

26 February 2021

1. SOLAS requires regular testing of Emergency Sources of Electrical Power.

Describe the recommended routine testing procedure for the emergency generator, in accordance with Maritime & Coastguard Agency (MCA) guidance.

(10)

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2. With reference to the International MARPOL Convention 73/78 Annex V - Garbage handling:

(a) list SIX defined categories of garbage; (6)

(b) list FOUR garbage handling procedures that require an entry in the garbage record book. (4)

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3. With reference to the STCW '78 as amended, machinery space watchkeeping requirements, state EACH of the following:

(a) the purpose of *standing orders*; (3)

(b) FOUR examples of *standing orders*; (4)

(c) the circumstances under which it would be inappropriate for an officer in charge of an engineering watch to hand over responsibility to a relief watchkeeper. (3)

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4. The Marine Accident Investigation Branch (M.A.I.B.) carries out investigations into casualties and accidents involving United Kingdom flagged vessels.

(a) List TWO responsibilities of the M.A.I.B. (2)

(b) State the Statutory requirements for reporting an accident. (4)

(c) List FOUR types of incident that are defined as *reportable accidents*. (4)

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5. With reference to the classification of a vessel:
- (a) list SIX items that would be inspected during a *special hull survey*; (3)
 - (b) describe how a *continuous hull survey* could be applied. (7)

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6. With reference to a vessel's maintenance:
- (a) list FOUR reasons why it is desirable for machinery to be covered by a planned maintenance system; (4)
 - (b) state FOUR reasons why unscheduled maintenance may need to be performed; (4)
 - (c) state ONE example of acceptable unscheduled maintenance. (2)

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7. With reference to vessel's survey requirements:
- (a) describe FIVE ways in which Government Surveyors will act in maintaining the statutory requirements of a vessel; (5)
 - (b) list FIVE ways in which Classification Surveyors can act to maintain the class and statutory requirements of the vessel. (5)

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8. With reference to the periodical dry-docking of a vessel:
- (a) state FIVE items of information that may be obtained from a *docking plan*; (5)
 - (b) state FIVE services that must be made available in order to maintain the safety of the vessel. (5)

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9. A vessel has bunkered 250 tonnes of diesel fuel of which 10% is assumed to be unpumpable. The average combined sea load of the vessel is 2800kW with a stated specific consumption of 0.35kg/kWh at a speed of 18 knots.

Calculate EACH of the following:

- (a) the daily fuel consumption of the vessel; (4)
- (b) the safe steaming range of the vessel. (6)

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10. With reference to transverse watertight bulkheads, state EACH of the following:

- (a) FOUR reasons why these are an important part of the vessel's structure; (4)
- (b) the positions of each of the FOUR most important watertight bulkheads; (4)
- (c) the reason why the foremost continuous bulkhead is of a stronger construction. (2)

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1. SOLAS requires regular testing of Emergency Sources of Electrical Power.

Describe the recommended routine testing procedure for the emergency generator, in accordance with Maritime & Coastguard Agency (MCA) guidance. (10)

SOLAS Emergency Generator Testing According to MCA Guidance

The International Convention for the Safety of Life at Sea (SOLAS) mandates regular testing of emergency generators to ensure they function reliably when needed. The Maritime & Coastguard Agency (MCA) provides guidelines for these tests, promoting safe and effective procedures. Here's a breakdown of the recommended routine testing for emergency generators:

Testing Frequency:

- **Weekly:** A **no-load test** (off-load test) should be conducted at least once a week as part of routine safety checks. This verifies the engine's starting capability on battery power.
- **Monthly:**
 - A **load test** (on-load test) with the emergency generator supplying power to the emergency switchboard for a minimum of **30 minutes** is recommended. This ensures the generator can handle the electrical load in an emergency.
 - Additionally, a **hydraulic starting test** should be performed to confirm the functionality of the hydraulic starting system.
- **Annually:** A more comprehensive test may be required during annual surveys, potentially involving simulating a complete blackout by opening the interconnecting feeder breaker at the main switchboard.

