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MEASURES TO HARMONIZE PORT STATE CONTROL (PSC) ACTIVITIES AND PROCEDURES WORLDWIDE

Guidance for port State control officers on inspection for ship's machinery and maintenance

Submitted by China, Caribbean MoU, Indian Ocean MoU and Tokyo MoU

SUMMARY

Executive summary:	This document provides guidance for Port State Control Officers on inspection for ship's machinery and maintenance in PSC procedures.
Strategic direction, if applicable:	1
Output:	1.11
Action to be taken:	Paragraph 3
Related documents:	Resolution A.1206(34) and III 12/6/1

Introduction

1 In recent years, based on the inspection practice and after multiple rounds of discussions, the co-proposers jointly drafted the Guidelines for PSCOs on enhanced machinery and maintenance inspections, as set out in the annex.

2 This guidance elaborates on the procedures for inspecting a ship's mechanical and electrical equipment, the objective evidence that requires detailed inspection, the main contents of detailed inspection, and suggested actions by PSCO for lack of maintenance, and reporting requirements of identified defects.

Action requested of the Sub-Committee

3 The Sub-Committee is invited to note the information in this document.

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ANNEX

GUIDELINES FOR PORT STATE CONTROL OFFICERS ON ENHANCED MACHINERY AND MAINTENANCE INSPECTIONS

1 Purpose

1.1 The purpose of this guidance is to assist PSCOs in having a harmonized approach in identifying and responding to technical or operational deficiencies found in relation to enhanced machinery and maintenance inspections requirements related to SOLAS chapter II-1.

2 Introduction

2.1 Machinery, the collective term for a ship's main power and auxiliary equipment, supplies propulsion power for safe navigation and ensures the crew's well-being. The propulsion equipment including the main engine, shafting, and propeller is the most important part of the ship's power plant. The ship's power plant also consists of boilers, generator sets, auxiliary machines serving the main engine, boiler, steering gear and other ship equipment, as well as electrical systems, piping systems (including the valves connecting them).

2.2 Machinery maintenance is a critical operational requirement to ensure the reliability of the ship's ability to safely operate and to optimize equipment service life, through a programme of routine maintenance, periodical maintenance and special maintenance.

2.3 Guidance to PSCOs regarding crew familiarity with the essential shipboard operations, including the operation of machinery, is provided in appendix 7, part 2, paragraph 1.3 of the IMO Procedures for Port State Control (as amended).

3 Inspection of ship's machinery

3.1 Document, logs, and records review

3.1.1 The machinery inspection is not a standalone inspection and forms part of the PSC inspection. Prior to conducting the physical inspection, the PSCO should verify that the ship holds a valid SOLAS Safety Construction Certificate (SAFCON), which has been appropriately endorsed. PSCOs are reminded that SOLAS 1974 regulation I/19 requires that this certificate be taken as prima facie evidence that the ship complies unless there are clear grounds to indicate otherwise.

3.1.2 Document review should confirm proper entries across machinery records, including the Oil Record Book (OWS use and sludge capacity), NOx Technical Files (MARPOL VI, regulation 13), fuel change-over records (ECA transitions), BDNs (Bunker Delivery Notes), SEEMP II/III Statement of Compliance (data submission and reporting year), and the latest Class Status Report for any outstanding machinery-related items.

3.1.3 The PSCO should ask if there are any Exemptions, letters or Conditions of Authority issued by the flag State or Conditions of Class issued by RO for propulsion or auxiliary machinery. Additionally, the PSCO should ask if there is currently any machinery under maintenance or currently inoperative or having sustained operational damage.

> ***Note:*** *Chapter II-1 of SOLAS permits the issue of exemptions under regulations 4 and 55 as well as Equivalence under regulation 5. Such exemptions should be taken at face value* unless there are clear grounds to indicate otherwise. *(as for the SAFCON).*

.1 The PSCO should check if the ship is surveyed and certified to SOLAS chapter II-1, part E: Additional Requirements for Periodically Unattended Machinery Spaces (UMS). If operating in UMS mode, verify compliance with company UMS procedures and also, this information is provided in the notation on the Certificate of Classification.

.2 A ship should have a documented maintenance system (which may be part of the safety management system (SMS) or is referred to by the SMS). The information in this system should include technical documents related to the systems onboard such as equipment operation manuals and maintenance manuals to facilitate crew operation and maintenance of equipment. The system and associated documentation are available in the working language or languages understood by the crew, or equivalent means such as a legible translation.

.3 The records of operation, maintenance (including repair) and inspection of machinery and associated equipment should be complete, accurate and reflect the dates recorded in Class status report and Nox Technical files.

3.2 Initial inspection of ship's machinery

3.2.1 The PSCO should use professional judgment to determine the scope of the PSC inspection. In the engine room, PSCOs should evaluate the overall condition of machinery to form a view of the standard of maintenance of machinery spaces to determine whether the ship's machinery appears to comply with SOLAS chapter II-1 and ISM Code section 10. Where the PSCO determines the machinery may not be operational or maintained as required, "clear grounds" may exist for a more detailed inspection (MDI).

