the same as that of air at 1.07, hence, staying inside the protected zone when the gas is discharged is not dangerous. While the gas is not an asphyxiant, every effort should be made to ensure all personnel are evacuated from the affected area.

Inergen gas provides an atmosphere that will sustain a person with full consciousness and the ability to think and respond normally, even in cases of extremely low oxygen. The system enables the protection of anyone who might be trapped in the fire area from the effects of the lowered oxygen levels. The inergen is stored at 200 bar in certified seamless steel cylinders, securely bracketed and kept in a centralized inergen room. This is a central banking system, where the cylinders are connected through a manifold to a selector valve, which serves the individual protected zones. These cylinders are grouped as per the estimated quantity by calculation. Distribution pipes run from the selector valves to the nozzles that are evenly placed in the protected zones. These nozzles are calibrated and marked according to calculation to ensure the right amount of inergen is distributed in each area. Objects which may alter the free flow of the inergen in a space should not be placed in front of the nozzles.

The inergen system on the vessel is split into two systems (main system No.1 and reserve system No.2), which allows for system redundancy. Each system has an equal number of inergen cylinders (127), pilot cylinders (6) and actuator stations (14). Each system is segregated by check valves in the distribution manifold to separate the pressurized and non-pressurized sides of the system (when activated). Both main and reserve systems are able to supply inergen to any of the protected spaces.

The inergen system pipework is split between a high pressure side and a low pressure side. Orifice plates fitted in the distribution lines to the protected area nozzles, reduce the system pressure to ensure a proper flow rate and distribution pattern through the nozzles. The hole size in each orifice is specifically calculated for each protected area. To avoid low

pressure build-up in the system, pressure relief valves and vent plugs are fitted in the system. Pressure allowed to build up in the pipework may accidentally cause the system to activate.

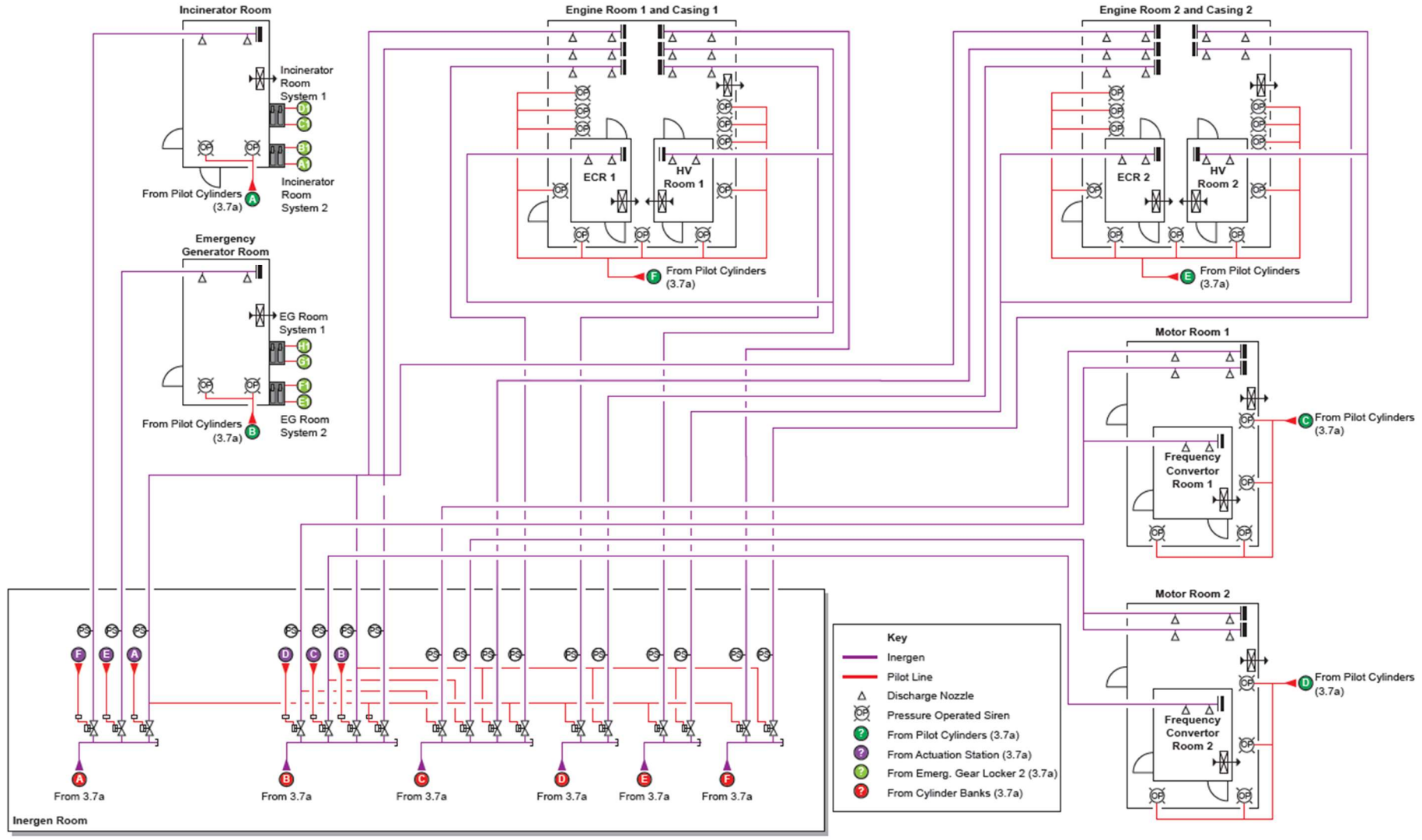
Inergen Release

Once activated, a sufficient number of inergen cylinders (pre-calculated for the volume of the protected space) is opened. This calculation is based on predicted temperatures of the protected space, storage temperature of the cylinders and known nozzle type, quantity and location, and pipe distribution layout. Hence, once installed, the system must not be altered in any way without consulting the system designer.

When inergen is admitted to a protected space, a discharge delay is incorporated into the system varying from 30 to 60 seconds depending on the size of the space. During this time, an alarm will sound, signaling for personnel in the space to evacuate and giving time for mechanical ventilation systems (fans and ventilation dampers) to shut down prior to inergen discharge. Both the time delay and alarm are driven from the inergen system and do not rely on any other external power. Inergen release alarms and their location will register on CAMS.