General Testing Procedures:

1. **Preparation:** Ensure the emergency generator and surrounding area are clear and ready for testing. Refer to the manufacturer's instructions and risk assessments for specific procedures.
2. **Weekly Off-Load Test:**
 - Set the generator to manual mode (if applicable).
 - Start the engine using the battery starting system.
 - Monitor engine parameters like voltage, frequency, and exhaust temperature.
 - Run the engine for a short period (typically 10-15 minutes).
 - Stop the engine following the manufacturer's instructions.
3. **Monthly Load Test:**
 - Follow steps for the off-load test to start the engine.
 - Gradually apply load to the emergency generator by connecting essential equipment on the emergency switchboard.
 - Monitor engine performance under load, ensuring it meets required voltage and frequency specifications.
 - Maintain the load for at least 30 minutes.
 - Gradually remove the load and stop the engine following proper procedures.
4. **Monthly Hydraulic Starting Test:**
 - Follow the manufacturer's instructions for this test.
 - This typically involves activating the hydraulic starting system to crank the engine without battery power.

5. **Record Keeping:** Document all test results, including start times, stop times, any observations, and corrective actions taken (if necessary).

Additional Considerations:

- **Simulating Blackout (Annual):** Consult MCA guidance and classification societies for specific procedures for simulating a blackout during annual surveys. This may involve opening the interconnector feeder breaker to test automatic start-up and load transfer capabilities.
- **Safety Precautions:** Always prioritize safety during testing procedures. Ensure proper personal protective equipment (PPE) is worn, and maintain a safe distance from moving parts.
- **Manufacturer's Instructions:** Refer to the specific emergency generator's operation and maintenance manuals for detailed testing procedures and safety precautions.

By following these recommendations and adhering to MCA guidance, crew members can ensure their vessel's emergency generator is properly tested and prepared to function reliably in the event of a power outage at sea.

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- (a) list SIX defined categories of garbage; (6)
- (b) list FOUR garbage handling procedures that require an entry in the garbage record book. (4)

MARPOL Annex V and Garbage Handling:

(a) Six Defined Categories of Garbage:

MARPOL Annex V categorizes garbage generated on ships to facilitate proper handling and disposal. Here are the six main categories:

1. **Food waste:** Includes all galley waste, leftovers, vegetable matter, fruit peels, and other food items not consumed.
2. **Plastics:** Encompasses all types of plastic materials, including packaging, utensils, ropes, fishing gear, and other plastic debris.
3. **Paper:** This category includes paper products like newspapers, cardboard boxes, paper towels, and office waste.
4. **Glass:** Broken or whole glass items, including bottles, drinking glasses, and laboratory glassware.
5. **Metal:** Metal cans, scrap metal, foil, and other metallic items generated onboard the ship.
6. **Operational waste:** This category includes non-consumable items associated with ship operations, such as used engine oil filters, greasy rags, cleaning chemicals, and expired chemicals.

(b) Garbage Handling Procedures Requiring GRB Entries:

The Garbage Record Book (GRB) serves as an official record of a ship's garbage management practices. MARPOL Annex V mandates entries for the following four specific garbage handling procedures:

1. **Discharge of Garbage at Sea:** Any discharge of garbage overboard, even if permitted under Annex V regulations (e.g., food waste beyond 12 nautical miles from land), must be documented in the GRB.
2. **Incineration of Garbage onboard:** If the ship has an incinerator and uses it to dispose of garbage, a record of each incineration operation needs to be entered in the GRB.
3. **Retention of Garbage onboard for Discharge Ashore:** When garbage is accumulated onboard for disposal at a reception facility in port, details of the stored garbage must be recorded in the GRB.
4. **Transfer of Garbage to Another Ship or to Shore Reception Facilities:** Entries are required for any transfer of garbage to another ship or to shore reception facilities at ports or terminals.

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 - (a) the purpose of *standing orders*; (3)
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 - (c) the circumstances under which it would be inappropriate for an officer in charge of an engineering watch to hand over responsibility to a relief watchkeeper. (3)

STCW and Machinery Space Watchkeeping Requirements:

(a) Purpose of Standing Orders:

Standing orders are written instructions provided onboard a vessel to guide the operation and maintenance of machinery and equipment, particularly within the engine room. Their main purpose is to:

- **Ensure Consistent and Safe Operation:** Standing orders promote consistent and safe practices for operating and maintaining machinery by outlining clear procedures for routine tasks, emergency situations, and unforeseen circumstances.
- **Reduce Risk:** By providing clear instructions, standing orders help minimize the risk of human error and equipment malfunctions during machinery space operations.
- **Facilitate Watch Handover:** Standing orders serve as a reference point for watchkeeping engineers, ensuring a smooth and informed handover of responsibilities between crew members.