3.2.2 When evaluating the overall general condition of the machinery space, the PSCO may consider examining some of the items listed below, (noting it is not necessary for the PSCO to check all these items for an initial inspection):

.1 whether it appears that the space has been kept clean and that:

.1 it is free of oil stains on machinery and lagging is not oil soaked;

.2 there is no accumulation of oil in the bilges or around the machinery itself in drip trays;

.3 temporary save-alls are not being used under leaking piping or joints; and

.4 oily rags have been removed rather than being left in the space after work completion;

.2 whether the ventilation systems are fully operational and effective in providing a safe atmosphere;

.3 whether lighting is operational and sufficient lighting is provided in locations where the crew may be working;

.4 whether electrical systems and equipment appear to be in good condition and to be free of earth faults, and are the insulation tests normal;

.5 whether piping systems, including control valves, quick-closing valves, pipe joints, relief valves and other associated equipment appear to be in good condition;

.6 whether the engine room control panel and monitoring system are free of abnormal or serious issues (PSCOs should note that some equipment will be in the alarm state when shut down or during maintenance.);

.7 whether the condition of machinery and associated systems (main engine, auxiliary engine, pumps, etc.,) appear to be in good condition, free of cracks, corrosion, leaks and excessive wear and tear or any other matters that may compromise safety (PSCOs should note that some isolation valves, e.g. fuel injection pump inlets, jacket water inlets/outlets, may have been shut to hide a leakage/drippage on critical machinery.);

.8 whether machinery space escape routes are clear of equipment, stores, waste or other materials that may impede escape from the space;

.9 whether gauges are undamaged and do the readings appear normal? (for example, the gauges to engine start air receiver(s) should indicate adequate pressure);

.10 whether the boiler automation system (UMS ships) is operational and whether the boiler has 2 water level indicators, which indicate proper water levels? Are the safety systems operational and unencumbered; and

.11 whether rubber expansion joints (REJs) appear to be in a satisfactory condition?

3.2.3 In regard to maintenance systems the PSCO should:

.1 check whether equipment maintenance records and other related work records are accurate, complete and verifiable (i.e. The PSCO can verify that the entries in engine logbooks are completed as required by the maintenance system, and this verification can be confirmed by physical examination);

.2 check if technical documents provided on board match the equipment model;

.3 check whether any work permits have been issued for ongoing maintenance, and whether lock-out equipment is available onboard and in place for the maintenance work;

.4 confirm that the officers and crew are familiar with the maintenance system on board the ship and are complying with the requirements to record and report information, and that they are aware of these requirements; and

.5 check if any events (i.e. system breakdowns) may have been related to a failure to undertake required maintenance.

3.2.4 Although the general state and condition of the ship is normally a good indication that maintenance is being performed by the crew, the PSCOs should be aware that the general state of the ship alone may not be sufficient in determining the overall effectiveness of the ship's maintenance system. If during the inspection of the ship, the PSCO becomes aware that the condition of the ship or of its equipment may not correspond substantially with the

particulars of any of the certificates, or that the ship and its equipment may not be in compliance with the provisions of regulation 11(a) and (b) of chapter I of SOLAS, then the PSCO should exercise his or her professional judgment to determine if non-compliance is possible with the requirements of SOLAS chapter II-1 and regulation 4 of chapter XI-1 (PSC operational requirements). Where there is evidence of suspected non-compliance, the PSCO should extend the scope of the inspection to conduct an MDI.

4 Clear grounds

4.1 Clear grounds are defined in section 1.7.2 of the *Procedures for Port State Control.*

4.2 In addition to the general examples of section 2.4 of the *Procedures for Port State Control,* the following conditions can warrant an MDI of machinery equipment and maintenance thereof:

.1 examples of Clear Grounds for MDI in Engine Room (non-exhaustive list):

.1 notification of a propulsion failure or lack of available power from the main engine;

.2 lack of the required number of auxiliary generators available for use, or lack of required available power or appropriate load sharing;

.3 excessive oil leakage, oil-soaked lagging, or collection of oil in bilges or save-alls;

.4 lack of familiarity of crew with regards to testing of equipment, in accordance with manufacturer's instructions;

.5 excessive number of alarms which are inhibited, off-scan, reposed, or manually suppressed;

.6 start air receiver does not have adequate pressure, or ship does not have the required number of air compressors in service;

.7 large earth faults on 220V (0.5 MOhm or less) or any earth fault on 440V system;

.8 engine compartment is cluttered with rubbish, oil-soaked rags, and unsecured spare parts;

.9 inoperable automated control systems, alarm systems, or safety systems on main engine, auxiliary engines, or boiler system; and

.10 evidence that an emergency repair recently took place on a critical machinery, e.g. loose tools and parts surrounding a particular equipment.