When inergen is released into a space, provision has been made for the air in the compartment to escape to avoid overpressure. After 30 or 90 seconds after discharge the ventilation dampers will open. After a further 120 seconds the dampers will be closed again.

Illustration 3.7b Full Flooding Inergen Gas System (ii)



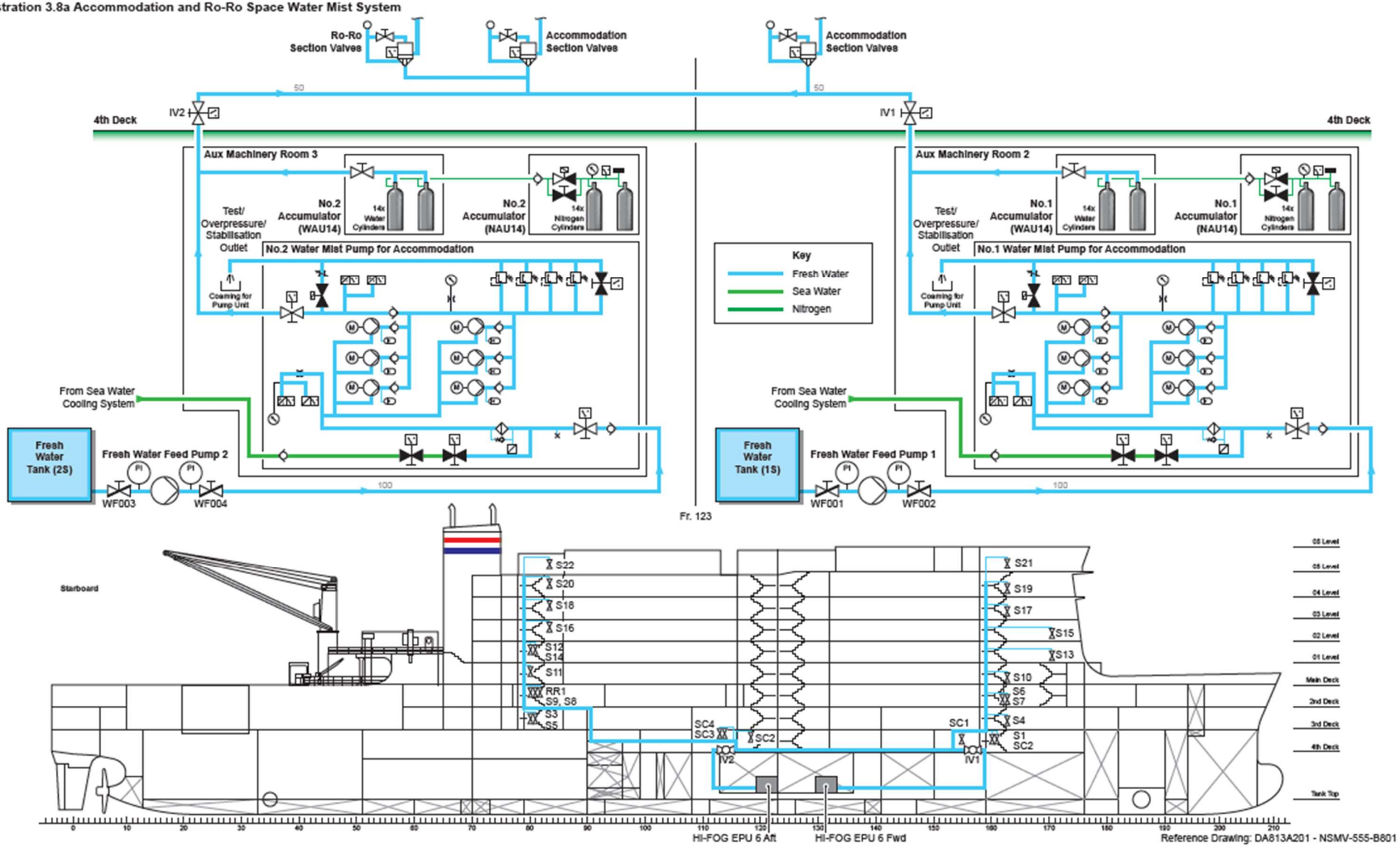
Accommodation and Ro-Ro Space Hi-Fog System

The Marioff Hi-fog water mist system provides fire protection in the accommodation and RO-RO areas. Water at high pressure is injected into the protected spaces through special spray heads which break down the water stream into very fine mist-like particles.
The basic working principle of the Hi-Fog system is that the very fine droplets of water tend to exclude oxygen from the area of the fire thereby starving the burning material of oxygen. When the fine water droplets come into contact with the flames, they are rapidly evaporated because of their large surface area for a small mass and this has a rapid cooling effect on the fire. The steam produced by the evaporation acts to further reduce the space available for oxygen. Because the water is in mist form, damage caused by the system is minimal and oxygen is still available, so personnel are safe if in the areas where the system is activated.

There are two separate Hi-Fog units located in AMR 2 and AMR 3. One unit is designated as master unit and the second acting as a standby unit, but they both supply the same consumers. Each Hi-Fog unit has five main and one standby high pressure, electrically-driven pumps which supply fresh water under pressure to the outlet main. The standby pressure in the system is maintained at 25 bar by a frequency controlled electrically driven standby pump, set at the pump control unit.

The EPU (Hi-Fog Pump unit) can start automatically, manually, or remotely. The automatic start is activated by flow and/or by low pressure. The manual start is activated from the pump unit control panel. The remote start can allow activation from an external source, such as release panel or a third-party signal from fire detection system. The Hi-Fog system in the accommodation areas consists of an automatic wet pipe system. For automatic operation, heat from a fire will cause the heat sensitive bulbs on one or more sprinklers to break, releasing the pressurized fresh water in the pipework. As water begins to flow, the pressure decreases in the system and this is indicated by pressure transmitters. The designated master EPU will activate if the system pressure drops below 17 bar for ten seconds (low pressure start) or is a standby pump is running longer than *typically* 10 seconds (flow start). Once system flow is detected, the control panel will indicate which section of the system has been activated and initiate an alarm. The EPU will starts its five pumps in sequence, with a short delay between each start. Should one pump fail to start, the standby pump is started automatically. Any excess flow is directed back to a break water tank through unloader valves. (The break water tank is a dedicated water tank where unused water is circulated when there is no reservoir available or not enough drain capacity). The high pressure pumps take their water supply from the fresh water break tank (of the relevant EPU) and it is replenished by the associated fresh water feed pump. The fresh water feed pump is controlled for automatic starting and stopping by means of level switches in the break water tank. Each EPU feed pump takes a dedicated suction from a fresh water tank (FWT 1S for No.1 EPU and FWT 2S for No.2 EPU).