(b) Four Examples of Standing Orders:

1. **Starting and Stopping Procedures:** Standing orders typically detail the specific steps for starting and stopping main and auxiliary engines, outlining proper safety precautions and sequence of operations.
2. **Alarm Response Procedures:** These orders specify the actions to be taken in response to various machinery alarms, ensuring prompt and appropriate responses to potential issues.
3. **Maintenance Routines:** Standing orders may outline routine maintenance procedures for critical equipment, including lubrication checks, filter replacements, and other preventive maintenance tasks.
4. **Emergency Procedures:** Orders may detail actions to be taken in emergency situations such as fires, flooding, or loss of propulsion, promoting a coordinated and effective response from the engine room crew.

(c) Inappropriate Circumstances for Handing Over Watchkeeping Duties:

The officer in charge of an engineering watch should not hand over responsibility to a relief watchkeeper under the following circumstances:

1. **During Critical Maneuvers:** When the vessel is engaged in critical maneuvers like entering or leaving port, navigating restricted waters, or encountering adverse weather conditions, it's crucial for the experienced officer to remain in charge.
2. **Equipment Malfunction:** If the machinery space is experiencing a significant equipment malfunction or breakdown, a qualified and experienced officer should oversee the situation until it's stabilized and corrective actions are initiated.
3. **Unfamiliar Crew Member:** In cases where the relief watchkeeper is unfamiliar with the specific vessel's machinery or lacks sufficient experience for the prevailing conditions, it might be prudent for the current officer to remain on watch until a more suitable replacement is available.
4. **Impaired Watchkeeper:** If the relief watchkeeper appears to be under the influence of alcohol, drugs, or is otherwise unfit for duty due to fatigue or illness, handing over responsibility would be inappropriate and potentially dangerous.

Ultimately, the officer in charge of the watch has the responsibility to exercise professional judgement and ensure a safe handover considering the prevailing circumstances and the competency of the relief watchkeeper.

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Marine Accident Investigation Branch (MAIB) and Accident Reporting

The Marine Accident Investigation Branch (MAIB) plays a vital role in maritime safety within the UK.

(a) Two Responsibilities of the MAIB:

1. **Independent Investigations:** The MAIB conducts independent investigations into accidents at sea involving UK flagged vessels **worldwide**. Their focus is not on assigning blame but on determining the causes and contributing factors to the accident.
2. **Safety Recommendations:** Following investigations, the MAIB publishes reports with safety recommendations aimed at improving maritime safety practices across the industry. These recommendations are directed toward ship operators, regulatory bodies, and equipment manufacturers.

(b) Statutory Requirements for Reporting Accidents:

The statutory requirements for reporting accidents involving UK flagged vessels are outlined in the Merchant Shipping (Accident Reporting and Investigation) Regulations. Here's a breakdown:

- **Legal Obligation:** The master of the ship, or in their absence, the senior surviving officer, has a legal obligation to report the accident to the MAIB.
- **Timeliness:** The report should be made **as soon as reasonably practicable** after the accident occurs.

(c) Four Types of Reportable Accidents:

The following four types of incidents are defined as reportable accidents to the MAIB:

1. **Collisions:** Any collision between a UK flagged vessel and another vessel or stationary object, resulting in personal injury, property damage, or environmental pollution.
2. **Groundings:** An incident where a UK flagged vessel runs aground, resulting in damage to the vessel, pollution, or risk of pollution from the vessel.
3. **Strandings:** A situation where a UK flagged vessel becomes immobilized due to navigational error or equipment failure, and is at risk of damage or pollution.
4. **Machinery Damage:** Damage to the main propulsion machinery or auxiliary machinery onboard a UK flagged vessel, resulting in loss of propulsion, restricted maneuvering capabilities, or near miss situations.