5 MDI of ship's machinery components

5.1 Sections 5.3 to 5.11 list a variety of items that may be considered as part of an MDI. These tests and checks are not to be applied as part of a routine initial PSC inspection and should only be inspected and/or tested where the PSCO has established that there are clear grounds for an MDI. As such, when establishing the scope of the MDI, the PSCO should only

apply the tests and/or checks that relate to the specific area where clear grounds have been established.

5.2 Many of the tests listed below are quite technical and complex and should be performed by a PSCO who is familiar with, has experience or training on the associated system, and should be performed in close coordination and clear understanding from the ship's crew. If there is uncertainty or unfamiliarity with a particular test which is unable to be demonstrated safely by the ship's crew, the item should be referred to the relevant RO for confirmation of conformance with SOLAS.

5.3 PSCOs should limit the extent and scope of items/areas to be inspected for machinery maintenance based on professional judgement in order to avoid excessive burden for both crew member onboard and PSCOs themselves.

5.4 **MDI on Main Engine Alarm Systems**

5.4.1 The main engine alarm system generally adopts a centralized alarm system, including sensors, alarms, alarm displays (centralized alarm panels), and actuators. The detailed requirements of the main engine alarm system are contingent upon the diverse types of engine rooms, specifically the continuously manned engine room and the periodically unmanned engine room.

5.4.2 ***General requirements***

.1 Visual inspection: Conduct a visual inspection of the main engine alarm system. Carefully check the alarm displays, alarms, uninterruptible power supplies (UPS), etc., for any damage. Verify whether the alarm displays can accurately and clearly show alarms, review historical alarm records, and check for false alarms. Ensure that alarms that are manually inhibited are done so for a reasonable cause. Check the appearance and secure connections of sensors.

.2 Performance test: Test the alarm function of the centralized alarm panel using the lamp and sound test buttons; and select critical alarms based on the type of machinery space to examine whether the alarm system functions properly, including whether alarms can be triggered, whether alarms can be clearly heard in all required locations (e.g., bridge, machinery space), whether alarms are displayed correctly (e.g., alarms are not manually inhibited without sufficient explanation), and whether actuators perform the corresponding actions.

5.4.3 ***MDI of the Ship***

.1 Test the cylinder liner cooling water high temperature alarm and exhaust gas high temperature alarm of the main engine and check whether they function properly (this should only be performed by a PSCO with knowledge and experience, in close consultation and clear communication with the ship's crew, or in conjunction with Class).

.2 Test the alarm system power supply failure alarm and check whether the alarm functions properly during a power supply failure.

.3 Test the low starting air pressure alarm of the main engine. For main engines that can be remotely controlled from the bridge, check whether the low starting air pressure alarm functions properly.

.4 Test the high-pressure fuel jacketed piping system leaks alarm. For ships with keels laid on or after February 1, 1992, the high-pressure fuel jacketed piping system leaks alarm shall be inspected for proper functioning, except for main engines equipped with appropriate enclosures.

.5 Test the crankcase oil mist alarm (this alarm may be replaced by a bearing temperature monitor or equivalent device). For internal combustion engines of 2,250 kW and above or having cylinders of more than 300 mm bore in unmanned machinery spaces, test whether the high crankcase oil mist concentration alarm functions properly.

.6 Test the automatic changeover alarm of auxiliary pumps serving the main engine. Ensure the alarm functions properly during the automatic changeover of main auxiliary pumps (e.g., lubricating oil pumps, fuel supply pumps, cooling pumps) in unmanned machinery spaces.

.7 Verify that the audible and visual alarms in the engine room are functioning properly. After returning to the Engine Control Room (ECR), check if the centralized alarm system displays the tested alarms or has a record of them.

5.5 **MDI on Main Engine Component Maintenance**

5.5.1 The components of the main engine include, but are not limited to, high-pressure fuel pumps, exhaust valves, fuel injectors, pistons, cylinder liners, connecting rods, bearing bushes, along with remote control systems, main starting systems, fuel piping systems, lubricating oil systems, and cooling systems. The ship is obliged to carry out periodic inspections, tests, and maintenance on the main engine components in compliance with the maintenance plan established by the shipping company and the manufacturer's specifications. These tests, maintenance and inspections should also match the records in NOx Technical Files.

5.5.2 ***General requirements***

.1 Document review: check the availability of engineering drawings, specifications, and technical data for the ship's main engine and its components, and confirm whether relevant items are incorporated into the maintenance schedule established by the shipping company. Furthermore, records of the maintenance and repair activities of the main engine shall be retained and match records in the ship maintenance system.

.2 Visual inspection: check the cleanliness of its exterior. Verify that the oil and water piping systems are duly secured. Thoroughly examine for any abnormal signs, including but not limited to corrosion, deformation, cracks, leaks, presence of external electrical wiring, and external piping connections. Additionally, ensure that the readings of instruments and gauges are within the normal range.