Illustration 3.8a Accommodation and Ro-Ro Space Water Mist System



Engine Room Water Mist System

The water mist system for the Main Generator Engines (MGEs), and incinerator is a Fixed Water-Based Local Application Fire Fighting System which operates on the dry pipe principle.

The basic working principle of the water mist system is that the very fine droplets of water tend to exclude oxygen from the area of the fire thereby starving the burning material of oxygen. When the fine water droplets come into contact with the flames they are rapidly evaporated because of their large surface area for a small mass and this has a rapid cooling effect on the fire. The steam produced by the evaporation acts to further reduce the space available for oxygen. Because the water is in mist form, damage caused by the system is minimal and oxygen is still available, so personnel are safe if in the areas where the system is activated.

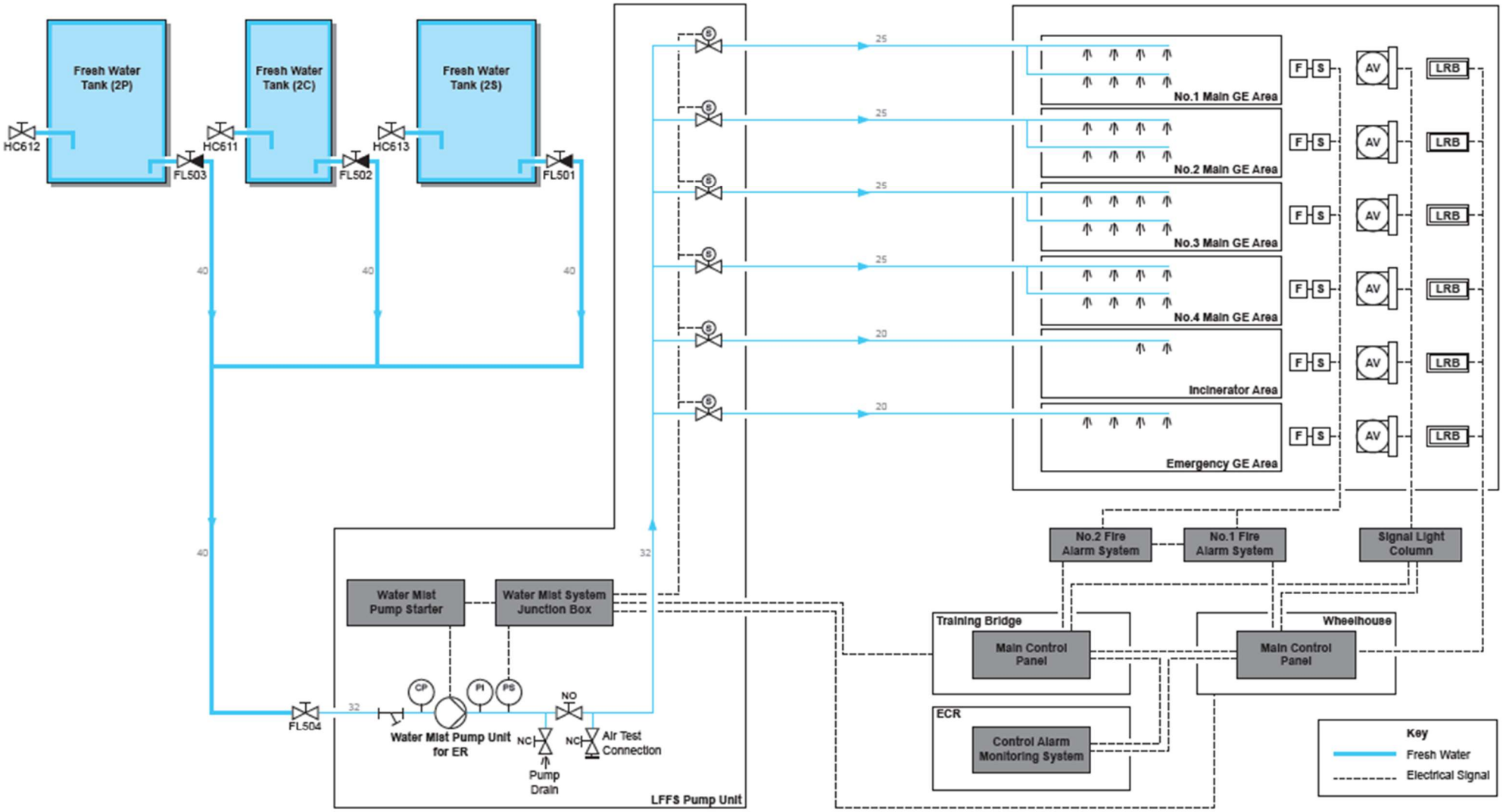
The water mist system comprises a skid mounted, high pressure, vertical, multi-stage centrifugal pump which takes suction from the following fresh water tanks (FWT: 2P, 2C or 2S). The suction point from each of the fresh water tanks is sufficiently higher than the pressure pump suction. This allows the pressure pump to have access to a reserve of water, allowing it to run for 20 minutes at full capacity supplying water to the largest protected area (which is any of the main engines). This reserve capacity has been calculated to be 1.93 m3. The areas protected by the system are shown in the following table:

Zone	Protected Area	Nozzle Qty	Flow Rate liters/min (Gal/min)
1	No.1 Main Generator Engine	8	80 (21.1)
2	No.2 Main Generator Engine	8	80 (21.1)
3	No.3 Main Generator Engine	8	80 (21.1)
4	No.4 Main Generator Engine	8	80 (21.1)
5	Incinerator	2	20 (5.3)
6	Emergency Generator Engine	4	40 (10.5)

Water Mist Pressure Pump

Water is supplied to the system by a an electrically-driven water mist pump, distribution manifold, and solenoid operated section valves. The pump, valves, distribution manifold and pump starter are all mounted on a common skid. The water mist pump is a vertical, multi-stage centrifugal pump which has a vertical shaft, where multiple stages are stacked one above the other and connected in series. Fluid enters the first chamber at suction line pressure and leaves at an elevated pressure. Upon leaving the first stage, the fluid enters the second stage where the pressure is increased further, and so on until the final discharge pressure.
The pump is normally left on-line, ready for automatic start with fresh water tank valves and pump suction and discharge valves left in the open position.