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Special and Continuous Hull Surveys for Vessel Classification

(a) Special Hull Survey Inspections:

A special hull survey is a comprehensive examination of a vessel's hull structure conducted by a Classification Society every five years. Here are six key areas inspected during a special hull survey:

1. **External Shell Plating:** Surveyors meticulously examine the exterior plating of the hull for signs of corrosion, cracks, deformations, or paint failures. Thickness measurements may be taken at critical locations to assess material integrity.
2. **Internal Structures:** Internal compartments of the hull are also thoroughly inspected for corrosion, cracking in frames and bulkheads, and damage to tank coatings. Cargo hold hatch coverings and sealing mechanisms are scrutinized for watertightness.
3. **Ballast Tanks:** Ballast tanks play a vital role in maintaining vessel stability. Special attention is given to inspecting ballast tank coatings for deterioration, checking for any internal structural damage, and verifying the operation of ballast pumping systems.
4. **Anchor and Mooring Equipment:** The anchors, chain cables, and winches used for anchoring and mooring the vessel are rigorously examined for wear and tear, ensuring their reliability in securing the vessel safely.
5. **Watertight Doors and Hatches:** Watertight doors and hatches are critical for compartment subdivision and vessel survival in case of damage. Surveyors check the operation of these closures, ensure watertight seals are in good condition, and verify the availability of remote control systems.

6. **Drainage and Bilge Systems:** The vessel's drainage and bilge systems are essential for removing water from decks and machinery spaces. The survey focuses on ensuring proper pipework integrity, pump functionality, and bilge well cleanliness.

(b) Applying Continuous Hull Survey Methods:

A continuous hull survey is an alternative approach to traditional special surveys, offering more frequent but less extensive inspections spread over a five-year period. Here's how it could be applied:

1. **Phased Inspections:** Instead of a single extensive survey, the continuous method distributes inspections across five years. Each year, a specific section of the hull (e.g., fore peak, cargo holds, engine room bilge) is intensively examined.
2. **Risk-Based Approach:** Areas susceptible to higher wear and tear (e.g., ballast tanks, bow sections) may be inspected more frequently (e.g., annually) compared to less critical areas (e.g., upper decks).
3. **Focus on Critical Zones:** During each annual inspection, surveyors prioritize critical areas like seams, welds, and areas of known historical weakness identified in previous surveys. Thickness measurements may be taken using sophisticated ultrasonic testing equipment.
4. **Data Collection and Trend Analysis:** Continuous surveys allow for data collection over time. Thickness measurements, corrosion rates, and identified deterioration are tracked to predict future maintenance needs and potential areas of concern for subsequent surveys.

By distributing intrusive inspections across a five-year period, continuous hull surveys can minimize vessel downtime compared to a single special survey while

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- (c) state ONE example of acceptable unscheduled maintenance. (2)

Planned vs. Unscheduled Maintenance on a Vessel

(a) Benefits of Planned Maintenance for Machinery:

A planned maintenance system (PMS) offers several advantages for vessel machinery:

1. **Prevents Unexpected Breakdowns:** By proactively scheduling maintenance based on manufacturer recommendations and condition monitoring, a PMS helps prevent unexpected equipment failures at sea. This reduces the risk of accidents, delays, and loss of revenue.
2. **Optimizes Equipment Lifespan:** Regular maintenance tasks like lubrication, filter changes, and adjustments minimize wear and tear on machinery components. This extends the equipment's useful life and reduces the need for costly replacements.
3. **Reduces Repair Costs:** Early detection of potential issues through condition monitoring allows for timely corrective action. Addressing minor problems before they escalate into major failures keeps repair costs under control.

4. **Improves Operational Efficiency:** Well-maintained machinery operates more efficiently, consuming less fuel and performing at optimal levels. This translates to cost savings on fuel and enhances overall vessel performance.

(b) Reasons for Unscheduled Maintenance:

While a PMS minimizes unscheduled maintenance, certain situations may necessitate immediate attention:

1. **Sudden Equipment Failure:** Despite precautions, components can fail unexpectedly due to manufacturing defects, material fatigue, or external factors like excessive loads. Unscheduled maintenance becomes necessary to restore functionality.
2. **Accidental Damage:** Collisions, groundings, or exposure to harsh weather conditions can damage machinery requiring immediate repair to ensure vessel safety and seaworthiness.
3. **Unexpected Wear and Tear:** Operating conditions may be more severe than anticipated, leading to accelerated wear and tear on components. Unscheduled maintenance becomes necessary to address excessive wear before complete failure.
4. **Safety System Activation:** Safety systems like alarms and shutdowns may trigger due to abnormal operating parameters. Unscheduled maintenance is required to diagnose the cause of the activation and ensure continued safe operation.