.3 Performance test: conduct simulated tests for low lubricating oil pressure slowdown/shutdown functions and bearing temperature detectors (if applicable) to verify their functionality (this should only be performed by a

PSCO with knowledge and experience, in close consultation and clear communication with the ship's crew, or in conjunction with the RO).

5.5.3 ***MDI of the Ship***

.1 Verify whether the company has conducted an assessment to identify if appropriate spare parts are provided to ensure the reliability of equipment and technical systems, the failure of which may result in a hazardous situation.

.2 For ships subject to the 2008 NOx Technical Code, check whether the main engine spare parts are in accordance with the NOx technical file for the engine.

.3 Check whether the ship has established an up to date Planned Maintenance System (PMS).

.4 Verify whether the crew responsible for relevant duties is familiar with the maintenance procedures for main engine components.

.5 Check whether the ship is provided with specialized provision to facilitate cleaning, inspection, and maintenance of main propulsion components.

.6 Check whether non-metallic expansion joints (such as rubber) are installed in auxiliary piping systems related to the main engine (especially below the deepest load waterline). If present, check their condition and whether they have been surveyed and replaced as required.

5.6 **MDI on Main Engine Starting Systems**

5.6.1 The main engine starting systems of ships are divided into air starting systems, electric starting systems, and accumulator starting systems. Most ships' main engines use air starting systems. To ensure the effective starting of the main engine, inspections of the main engine starting and control air system can be conducted from the aspects of visual inspection, system inspection, and performance testing.

5.6.2 ***General requirements***

.1 Visual inspection: check the appearance of equipment related to the main engine starting system for obvious damage, depending on the starting method. For example, in air starting systems, check whether the air compressors and air receivers are clean, whether the protective covers of the air compressors are intact, and whether there are leaks in air pipelines or connections. In electric starting systems, check whether batteries and electrical connections are corroded or aged. In accumulator starting systems, check whether hydraulic oil pipelines are leaking or whether springs are deformed.

.2 Performance test: conduct inspection of the components and valves of the main engine starting system. For example, in air starting systems, check whether the main/auxiliary air compressors, main/auxiliary air receivers, main starting valves, air distributors, cylinder starting valves, overpressure safety valves (not leaking air by their outlets/discharges), flame arresters, drainage valves, and control air-related components (e.g., pressure-reducing valves, drainage valves, water separators and refrigeration air dryers) are

functioning properly. Check whether bypass valves are being used, and back-up systems, such as the air pressure reducer, are also functional. Conduct turning gear interlock tests to ensure that the starting air or electrical circuit is disconnected when the turning gear is engaged.

5.6.3 ***MDI of the Ship***

.1 Check whether the crew responsible for relevant duties is familiar with the operation and maintenance procedures of the equipment.

.2 Check whether the emergency starting system, including the emergency air compressor and emergency air receiver, is capable of being activated effectively.

.3 Check whether the pressure gauges of the air starting system display correctly and whether safety valves or fusible safety plugs installed in the starting air system are leaking or failed.

.4 Check whether the non-return valves or other equivalent blocking devices in the air pipelines to prevent backfiring are damaged or failed.

.5 Check whether the *overpressure safety valves* have the 5-year test tags, with no paint covering and no signs of corrosion.

.6 Check whether all starting air pipelines from the air receivers to the main engine are completely separated from the discharge pipelines from the air compressors to the air receivers.

.7 Check whether the drain valve of the air receiver opens and closes are flexible, with no jamming or leakage. During the draining process, it is necessary to confirm that the oil-water mixture accumulated at the bottom of the air receiver can be discharged smoothly, without residue or blockage.

5.7 **MDI on Power Generation**

5.7.1 Power generation is a crucial component of a ship's electrical power system. To ensure the effective operation of power generation equipment, inspections of generation can be conducted from aspects including document review, visual inspection, system inspection, and performance test for both the generator unit as a whole and its auxiliary equipment.

5.7.2 ***General requirements***

.1 Document review: check the engine logbook to examine historical equipment malfunctions and the ship's corrective measures; verify whether the ship has established a maintenance plan for generators and implemented it accordingly, and confirm that auxiliary generators are cycled through properly, adequately shares load, and have consistent exhaust temperature readings; review periodic survey reports and related certificates.

.2 Visual inspection: conduct a thorough inspection of the generator and its auxiliary equipment from the overall structure to individual components, checking for visible damage. This includes examining system pipelines, valves, instruments, and equipment. Check the exhaust pipe for signs of smoke leaks. Verify that the lubrication oil for turbochargers and governors

is sufficient and check for oil deterioration. (Note: This refers to the bearings, and the sight-glass should be half-full).