Illustration 3.9a Engine Room Water Mist System



Heli Deck Foam Fire Fighting System

The helideck is protected by a foam fire extinguishing system delivered via two remotely operated foam monitors and two manually operated hose reels. The purpose of the system is to protect the integrity of the vessel's helideck during helicopter activities.

The system comprises the following:

- Sea water supply.
- Foam tank.
- Foam pump.
- Foam pump starter.
- Foam/water proportioner.
- Two foam monitors with nozzles adjacent to helideck.
- Two local monitor control panels.
- Two hose reels with nozzles adjacent to helideck.
- Distribution pipework to the monitors and hose reels.
- Main control panel.
- Remote control panel.

Foam is generated by mixing the foam-making chemical (Ansulite) with sea water in a foam proportioner, at a rate of 3% chemical solution to 97% sea water and is supplied from the fire main. From the proportioner, the combined mixture passes into the distribution main and onto the foam monitors and hose reels. Constant flow nozzles attached to the monitors and hose reels perform the function of mixing the foam solution with air to form the characteristic foam blanket.
Hose reels allow operators to spread a foam blanket on spilled fuel that has not yet ignited or to combat fires that are not protected by the monitors. The foam entering the active fire zone suppresses the fire by separating the fuel from the air (oxygen). This is carried out by the following method:

- Foam blankets the fuel surface, smothering the fire.
- The fuel is cooled by the water content of the foam.
- The foam blanket suppresses the release of flammable vapors that can mix with the air.

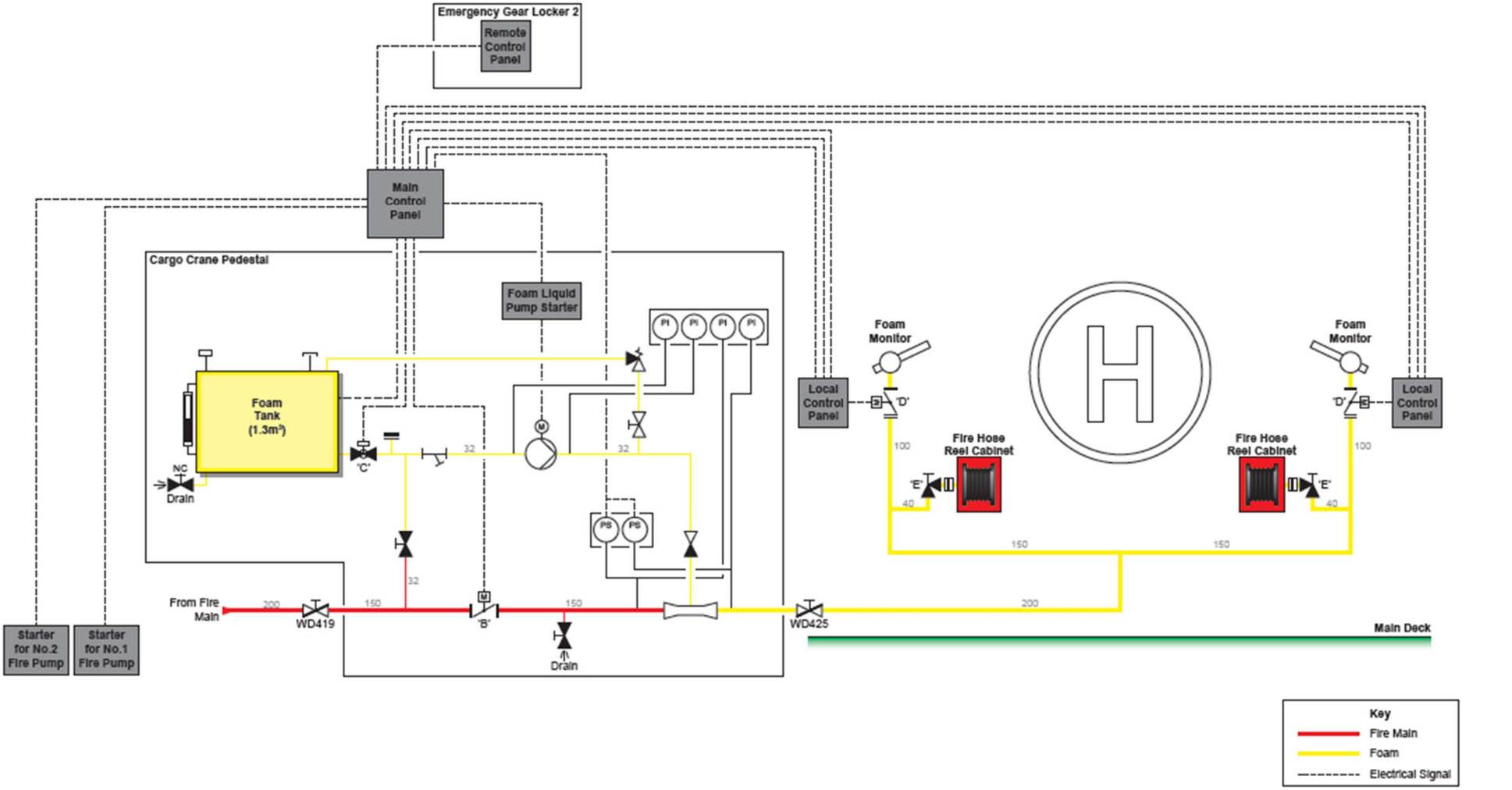
Foam Concentration

The foam system on this vessel has been designed to operate on a 3% foam injection concentration. If the foam concentrate is proportioned at a rate lower than this, the foam solution will be weak and may not be able to form stable bubbles. As a result, the solution will produce a foam blanket that has less resistance to breakdown from the heat and flames of the fire. The water in the foam will also drain off faster and cause the foam blanket to deteriorate quicker.
If a higher than required percentage of foam concentrate is added, the foam will be too thick and will not flow quickly across the surface of the fire or around obstructions. In addition, because more foam concentrate than required is being injected into the water, the supply of the concentrate will be depleted
quicker.