(c) Example of Acceptable Unscheduled Maintenance:

One example of acceptable unscheduled maintenance could be replacing a blown fuse on a critical electrical circuit. This minor repair can be performed relatively quickly and does not require extensive disassembly of machinery. However, the incident should be investigated to determine the cause of the fuse blowing to prevent future occurrences.

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 - (b) list FIVE ways in which Classification Surveyors can act to maintain the class and statutory requirements of the vessel. (5)

Ensuring Vessel Safety: Roles of Government and Classification Surveyors

(a) How Government Surveyors Maintain Statutory Requirements:

Government surveyors play a critical role in upholding the statutory safety and environmental regulations for vessels. Here are five key ways they achieve this:

1. **Conducting Initial Surveys and Issuing Certificates:** Government surveyors assess new vessels against national and international regulations. Upon successful inspection, they issue statutory certificates like Safety Equipment Certificates (SEC) and International Safety Management Code (ISMC) Certificates, which are mandatory for commercial operation.

2. **Performing Periodic Surveys:** Throughout a vessel's operational life, government surveyors conduct regular surveys to ensure continued compliance with statutory requirements. These surveys may focus on life-saving appliances, fire safety equipment, navigation systems, and pollution prevention measures.
3. **Investigating Accidents and Incidents:** In the event of accidents or incidents at sea, government surveyors may be called upon to investigate the cause. They analyze evidence, interview crew, and assess whether statutory non-compliance contributed to the incident.
4. **Enforcing Regulations Through Port State Control:** Government surveyors conduct port state control inspections on foreign vessels entering national ports. These inspections verify that the vessels comply with international maritime regulations, potentially detaining non-compliant vessels until corrective actions are taken.
5. **Collaborating with Classification Societies:** Government surveyors often maintain close working relationships with classification societies. They may share survey information and work cooperatively to ensure vessels meet both statutory and class requirements.

(b) How Classification Surveyors Maintain Class and Statutory Requirements:

Classification societies supplement government efforts by providing classification surveys that address both class rules and statutory requirements. Here are five ways they contribute:

1. **Plan Review and Approval:** Classification societies review ship designs to ensure compliance with their class rules, which often exceed minimum statutory requirements. This proactive approach enhances vessel safety beyond the bare minimums.
2. **Construction Oversight and Surveys:** Throughout construction, classification surveyors conduct inspections to verify adherence to approved plans and materials. This helps identify potential statutory non-compliance issues early on during construction.
3. **In-Service Surveys and Audits:** Classification societies conduct regular in-service surveys to ensure vessels maintain class and statutory compliance. These surveys can include machinery surveys, hull inspections, and safety equipment checks.
4. **Issuing Class Certificates:** Upon successful completion of surveys, classification societies issue class certificates. These certificates demonstrate a vessel's adherence to higher safety standards than just statutory regulations, potentially leading to lower insurance premiums.
5. **Continuous Improvement and Rule Updates:** Classification societies proactively update their class rules to reflect advances in technology and best practices in maritime safety. This indirectly encourages vessels to maintain a level of safety that may exceed current statutory requirements.

By working together, government surveyors and classification societies create a multi-layered system of checks and balances to ensure that vessels operate safely and in compliance with both statutory regulations and higher industry standards.