.3 *Performance test* : conduct inspections of the fuel oil system, lubricating oil system, cooling water system, and starting air system. For fuel Oil System, check thermal insulation protection for hot surfaces on machinery. For lubricating Oil System, verify normal inlet/outlet pressure of the lubricating oil filter, check pipelines for oil leaks, and review periodic oil analysis reports. For cooling Water System, check pipelines for leaks and corrosion, measure cooling water outlet temperature. For starting air system, examine air compressors, main/auxiliary air receivers, and associated pipelines; check safety valves and drainage valves for visible damage, corrosion, or leaks. verify the functionality of safety protection devices (low lubricating oil pressure, etc.); test generator paralleling and load shedding operations; and check the performance of fuel oil isolation valves (applicable to ships with keels laid on or after 1 July 2002).

5.7.3 ***MDI of the Ship***

.1 Verify whether the ship is provided with provision to facilitate cleaning, inspection, and maintenance of the generator.

.2 Check whether the diesel engine's low lubricating oil pressure safety devices are functioning properly.

.3 Check the generator set' s capacity to confirm that, with any one generator out of operation, the remaining generator sets are capable of supplying power to equipment critical for normal propulsion, safety, and minimum comfortable conditions of habitability (referring to load calculation tables).

.4 Test the remote and local control functions of the generator, including synchronization and load-shedding capabilities, and verify that the responsible engineer is familiar with synchronization and load-shedding procedures (if possible) (Note: this may interfere with cargo operations as cranes and reefers may be on pre-trip inspection).

5.8 **MDI on Electrical Systems**

5.8.1 A ship's electrical system is an integrated network composed of power supply units, distribution equipment, electrical networks, and loads interconnected in a specific configuration. It encompasses all onboard devices and networks involved in the generation, transmission, distribution, and consumption of electrical energy. To ensure the safe and stable operation of the electrical system, inspections may focus on the following aspects: power supply units, cable installation, protection of electrical equipment, and operational practices.

5.8.2 ***General requirements***

.1 Visual inspection: ensure that the switchboard and its surroundings are clear. Verify that the panel indicator lights and the insulation alarm functions for power and lighting are operating correctly (i.e. low insulations are often hidden by the crew by switching off the breaker of a faulty circuit). Check that appropriate protective devices are installed for the live parts of the switchboard and electrical equipment (i.e. insulated mats, back panels and handrails). Confirm that the metal casings, frames, and other parts of

electrical equipment are reliably grounded. For electrical equipment used in hazardous environments such as damp, flammable, or explosive conditions, ensure that special protective measures such as explosion-proof, moisture-proof, and anti-corrosion features are in place.

.2 Performance test:

.1 main Source of power - verify whether the ship's main power source (typically the main generator) can consistently and stably supply sufficient power across all 3 phases as required by Regulation 41 of chapter II-1 of SOLAS; and

.2 confirm that the emergency source of electrical power (emergency generator or accumulator batteries) can provide power as specified in regulation 43.3 of chapter II-1 of SOLAS noting that:

i. where the emergency source of power is an emergency generator, it can start automatically and supply the required load within a maximum of 45 Seconds from the failure of the main source of power;

ii. where the emergency source of power is accumulator battery it should be capable of providing power immediately after the failure of the main source of power; and

iii. test whether electrical equipment (such as motors, transformers, switchboards, etc.) can operate normally.

5.8.3 ***MDI of the Ship***

.1 Verify that the fuel tank of the emergency generator contains an adequate amount of fuel. The fuel quantity should be sufficient to enable the emergency generator to operate continuously for 18 hours for cargo ships and 36 hours for passenger ships as mandated by SOLAS regulations. Check fuel tank gauges and records of fuel replenishment.

.2 Verify that the energy storage capacity of the emergency generator's automatic starting arrangements meets the requirement of regulation 44.2 of chapter II-1 of SOLAS for at least three consecutive starts. Additionally, check whether a secondary energy source is provided to enable three further starts within 30 minutes, unless manual starting is demonstrated to be effective.

.3 Verify whether the rating or appropriate setting of the overload protective device for each circuit is permanently indicated at the location of the protective device.

.4 Check whether the lighting fixtures are securely installed and whether appropriate anti-vibration and waterproof measures are in place for fixtures in vibrating or damp environments.

.5 Verify whether the protection rating and grounding of electrical apparatus enclosures are sufficient to prevent injury when handled or touched in normal manner.

.6 While on load, start equipment such as emergency fire pump and steering pump to load test the emergency genset.

5.9 **MDI on Steering Gear Systems**

5.9.1 Each ship shall be equipped with a main steering gear and an auxiliary steering gear, arranged in such a way that the failure of one will not render the other inoperative. (If the main steering gear consists of two or more identical power units and meets other requirements of the convention, an auxiliary steering gear need not be provided.) To ensure the effective operation of the steering gear, inspection should be conducted on the steering gear's electrical system, hydraulic system, alarm devices, and operational aspects.

5.9.2 ***General requirements***

.1 Document review: Review the records of steering gear calibration and testing, as well as the records of emergency steering drills conducted at least every three months.