Foam Tank Unit

The foam tank unit is skid mounted and comprises the foam tank, foam pump, proportioner, pump starter and foam delivery pipework and fittings including valves, pressure switches and gauges. It is located in the cargo crane pedestal. AFFF concentrate is stored in the foam tank .

Illustration 3.10a Helideck Fire Extinguishing System



Reference Drawing: DA800D207 - NSMV-555-B401

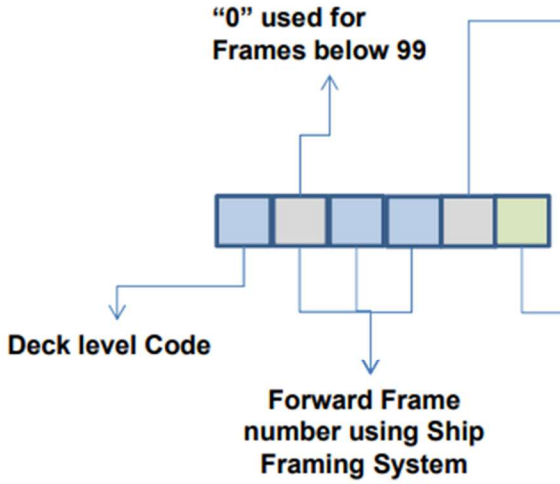
Compartment numbering system

NSMV Compartment and Room numbering changes

Room/Compartment "Labeling"

Deck level Code

Code	Description
1	Tank Top
2	4th Deck
3	3RD Deck
4	2nd Deck
5	Main Deck
6	01 Level
7	02 Level
8	03 Level
9	04 Level
10	05 Level



Compt Port/Stbd Code

Code	Description
0	Any Compartment crosses-centerline
1,3,5,7,9	Sequentially Numbered Stbd Compartments
2,4,6,8	Sequentially Numbered Port Compartments

Compt Description
"Single Alpha/Letter Code"
SWBS 640

Code	Description
A	Provisions Spaces
C	Control Spaces
E	Engineering Spaces
L	Living Spaces
O	Offices, Training
P	Passageway / Ladderwell / Stairways
T	Trunks
Q	Miscellaneous
W	Water
F	Fuel
V	Void Compartments

Specification 640.
Living spaces, Public spaces, Control spaces, Passage spaces, Catering spaces, Provisions spaces, Sanitary spaces, Machinery spaces, Sundry spaces, Training & class spaces.

Emergency Procedures

The following emergency procedures are adapted from the *PATRIOT STATE* SOLAS manual. These are standard operating procedures as dictated by the vessel manufacturer and may be superseded by vessel operating procedures and standing orders.

Flooding in the Engine Room

Pumps Available for Flood Water Bilge Pumping Duties

Bilge Housekeeping Pumps No.1+2
Manufacturer: Wilden
Type: Pneumatic membrane
Model: E3AA1R110H-B-ATEX
No. of sets: 2 (1x No.1 ER + 1 x No.2 ER)
Capacity: 5m3/h (176ft3/h) at 3.5 bar (51psi)
Air supply: 24m3/h (848ft3/h) at 3.8 bar (55psi)

Bilge/Ballast Pumps No.1+2
Manufacturer: Naniwa
Type: Vertical centrifugal
Model: FEV-200D
No. of sets: 2
Capacity: 250m3/h (8.829ft3/h) at 2.0 bar (29psi)
Motor: 440V, 33kW(44hp), 1,750 rpm

Bilge/Auxiliary Sea Water Cooling Pumps No.1+2
Manufacturer: Naniwa
Type: Vertical centrifugal (self-priming)
Model: FEV-200D
No. of sets: 2
Capacity: 250/190m3/h (8.829/6,710ft3/h) at 2.0 bar (29psi)
Motor: 440V, 33kW(44hp), 1,750 rpm

Main Sea Water Cooling Pumps No.1+4
Manufacturer: Naniwa
Type: Vertical centrifugal
Model: FEV-200D (self-priming)
No. of sets: 2
Capacity: 220m3/h (7,769ft3/h) at 2.7 bar (39psi)
Motor: 440V, 30kW(40hp), 1,765 rpm

Before any bilges are pumped directly overboard, it must be confirmed that no local or international anti-pollution regulations will be contravened except where the safety of the ship or personnel are involved.

Flooding in the engine rooms can occur due to a defect in the hull structure caused by grounding, berthing, collision damage, or more likely, due to a defect in the sea water pipeline system.

Measures to Prevent or Alleviate Flooding

• Maintain pipelines externally, tighten slack supports, and replace broken U-bolts on pipe brackets to minimize fretting in way of the supports.

• Operate all of the ship-side valves regularly, so they can be operated easily when required. ER1 valves such as the No.1 bilge/ballast pump direct bilge suction valves BS035/6, and No.1 main cooling sea water pump bilge emergency bilge suction valve BG199, both which are normally closed, but should be opened and closed regularly to ensure free movement. The same routine applies to ER2 valves.

• Before opening any sea water filters for cleaning, ensure the isolating valves are tightly closed by opening the vent in the cover. In any case, break open the cover joint before removing all of the cover bolts. The same applies when opening coolers and pipelines in the system.

• Care must always be taken when removing covers or opening any part of the sea water pipe system, as valves which are indicated as being closed may not be fully closed. Where gate valves or cocks are used for draining and venting, prove them clear by rodding before removing covers.

• Double bottom sounding pipe cocks and caps should be secured after use.

• If the source of water ingress is rapid and cannot be identified, close all remote-operated sea and ship-side valves either from CAMS or using the local hydraulically operated emergency handpumps. This action assumes the water level has reached above the floor plates.

• Personnel should be familiar with the position of the bilge suctions, and the pumps that can be used for bilge pumping duties. They should also be familiar with the position of the main sea suction and overboard valves, and know which main suction is currently in use.