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8. With reference to the periodical dry-docking of a vessel:
 - (a) state FIVE items of information that may be obtained from a *docking plan*; (5)
 - (b) state FIVE services that must be made available in order to maintain the safety of the vessel. (5)

Information Gleaned from a Docking Plan:

(a) Five Key Details from a Docking Plan:

A well-prepared docking plan provides valuable information for a successful dry-docking operation. Here are five key details you can typically find:

1. **Vessel Characteristics:** The plan will include basic vessel information like dimensions (length, breadth, draft), weight, and center of gravity. This data is crucial for calculating block placement and ensuring proper support during dry-docking.
2. **Docking Block Arrangement:** The plan details the specific type, size, and placement of docking blocks used to support the vessel in the dry dock. This ensures even weight distribution and minimizes stress on the hull structure.
3. **Sea Chest and Valve Locations:** The plan identifies the location of all sea chests (openings for water intake/outflow) and associated valves. This information is essential for divers to blank off these openings and prevent water ingress during flooding.
4. **Planned Maintenance and Repairs:** The docking plan outlines the specific maintenance and repair tasks scheduled for the dry-docking period. This helps coordinate workforces and allocate resources efficiently.
5. **Stability Calculations and Ballast Distribution:** The plan may include stability calculations to determine optimal ballast water distribution within the vessel during dry-docking. This maintains vessel stability and prevents tipping while out of the water.

(b) Five Essential Services for Vessel Safety During Dry-Docking:**(b) Five Essential Services for Vessel Safety During Dry-Docking:**

Several crucial services are required to maintain vessel safety throughout the dry-docking process:

1. **Mooring and Shoring:** Skilled personnel secure the vessel within the dry dock using mooring lines and provide additional support with shoring (temporary structures) as needed. This prevents the vessel from shifting or tipping during flooding and dry-docking.
2. **Firefighting and Safety Equipment:** The dry dock facility must have readily available firefighting equipment and emergency response procedures in place to address any potential fire hazards during hot work (welding, cutting) performed on the vessel.
3. **Waste Management:** A plan for handling and disposing of waste generated during maintenance activities, such as paint scrapings, sandblasting debris, and oily wastes, is essential to comply with environmental regulations and maintain a safe work environment.
4. **Scaffolding and Access Platforms:** For repairs conducted on elevated sections of the hull, properly constructed scaffolding and access platforms are needed to ensure safe working conditions for maintenance personnel.
5. **Marine Growth Removal and Hull Cleaning:** Specialized services are required to remove marine growth like barnacles and algae from the hull. This improves fuel efficiency and reduces frictional resistance once the vessel returns to service.

By ensuring the availability of these essential services, dry dock facilities can contribute significantly to safe and efficient vessel maintenance during periodical dry-docking operations.

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9. A vessel has bunkered 250 tonnes of diesel fuel of which 10% is assumed to be unpumpable. The average combined sea load of the vessel is 2800kW with a stated specific consumption of 0.35kg/kWh at a speed of 18 knots.

Calculate EACH of the following:

- (a) the daily fuel consumption of the vessel; (4)
- (b) the safe steaming range of the vessel. (6)

Fuel Consumption and Steaming Range Calculations

We can calculate the daily fuel consumption and safe steaming range of the vessel based on the provided information.

(a) Daily Fuel Consumption:

1. Calculate usable fuel:

- Unpumpable fuel = Bunkered fuel * 10% = 250 tonnes * 0.1 = 25 tonnes
- Usable fuel = Bunkered fuel - Unpumpable fuel = 250 tonnes - 25 tonnes = 225 tonnes

2. Convert tonnes of usable fuel to kilograms:

$$\begin{aligned}\text{Usable fuel (kg)} &= \text{Usable fuel (tonnes)} \times 1000 \text{ kg/tonne} \\ \text{Usable fuel} &= 225 \text{ tonnes} \times 1000 \text{ kg/tonne} \\ \text{Usable fuel} &= 225,000 \text{ kg}\end{aligned}$$

3. **Convert kW to kWh (kilowatt-hours):** Since we're interested in daily consumption, we need to consider the total operating hours per day. A day has 24 hours, so:

$$\text{Total daily operating hours} = 24 \text{ hours/day}$$

4. Calculate daily energy consumption:

$$\begin{aligned}\text{Daily energy consumption (kWh)} &= \text{Average combined sea power load (kW)} \times \text{Daily operating hours (hours/day)} \\ \text{Daily energy consumption} &= 2800 \text{ kW} \times 24 \text{ hours/day} \\ \text{Daily energy consumption} &= 67200 \text{ kWh/day}\end{aligned}$$

5. Calculate daily fuel consumption:

$$\begin{aligned}\text{Daily fuel consumption (kg)} &= \text{Daily energy consumption (kWh)} \times \text{Specific consumption (kg/kWh)} \\ \text{Daily fuel consumption} &= 67200 \text{ kWh/day} \times 0.35 \text{ kg/kWh} \\ \text{Daily fuel consumption} &= 23520 \text{ kg/day}\end{aligned}$$

Therefore, the daily fuel consumption of the vessel is 23,520 kg/day.