.2 Visual inspection: Check for any oil leaks or seepage at pipe joints, valves, and cylinder. Verify whether there is oil accumulation in the floor's oil containment trough. For hydraulic steering gear, ensure that a recharging tank and a fixed filling pipeline connected to the steering gear's hydraulic system are installed. Confirm that the reserve hydraulic oil in the storage tank is sufficient. Check whether the storage tank is equipped with a level gauge. Verify whether air vent valves and pressure gauges are installed at both ends of the cylinders and whether all pressure gauges are functioning properly. Check whether the temperature gauge and level gauge on the steering gear oil tank are operating normally. For level gauges with self-closing devices, ensure the self-closing device is not held open. Check whether there is water ingress at the rudder stock sleeve due to seal failure. Check whether the linkages of all steering gear components are loose.

.3 Performance test: The steering gear should respond promptly and accurately to steering orders, maintain satisfactory performance during continuous operation, and achieve the maximum rudder angle and slewing speed required by regulations. All safety devices, alarms, and interlocks shall be fully operational.

5.9.3 ***MDI of the Ship***

.1 During steering gear operation, cut off the power supply to confirm whether an audible and visual alarm is triggered. Test whether the steering gear can automatically restart after power is restored following an interruption of the power supply.

.2 Check for excess 'play' between rudder stock and steering gear that would affect navigational requirement to hold steady course.

.3 Conduct a local steering test at the steering gear to verify whether the rudder response time of the main and auxiliary steering gear meets the convention requirements, and test whether the steering gear limit switches function correctly. (should be completed by duty engineer).

.4 Check whether the crew is familiar with the valve closing procedures in the isolation system of the main steering gear (applicable only to cargo ships).

.5 Test the means of communication between the navigation bridge and the steering gear compartment, and verify whether the communication point location in the machinery space is convenient for operating the steering gear and that angle indicator on bridge matches local readings.

.6 Test whether the audible and visual alarms of the steering gear (including power failure, short-circuit protection, overload alarm, and phase failure alarm) are functioning properly. (Alarm locations shall be in the machinery spaces or the control room for normal machinery operation and on the bridge.).

.7 Conduct an emergency steering drill to ensure operational readiness.

5.10 **MDI on Boilers**

5.10.1 To ensure safe and efficient operation, the boilers shall be so installed and protected as to minimize any danger to persons on board, due regard being paid to moving parts, hot surfaces and other hazards, and an inspection of the boilers may be conducted in respect of the feedwater systems, steam systems, fuel oil supply systems, safety protection, mechanical air supply, etc.

5.10.2 ***General requirements***

.1 Document review: check the ship's survey certificate, calibration report and engine logbook of the boiler and its appurtenant equipment, including surveys that the boiler shall be subject to in accordance with the requirements, calibration of the safety valve, boiler water dosing, records of the regular water quality tests(Check for shore-based monitoring of water quality of boiler and availability of chemicals used for treating water onboard) and records of the routine maintenance of the boiler.

.2 Visual inspection: check the overall and safety protection condition of the boiler and its appurtenant equipment, including whether there is any corrosion, deformation, cracks, leaks, smoke and gas leaks on the exterior of the boiler body, boiler seat, burner, exhaust pipe, feedwater and steam pipelines, valves, manhole doors, etc.; whether the burner is properly operable, whether the sight glass is clean, and whether there is any black smoke in the discharged exhaust gas.

.3 Performance test: confirm that the boiler operates reliably under normal and varying load conditions, that all safety devices, alarms, interlocks, and automatic control systems function correctly. The overall condition of the boiler shall reflect effective implementation of the ship's maintenance system.

5.10.3 ***MDI of the Ship***

.1 Check whether the insulation materials of the boiler body, fuel oil, steam, feedwater piping system, and their fittings are intact and check for any leaking in the pipelines.

.2 Check whether the main steam valve, boiler water sampling valve, upper and lower drainage valves, steam stop valves, and other valves of the boiler are in good condition, and operate the valves to confirm whether they are free from corrosion and failure.

.3 Check whether the easing gear of the safety valve is improperly set, cracked, corroded, etc., whether the steam outlet is a safe area, whether there is a gas leak.

.4 Check the boiler safety protection alarms to confirm whether each oil-fired boiler which is intended to operate without manual supervision is capable of shutting off the fuel supply and giving an alarm and automatically shutting off the fuel system in the case of low water level, air supply failure or flame failure, and whether the responsible crew is familiar with the tests for alarms.

.5 Check whether the boiler is provided with at least two means for indicating its water level, at least one of which is a direct reading gauge glass and in working condition. Check that remote operation of safety valves can be achieved.

5.11 **MDI on Unmanned Machinery Spaces (UMS)**

5.11.1 With regard to periodically unmanned machinery spaces, additional inspection requirements shall be added for fire precautions, protection against flooding, control of propulsion machinery from the navigation bridge, communication, alarm system, safety systems, machinery, boilers and electrical installations.

5.11.2 ***General requirements***

.1 Document review: verify the ship's Minimum Safe Manning Certificate and the ship's engine room Watch Arrangement Sheet to confirm whether the ship's manning corresponds to the watch requirements. (Note: a valid UMS Notation ship will be allowed to carry less Engineering Officers and Motormen/Oilers.)