In the event of major flooding when it is considered necessary to use either No.1 or No.4 main cooling sea water pumps, it is important that suction is not lost. When the pump has picked up suction, and the flood level is under control, the sea water suction should be used or the pump discharge valve throttled to control the rate at which flood water is being removed. Initially, the effort should be to control the rising water level, and maintain it at an acceptable level. Efforts can then be made to identify then secure the point of water ingress.

The first assessment will be which pumps to use, the bilge pumps or No.1 or No.4 main cooling sea water pumps, depending on which ER is flooding. These pumps are rated at 220m3/h (7,769ft3/h). No.1 and 2 bilge/ballast pumps have a maximum capacity of 250m3/h (8.829ft3/h). If No.1 or No.4 main cooling sea water pumps are unable to cope with the flooding through the emergency bilge suctions, then No.1 and 2 bilge/ballast pumps should be used as additional pumping capacity to control the flooding, from the direct bilge suctions.

Emergency Bilge Suction Valve

No.1, and No.4 main cooling sea water pumps each has a 200mm diameter direct bilge suction valve, the opening of which is positioned approximately 460mm above the tank top. These valves do not have a suction strainer so it is important no rags or rubbish are left on the tank tops that could block the pump casings, and stop them from operating in an emergency. As these pumps can be used for bilge pumping duties, the pump casings are fitted with pneumatically operated self-priming devices.
The emergency bilge suction valves for these pumps BG199, and BG399 are fitted with handwheels on extended spindles that protrude 460mm above the engine room floor plates. Before opening, it is preferable to have the pump initially operating on sea water, then the emergency bilge suction valve slowly opened. Once the pump has picked up suction on the bilge/flood water, the valve can be opened further, and the pump's sea water suction valve CWV07 for No.1 pump, or CW207 for No.4 pump, throttled towards the closed position. The level of the water in the bilges should be monitored, and kept under control using the pump sea water suction valve to maintain suction until the source of the leak has been identified and eliminated.

Bilge Suction Strainers

Bilge suction strainers should be checked and cleaned whenever the opportunity arises. Frequent checking and cleaning will reduce the risk of a strainer becoming blocked which may be difficult to clear during flooding. It is considered good housekeeping to keep the bilges and tank tops clear of any rags and debris which might otherwise be drawn into the bilge wells and block the suction strainers.
It is important to lower any bilge well that is in alarm to the empty level as soon as possible to give as much warning as possible should flooding occur.

Emergency Bilge Pumping

Procedures to Carry-out Should Engine Room Flooding Occur

a) Inform the Chief Engineer, Master and the OOW on the bridge of the emergency situation developing in the engine room, and the intention to pump the flood water out using either No.1 or No.4 main cooling sea water pumps. If the duty engineer is unable to make contact with the bridge or Chief Engineer, the general alarm should be sounded.
b) If not already running, start No.1 or No.4 main cooling sea water pump, and monitor the water level in the engine room. As the level decreases, the pump may start to lose suction. This can be controlled by throttling suction valves CW007 or CW207 from the sea water crossover mains. If the flooding is coming from a fractured crossover main, suction valves CW007 or CW207 will need to be closed, and the pump flow regulated using discharge valve CW011 or CW211.
c) When the flood water has been removed and the cause of the emergency resolved, close the emergency bilge suction valves BG199, and BG399, then return the main sea water cooling pump to normal operation.
d) After pumping the bilges, the pump and discharge lines must be thoroughly flushed with 'clean' sea water before being returned to normal duties.

Pumping Engine Room 1 Bilges with No.1 Bilge/Ballast Pump

No.1 bilge/ballast pump has two direct bilge suction valves in ER1. Valve BS036 takes suction from the port aft bilge well, and valve BS035 takes suction from the starboard bilge well, and discharges directly overboard through valve BS038. Valve BS033 connects this pump to the bilge main.

The discharge from this pump will go directly overboard without passing through an oil content monitor, therefore its use on emptying these bilge wells has to be regarded as an emergency operation, and only used when the safety of the vessel or personnel on board are at risk. The pump is located in ER1 at floor plate level starboard side aft of No.1 MGE. The pump discharges directly overboard:

No.1 Engine Room Main Cooling Sea Water Pump

No.1 main sea water cooling pump has ER1 emergency direct bilge suction valve BG199 fitted to its suction line. This can be opened and used for the direct transfer of bilge water overboard via the cooling water system.

Pumping Engine Room 2 Bilges with No.2 Bilge/Ballast Pump

No.2 bilge/ballast pump has two direct bilge suction valves in ER2. Valve BS049 takes suction from the port aft bilge well, and valve BS048 takes suction from the starboard bilge well, and discharges directly overboard through valve BS047. Valve BS044 connects this pump to the bilge main.

The discharge from this pump will go directly overboard without passing through an oil content monitor, therefore its use on emptying these bilge wells has to be regarded as an emergency operation, and only used when the safety of the vessel or personnel on board are at risk. The pump is located in ER2 at floor plate level port side forward of No.4 MGE. The pump discharges directly overboard:

No.2 Engine Room Main Cooling Sea Water Pump

No.4 main cooling sea water pump has the engine room emergency direct bilge suction valve BG399 fitted to its suction line. This can be opened and used for the direct transfer of bilge water overboard via the cooling water system.

Emergency Steering

Emergency Operation of the Steering Gear from the Bridge

The steering gear can be operated manually from the bridge if the control panel is equipped with Override Non-Follow-Up section for emergency steering. There are two ways to activate the emergency steering.

Direct Activation

Through operation of the Non-Follow-Up buttons (Port and Starboard):

1) Start one or both pumps from the bridge.
2) Operate the Non-Follow-Up buttons marked 'PORT' and 'STARBOARD' to activate override mode and move the rudder in the desired direction.
3) Reset the audible warning by pushing the 'BUZZER RELEASE' button.
4) Resume normal operation by turning the 'OVERRIDE' switch to the 'RELEASE' position. The override switch will return to the rest position marked with '0'.

Manual Activation

Through operation of the 'OVERRIDE' selector switch:

1) Start one or both pumps from the bridge.
2) Set the override switch to the 'OVERRIDE' position.
3) Push the non-follow-up buttons marked 'PORT' and 'STARBOARD' to operate the rudder in desired direction.
4) Resume normal operation by turning the 'OVERRIDE' switch to the 'RELEASE' position. The 'OVERRIDE' switch will return to the rest position marked with '0'.