(b) Safe Steaming Range:

Important Note: Calculating the exact safe steaming range is complex and depends on various factors beyond just fuel consumption, such as weather conditions, sea state, and vessel efficiency at different speeds. Here, we can estimate a theoretical maximum range based on the following assumptions:

- All 225,000 kg of usable fuel are consumed.
- There are no inefficiencies in fuel consumption.

1. **Estimate safe steaming range:**

$$\begin{aligned} \text{Safe steaming range (days)} &= \text{Usable fuel (kg)} / \text{Daily fuel consumption (kg/day)} \\ \text{Safe steaming range} &= 225,000 \text{ kg} / 23,520 \text{ kg/day} \\ \text{Safe steaming range} &\approx 9.56 \text{ days (rounded to two decimal places)} \end{aligned}$$

Therefore, the safe steaming range of the vessel at a speed of 18 knots is approximately 9.56 days. This is a theoretical maximum, and the actual range may be lower in real-world conditions.

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- FOUR reasons why these are an important part of the vessel's structure; (4)
- the positions of each of the FOUR most important watertight bulkheads; (4)
- the reason why the foremost continuous bulkhead is of a stronger construction. (2)

Show drafts

Draft 1

Transverse Watertight Bulkheads: Maintaining Vessel Integrity

(a) Importance of Transverse Watertight Bulkheads:

Transverse watertight bulkheads are crucial elements of a vessel's structure, ...

Transverse Watertight Bulkheads: Maintaining Vessel Integrity

(a) Importance of Transverse Watertight Bulkheads:

Transverse watertight bulkheads are crucial elements of a vessel's structure, offering several benefits:

- Compartmentalization:** They divide the vessel's interior into watertight compartments. If the hull breaches in one compartment, water ingress is limited to that specific area, preventing catastrophic flooding and potential sinking.
- Maintaining Buoyancy:** By isolating flooded compartments, watertight bulkheads help maintain sufficient buoyancy in the remaining compartments, allowing the vessel to stay afloat.
- Structural Strength:** These bulkheads add transverse strength to the hull, helping the vessel resist bending forces encountered during harsh weather conditions or rough seas.
- Fire Containment:** They can act as fire barriers, preventing the spread of fire from one compartment to another, buying time for crew to extinguish the flames and minimize damage.

(b) Positions of Four Important Watertight Bulkheads:

The positions of the four most important watertight bulkheads on a typical vessel are:

1. **Collision Bulkhead:** Located at a distance from the fore perpendicular (bow) of the vessel, this bulkhead is the first line of defense in case of a head-on collision.
2. **Machinery Space Bulkhead:** This bulkhead separates the machinery space (containing engines and boilers) from the rest of the vessel, preventing potential fire or flooding in the machinery space from spreading to other compartments.
3. **Aft Peak Bulkhead:** This bulkhead is located at the vessel's stern (rear) and forms the boundary of the aft peak tank, a compartment that can be ballasted with water to trim the vessel.
4. **Bulkheads at Intervals:** Additional transverse watertight bulkheads are positioned throughout the vessel's length at specified intervals determined by classification society regulations. These bulkheads further subdivide the vessel into smaller compartments, enhancing overall compartmentalization and damage control capabilities.

(c) Stronger Foremost Continuous Bulkhead:

The foremost continuous bulkhead, also known as the collision bulkhead, is designed with a stronger construction compared to other transverse bulkheads for two main reasons:

1. **Head-on Collisions:** The collision bulkhead is the first point of impact in the event of a head-on collision. A stronger construction helps absorb the impact force, minimizing damage to the vessel's interior and critical systems.
2. **Restraining Cargo:** The foremost part of a vessel often houses cargo holds. A stronger collision bulkhead can better restrain cargo during heavy seas or sudden maneuvers, preventing cargo shifting and potential damage to the hull structure.