.2 Visual inspection: check whether there are main engine control position indicators (ahead, astern and stop), RPM indicators, starting air pressure gauges and their display conditions on the bridge; check the appearance of temperature, smoke or light sensing probes on the main engine, boiler, etc., whether there are any aging or poor contact; and any LCD screen or other visual device should be clearly readable, with no abnormal symbols, etc. indicating potential internal or communication fault.

.3 Performance test: Verify that all functions of the UMS, including alarm, monitoring, automatic control, safety interlock and power supply, are in good and reliable working condition. All safety-related alarms, including temperature, pressure, level, flow, fault, fire and safety alarms, shall be clearly indicated with visual and audible signals at the engine control room, wheelhouse and accommodation alarm panels. Automatic operations such as automatic start/stop, automatic changeover, load sharing and load shedding of generator sets and essential auxiliaries shall function correctly. Safety interlocks and protective devices shall operate properly to ensure safe shutdown or necessary automatic actions under fault conditions. The alarm system and essential control equipment shall be continuously powered by

both main and emergency power supplies, with reliable changeover. Personnel alarm (or Deadman alarm where fitted) shall be tested and function in accordance with paragraph 3.3.7 and section 8.1 of IMO Res. A1021(26). (Note: There is no explicit requirement for a Deadman alarm in SOLAS. However, paragraph 3.3.7 and section 8.1 of IMO Res. A1021(26) provide guidance on the arrangement where a personnel alarm is fitted.)

5.11.3 ***MDI of the Ship***

.1 Check whether the high-level alarm of the bilge is functioning properly, and check whether means is provided to give alarm in the case of the prolonged operation or frequent automatic start/stop of the bilge pumps and test its performance.

.2 Check whether the location of the controls of any valve serving a sea inlet, a discharge below the load line or a bilge injection system are so sited as to allow adequate time for operation in case of influx of water to the space, having regard to the time likely to be required in order to reach and operate such controls. If the level to which the space could become flooded with the ship in the fully loaded condition so requires, arrangements shall be made to operate the controls from a position above such level.

.3 Check whether the machinery control alarm display and function of the alarms in the central control room and the extended alarm system are functioning properly, whether the alarm system power supply failure alarms are operable, whether there are any alarms that are locked out (isolated).

.4 Check whether the function of the reset button of the engineers alarm located at the machinery space is normal, whether a personnel alarm is capable of being set off automatically when the alarm is not reset by the engineer on duty from the machinery spaces not exceeding 30 minutes, and whether the function of the pre-warning signal is normal for the first 3 minutes before the personnel alarm is given.

.5 Test whether the automatic switching of dual pumps is normally functioning, and whether the other standby pump can be started automatically and trigger an alarm when one pump is stopped.

.6 Test whether the automatic starting, synchronization and load sharing, de-loading, load distribution, and step load shedding controls between the standby generator of the ship's power station are operating normally.

6 Suggested PSCO actions for lack of maintenance, and reporting requirements of identified defects

6.1 In respect of the handling of ship-related deficiencies, it is a general requirement that the shipowner effect rectifications prior to the ship's departure. Simultaneously, when certain conditions are met, such as the implementation of temporary corrective measures, or when the professional assessment of the PSCO determines that these deficiencies will not present an immediate threat to the safety of the ship, personnel on board, and the marine environment, or when permanent repairs cannot be carried out within the port precinct, the shipowner may be granted permission to resolve these deficiencies within a defined time period. For critical deficiencies, detention should be considered.

6.2 Reporting requirements

6.2.1 Whenever a defect is discovered, which affects the safety of the ship or the efficiency or completeness of its life-saving appliances or other equipment, the master or owner of the ship shall report at the earliest opportunity to the flag State Administration, the nominated surveyor or RO responsible for issuing the relevant certificate. If the ship is in a port of another Contracting Government, the master or owner shall also report immediately to the appropriate Authorities of the port State and the nominated surveyor or RO shall ascertain that such a report has been made.

6.2.2 Should the ship voluntarily report malfunctions in its mechanical and electrical equipment or operational defects and no serious consequences, such as marine casualties, have ensued, the competent authority should take measures such as rectification prior to departure to address the deficiencies. In principle, the ship should not be detained. Even if a defect has been reported in advance, a detention may still be imposed in cases where the onboard repair measures are deemed inadequate, where previously identified defects are not continuously and properly rectified, or where the same defect is repeatedly reported. If a defect or casualty which is duly reported as per Procedures for Port State Control (IMO Resolution A.1185(33) (as amended)) as per paragraph 2.3.7, and is a verifiable direct result of a lack of maintenance (and therefore NOT accidental), a detention may be considered.