Emergency Control from the Steering Gear Room

Should all the control systems fail (including the local NFU control system), steering capability can be maintained by manually operating the solenoid valves on the hydraulic control units. The selector switch on each of the steering gear motors starter cabinets and the local steering control cabinets should be set in the LOCAL position. The manual operating levers are then unlocked and used to control the rudder via the solenoid valves. The pump operates to turn the rudder in the required direction whilst the solenoid pushbutton is held depressed. Only one pump should be in operation for each steering gear when in emergency control.

In the event of complete failure of the steering gear control system, the steering gear must be operated in emergency manual mode from the steering gear compartment.

a) Establish communication with the bridge from the steering gear room(s).
b) At the steering motor control cabinet, change the selector switch to the LOCAL position.
Note: Operate one steering pump only.
c) At the emergency valves on the hydraulic actuator unit, remove the pin which secures the operating handles. The handles are colored red and green for port and starboard rudder movement respectively. Using the appropriate handle, press the manual pushbutton on the solenoid valve according to the helm commands. Observe the rudder movement on the scale fitted to the actuator. Release the solenoid pushbutton when the rudder reaches the desired angle.

When the need for emergency manual steering is finished, the switch on the steering motor control cabinets must be returned to the REMOTE BRIDGE control position, and the manual control handles secured.

Emergency Fire Pump Operation

Manufacturer: Naniwa
Type: Vertical single-stage in-line centrifugal
Model: FE2V-200-30 with self-priming
No. of sets: 1
Capacity: 210m3/h at 10.5 bar
Motor: 440V, 120kW, 1,750 rpm

The emergency fire pump is an electrically-driven self-priming vertical centrifugal pump which is situated on the tank top in AMR2 between FW tank 1S and GW tank 1S. Its power supply is taken from the emergency switchboard. The pumps suction draws from the main sea water crossover.

The pump can be started from three locations:
- Locally at the pump starter.
- Remotely from the bridge.
- Remotely from the fire control room.

Suction and discharge valves from this pump are locked open so that the pump may be started, and will supply water to the fire main immediately.

To Operate the Emergency Fire Pump

Set the emergency fire pump valves as in the table below:

Position	Description	Valve
Open	Emergency fire pump sea suction valve (locked open)	WD010
Open	Emergency fire pump non-return discharge valve (locked open)	WD011

Electrical Power Failure

The diesel generators are fitted with many alarms and safety features, such as preferential trips and automatic load sharing, which are designed to reduce the possibility of a loss of the power supply. However, it is simply not possible to allow for all eventualities and a complete power failure remains a possibility. In the event of failure of the main electrical supply system resulting in a blackout, the emergency generator will automatically start, connect to the emergency switchboard and supply power to those items of equipment which are supplied from the emergency switchboard.
Should there be a failure of the automatic starting arrangement for the emergency generator, the generator can be started and connected to the emergency switchboard manually.
An emergency battery supply system is also available, and this provides power for essential lighting and navigation and communication systems when the main electrical system is not available. The batteries are maintained on a constant trickle charge, so there is always full emergency power available in the event of loss of generated electrical power. The battery system will provide essential services whilst the main electrical system is being repaired.

Personal Safety During a Power Failure

Power failures are usually sudden in nature and can occur without warning. For short periods, it is possible that blackout conditions may exist in the engine room. During any blackout, it is important that personnel do not place themselves at unnecessary risk. Accidents can be avoided by following a few simple rules.

- Should there be a total lighting failure, stop whatever you are doing and remain still. Do not panic.
- On restoration of emergency lighting, or should a torch be available, move slowly and carefully towards the engine control room or emergency exit.
- If the blackout is prolonged for any reason, it is recommended that no attempt to move is made until some form of lighting is available. If, however, it is clear that to remain stationary is in itself placing the individual at risk, any attempt to move should be made on hands and knees, both very carefully and very slowly. Engineers should, as a matter of urgency upon joining a vessel, make themselves aware of the engine room layout, and the position of doors and ladders through which escape can be made.
- During normal working, it is important to leave the engine room tidy to avoid obstructions during emergency situations. Any lifted floor plates must be cordoned off in a safe manner at all times.

Automatic Recovery of Main Switchboard Power in the Event of a System Blackout

The hard-wired blackout recovery logic of the emergency switchboard, starts and connects the emergency generator on detection of a blackout. The starting and stopping of the emergency generator is without the intervention of the PMS.

The emergency switchboard supplies all the essential services required to start the main generators, the PMS will initiate a blackout recovery sequence as follows:

a) When a blackout is detected, the PMS issues a BLACKOUT CONDITION alarm, all the 6.6kV switchboard VCBs will be tripped by under voltage trips.

b) The PMS issues a START command to the generators, the generators will run up to their nominal voltage the PMS will issue CLOSE commands to the generators. When the first generator reaches its nominal voltage its VCB will close, then when the second generator has reached its nominal voltage it will synchronize with the bus and its VCB will also close and so on. When the 6.6kV bus bar is live the PMS will issue CLOSE commands to the 6.6kV ship services transformers associated with the live bus bar, this will initiate the pre-magnetization of the transformers, and their VCBs will close. The ship service 450V ACB at the 450V switchboard will close on closure of the 6,6kV VCB and the power on the 450V switchboard will be restored.

c) With power restored to the 450V switchboard the PMS will start all the services that do not have under voltage trips that were running before the blackout.

d) If the propulsion system was running before the blackout, it will be started.

e) All the consumers that were tripped on under voltage at blackout will then be started manually until full service is restored.

Sequential Restarting

After a blackout event when power is restored, certain essential services will be restarted automatically in a sequential manner, so as not to overload the generators by too many consumers being put online at one time. This is known as sequential starting and is arranged as follows:

Group	Consumer
0 sec	Lighting, navigation and communication control and instrument equipment. No.1 and No.2 steering gear. Nos.1, 2, 3 and 4 main generator DE LO pumps, NDE LO pumps.
5 sec	Nos. 1, 2, 3 and 4 auxiliary CSW pumps.
15 sec	No.1 and No.2 bow thruster fresh water cooling pumps.
20 sec	No.1 and No.2 fresh water pump for water mist system. No.1 and No.2 main fire pumps. No.1 and No.2 fire main hydrophore pump. Emergency fire pump.
25 sec	No.1 motor room supp/exh fan (MR1). No.2 motor room supply fan (MR1). No.3 motor room supp/exh fan (MR2). No.4 motor room supply fan (MR2).