6.3 Suggested actions for identified defects

The following provides a compilation of the handling procedures for certain prevalent deficiencies in machinery space, serving as a reference:

6.3.1 *Deficiencies Related to Main engine systems*

.1 In cases of functional failures within the main engine system, such as the inability to start, reverse, regulate speed, or stop, as well as cracks in the cylinder liner (or cylinder head), which severely impact the safe navigation of the ship, these should be regarded as detention-worthy deficiencies. Resolution of these issues should only be permitted after additional surveys by the RO have been carried out.

.2 Significant deviations in various system parameters of the main engine (including pressure, temperature, cylinder load distribution, non-ignition, oil emulsification, etc.), abnormal vibrations of the main engine and its exhaust gas turbocharger (not attributable to improper adjustment of intake and exhaust timing, fuel injection timing, valve clearance, bearing clearance, etc.), and the main engine's inability to maintain the minimum stable speed, may result in the ship being considered for detention.

.3 In the event that individual auxiliary equipment in the automation system fails to operate automatically, rectification should be completed prior to the ship's departure. If the main equipment cannot be automatically controlled, resulting in the inability to maintain periodically unmanned engine room operations and an insufficient number of crew members on board (in such cases, the requirements for manned engine-room operations should be referred to), this should be regarded as a detention-worthy deficiency.

.4 Malfunctions of the voice-powered telephone and telegraph that prevent normal communication between the bridge and the engine room, may result in the ship being considered for detention.

.5 Water leakage and oil seepage from the tail shaft should be addressed differently according to the type of the tail shaft. For minor leakage and oil seepage into the engine room, rectification can be carried out during the ship's annual inspection and dry – docking repair. In cases of severe oil or water leakage, immediate repair in a dry dock is mandatory. If the oil leaks results in pollution of the sea area, an investigation into violations of MARPOL Annex I regulations must also be initiated.

.6 Other deficiencies in the main engine systems should generally be rectified prior to the ship's departure.

6.3.2 ***Deficiencies Related to Compressed Air System***

6.3.2.1 The compressed air system is indispensable auxiliary equipment for the ship's power plant. In principle, any deficiencies therein should be rectified prior to the ship's departure. In the event that malfunctions within the compressed air system leading to the abnormal operation of other power systems, such deficiencies should be regarded as grounds for detention.

6.3.3 ***Deficiencies Related to Boiler and Steam System***

6.3.3.1 Deficiencies pertaining to the boiler and steam system should, in general, be rectified prior to the ship's departure. In the event of structural defects, such as cracks in the boiler tubes or leaks in the water pipes, which render the boiler inoperable and cannot be repaired by the ship's crew, repairs should be conducted at the port or dockyard. Additionally, the boiler should undergo a survey by the RO before the ship sets sail. If the manual water supply function operates normally while the automatic water supply function fails, or if the manual ignition function operates properly but the automatic ignition function malfunctions, and the repairs cannot be completed within the port area, a time limit for rectification may be duly set. Nevertheless, the ship's crew is required to intensify the watchkeeping duties and enhance the operational management of the boiler.

6.3.4 ***Deficiencies Related to Steering Gear System***

6.3.4.1 For steering gear malfunction, if the rudder response time of the main (or auxiliary) steering gear exceeds 28 seconds (or 60 seconds), or the required rudder angle cannot be attained despite adjustment, or the steering gear alarm system malfunctions, it can be regarded as a detainable deficiency. Regarding the leakage at the steering gear rod, the gravity and characteristics of the leakage should be evaluated. Should the leakage be severe and the ship lack an Immediate repair scheme, it may be deemed as a detainable deficiency. Other deficiencies should be rectified prior to departure or within a specified time limit, contingent upon the circumstances.

6.3.5 ***Deficiencies Related to Piping Systems***

.1 Deficiencies on non-critical piping systems are generally required to be rectified before departure.

.2 Deficiencies noted on critical piping systems, such piping related to fuel systems, cooling systems, hydraulic systems related to the main engine or steering gear, etc., should at a minimum be rectified to the satisfaction of classification society / RO prior to departure, or be considered detainable.

6.3.6 ***Deficiencies Related to Electrical Systems***

.1 General deficiencies in the electrical systems, such as low electrical insulation, lighting failures, damaged or missing protective covers for lighting fixtures, temporary cable connections, faults in ordinary electrical control systems, malfunctions in pump and fan motors but with appropriate alternative measures in place, and failure of electrical instrument displays, among others, should be rectified before departure.

.2 Detention actions may be considered and imposed for serious electrical deficiencies, which encompass the following scenarios:

.1 failure of one or more main generator that leads to the incapability of maintaining or immediately restoring the power supply to the ship's electrical system;

.2 failure of one or more main generator and the remaining generators cannot ensure power supply to equipment necessary for normal propulsion and safety operations;

.3 malfunction of critical electrical equipment (such as the electric motor driving the air compressor), preventing the normal operation of propulsion machinery from being maintained or restored;

.4 malfunction of the emergency source of power; and

.5 the use of jumper cables by ship's crew to isolate malfunctioning sensors / indicators on critical alarms.