Preferential Tripping

For the prevention of blackout circumstances, there are two scenarios for the activation of the preferential trips:

- **Frequency** - If the frequency of the supply should fall below 57Hz for 5 secs, PT-1 will trip. If the frequency were to remain below 57Hz for a further 5 secs then PT-2 will trip.
- **Load** - If the load on the generators is 100% for 5 secs then PT-1 will trip, if the load remains at 100% for a further 5 secs then PT-2 will trip.

The following are the affected units:

PT-1

- No.1 load center panel.
- No.1 to No.10 hot water calorifiers.

PT-2

- Starters No.1 to 4 A/C chilled water plants.
- Control panels AHU No.1 to No.5.
- Control panels AHU No.7 to No.16.
- Starters for chilled water pumps No.1 to No.4.
- Starters for heated water pumps No.1 to No.4.
- Control panels for FCU1 and 2.
- Control panels for FCU4 to 10.
- RPD-1.
- Control panels for provision refrigeration plant compressors No.1 and No.2.
- Control panel for refrigerated provision store 1/2 and lobbies.
- Control panel for refrigeration system of daily room (galley).

Start Blocking of Heavy Consumers

The heavy consumers on this vessel are the bow thruster (1800kW) and stern thrusters (890kW) If the PMS receives a start request from the bow or stern thrusters it will evaluate if there is sufficient spinning reserve of power to start, if there is not, then the PMS will start the next generator that is in standby and when it is on line and synchronized the PMS will then issue a start enable signal to the thruster to start.

Actions After the Restoration of Partial Power

Following the restoration of power to the emergency switchboard, the cause of the failure of the main generators should be established and corrected as quickly as possible. Without power, the main engines will continue to turn due to the momentum of the ship. Consideration must be given to stopping the shafts as quickly as possible to prevent damage due to lack of lubrication.

Actions After the Restoration of Full Power

On the restoration of full power, the sequential restart system will activate. This will automatically supply power to most engine room services. If the cause of the power failure is apparent and has been corrected, any remaining services can be restarted. If not, efforts should be made to identify the problem and correct it before concentrating on the restoration of the remaining services.

It is possible the power failure may cause problems with controllers/equipment which is not immediately apparent, therefore, all engine room functions should be closely monitored for a significant period following any power failure.

Loss of Propulsion Control

The normal means of maneuvering the engines is from the bridge or ECR consoles. A third means is available via the Local Control Station (LCS) located at each engine. In the event of a breakdown of the normal maneuvering systems, the LCS can be used. The bridge system, ECR system, and the LCS are all part of the remote control system, with only one station active at a time.
However, the LCS has the highest priority, and control can be taken by this position at any time, even if the bridge or ECR are in control.
In addition to the above, a telegraph system operates between the wheelhouse and the ECR, and the wheelhouse and the LCS. The telegraph system allows the engines to be maneuvered remotely from the Engine Control System (ECS), or from the LCS, according to orders from the bridge.

Local Control Station (LCS)

The LCS is the interface with the engine operator. The LCS contains the Consolidated Function Display (CFD) screen for operator interaction. Also, the CFD holds several indicator lights that indicate system status, and various switches for engine control.

Local/Remote Engine Operation

When in Local Mode, engine speed is controlled by the Increase/Decrease Speed switch on the LCS. The engine speed will ramp up or down in a consistent rate. The rate of speed increase and decrease is configurable. In Remote Mode, engine speed is controlled by either a 4-20mA throttle for variable speed engines, or a ±3VDC bias signal for constant speed engines. Similar to the local control, the speed will increase and decrease at a steady rate.
The transition from local mode to remote mode can happen from either the local station or a remote station.
To initiate Remote Control from the remote station, the operator at the remote station has to press, and hold the 'Remote Control Acknowledged' button. After being pressed, the CFD at the LCS will alarm 'Remote Control Requested'. At the LCS switches the operator then turns Local/Remote switch to 'Remote'.
The engine will now be in remote mode.
To initiate Remote Control from the LCS, the operator must put the Local/ Remote switch to 'Remote'. The CFD will alarm 'Local Station Requesting Remote Control'. The remote operator must then press the 'Remote Control Acknowledged' button. The engine will then be in remote mode.
The speed of the engine will not change until the speed signals match, i.e. the engine speed from the remote station will not change until it matches the current engine speed. This is to prevent inadvertent speed increase or decrease upon changing control stations.
To change from remote mode to local mode, the operator at the LCS moves the switch to 'Local'. The engine control is then in local mode. Engine speed will not change.

Local Control Station

Reset Button

The reset pushbutton is located on the front panel of the LCS. The button can be used to reset the control system, allowing the engine to restart after a shutdown or emergency stop has occurred. This reset can only be applied at the LCS, as typically a critical shutdown requires a thorough inspection of the equipment, and root cause of the shutdown determined, and corrective action taken. To use the Reset Button, press and hold the button until the 'System OK' LED illuminates (about three seconds). A soft key on the CFD is also available on the Active Alarms screen.

Emergency Stop Pushbutton

The Emergency Stop pushbutton is located on the LCS. This emergency stop can be used for immediate shutdown of the engine in the event of an emergency. Restarting the engine after an emergency stop will require a manual reset of the system.

System Power Switch

The System Power Switch is located on the front of the LCS. This switch is used to turn power to the system ON or OFF.

Note: Do not turn system OFF if the engine is running.

When turning the system off, the power supply will send a signal to the ECU and SFU, instructing these units to conduct a controlled bootdown. The controlled bootdown will allow the ECU and SFU to save information as required, and shut down safely, similar to a computer. When ready, the ECU and SFU will send a signal to the PSU, at which point the PSU will turn off its outputs to these units. This switch will also cause the Local CFD to go into a controlled bootdown. However, there is no interaction between the CFD and the PSU. The PSU will not reset until the switch is turned back to the ON position.