



SAFETY MANAGEMENT MANUAL

ARM 10.2 MAINTENANCE OF CRITICAL SYSTEMS

Originator:

Gary McGrath

Approved By:

Albert F. Suchy

1. Purpose

The purpose of this procedure is to set forth the identity and procedures associated with the critical systems and equipment to ensure their reliability on R/V Armstrong.

2. References

a. Condition Monitoring and Reliability Systems (CMRS), Siemens.

3. General

The ISM Code requires (1) the identification of equipment and technical systems that are considered critical, (2) procedures are set in place to ensure that these systems are adequately maintained and (3) specific measures which aim to promote the reliability of such equipment or systems are established. These measures shall include the regular testing of stand-by arrangements and equipment or technical systems that are not in continuous use.

The critical equipment and systems are specifically set forth in this procedure. The reliability of critical equipment and systems is maintained through a combination of operation rotation, periodic testing, preventative maintenance, vibration monitoring, and/or oil analysis depending on the equipment or system.

Systematic preventative maintenance is scheduled and performance records are maintained in the NS5 maintenance software. Each piece of equipment designated as critical, will have routine preventative maintenance scheduled in NS5. Periodic preventative maintenance is conducted through standard jobs that are scheduled through the maintenance software. Repairs and unscheduled work are recorded in Work Orders. The record of all maintenance activities is located in NS5.

R/V Armstrong is equipped with the Siemens Condition Monitoring and Reliability System (CMRS) which includes vibration monitoring. Most of the major pieces of equipment on the vessel are included in the vibration monitoring system. This system continually monitors the equipment. The following critical systems are monitored at this time:

- Main Propulsion
- Bow Thruster
- Stern Thruster
- Steering Gear
- Diesel Generator Sets



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Most pieces of equipment that have lube oil or hydraulic oil systems associated with them are subject to an oil analysis program. The oil analysis program subjects the oil in the system to periodic sampling to be sent out for analysis.

Additional Critical Systems Are:

- Emergency Electrical Power System
- Fire Pump & Hi-Fog Fire Suppression System
- Bilge System
- Fuel Oil Purification System
- Fire Detection System

4. Specific Details of the Critical Systems:

A. Main Propulsion/Ship's Service Diesel Generator System

This system consists of four (4) Cummins QSK38 DM diesel electric generators available to be put on a common buss for distribution between the propulsion needs and the ship's service requirements. The system may run from one (1) to four (4) generators on line at a time. Cooling water for the main motors is provided via the central fresh water cooling system

1. Operation procedures
 - a. At least two generator sets are to be online in restricted maneuvering situations.
 - b. Generator sets are rotated to be online to spread running hours and ensure dependability.
 - c. Motor cooling pumps shall be rotated weekly.
 - d. Motor cooling pumps are set up for standby to auto start at the loss of cooling water pressure.
2. Periodic Tests
 - a. Annual automation system check.
3. Preventative Maintenance
 - a. Standard jobs are maintained and scheduled in NS5.
4. Vibration Analysis
 - a. Vibration analysis is contained in the Siemens CMRS program.



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5. Oil analysis

- a. All diesel engines are part of the oil analysis program.

B. Propulsion Motors and Shafting

The propulsion motors consist of two Siemens 1FW4-Series 836kW motors. The shafting is Hundedsted propeller propulsion shaft, bearings and controllable pitch propellers. Both shafts are operating when the vessel is underway.

1. Periodic Tests
 - a. Annual automation system check.
2. Preventative Maintenance
 - a. Standard jobs are maintained and scheduled in the NS5.
3. Vibration Analysis
 - a. Vibration analysis is contained in the Siemens CMRS program.
4. Oil analysis
 - a. The CPP hydraulic system is part of the oil analysis program.

C. Emergency Electrical Power System

The emergency electrical power system consists of a MTU series 60 210 kw generator set, starting system, emergency switchboard and distribution system.

1. Operation procedures
 - a. Set on stand by.
2. Periodic Tests
 - a. Start and run once per week (logged).
 - b. Load test performed once per month (logged).
 - c. Pre USCG inspection.
3. Preventative Maintenance
 - a. Standard jobs are maintained and scheduled in the NS5.
4. Vibration Analysis
 - a. Vibration analysis is not established.
5. Oil analysis
 - a. The diesel engines are part of the oil analysis program.

D. Steering System

The steering system is a Matthews Marine Systems, Inc. Which consists of two steering cylinders on each rudder with two 15 HP Motors.



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1. Operation procedures
 - a. Steering checked prior to entering or departing a port.
2. Periodic Tests
 - a. Prior to departure (logged).
 - b. Annual automation tests.
3. Preventative Maintenance
 - a. Standard jobs are maintained and scheduled in the NS5.
4. Vibration Analysis
 - a. The system is continuously monitored for vibration with the Siemens CMRS system.
5. Oil analysis
 - a. The hydraulic oil system is part of the oil analysis program.

E. Fire pump

R/V Armstrong has two fire pumps. One is located in the workshop and the other in the lower main machinery room and is labeled Bilge/Ballast/ Fire Pump.

1. Operation procedures
 - a. Run during fire and boat drills.
2. Periodic Tests
 - a. Tested during fire and boat drills (logged).
 - b. Tested monthly (logged).
3. Preventative Maintenance
 - a. 3 month standard job on fire pumps.
 - b. Annual standard job on fire pumps.
 - c. 5 year standard job on fire pumps.
4. Vibration Analysis
 - a. The fire pumps are not included in the vibration analysis program.
5. Oil analysis
 - a. The fire system is not subject to the oil analysis program.

F. Bilge System

R/V Armstrong has a bilge pump and a bilge, ballast and fire pump. The system also consists of bilge level sensors and an oily water separator.

1. Operation procedures
 - a. Used regularly to dewater bilges.
2. Periodic Tests
 - a. Annual operation tests on pumps and alarms.



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3. Preventative Maintenance (Standard jobs are in NS5)
 - a. Annual standard job on pumps.
 - b. 5 year standard job on pumps.
4. Vibration Analysis
 - a. Pumps in the bilge system are not included in the vibration analysis program.
5. Oil analysis
 - a. The bilge system is not part of the oil analysis program.

G. Fuel Oil Purification System

R/V Armstrong has two fuel oil purifiers. These purifiers are self-cleaning and each is capable of supplying all the vessel's fuel oil needs.

1. Operation procedures
 - a. The fuel oil purifiers are rotated weekly.
2. Periodic Tests
 - a. Annual operation tests.
3. Preventative Maintenance (Standard jobs are in NS5)
 - a. Monthly standard job on fuel oil purifier.
 - b. Quarterly standard jobs on fuel oil purifier.
 - c. Annual standard job on fuel oil purifier.
 - d. 3 year standard job.
 - e. 5 year standard job.
4. Vibration Analysis
 - a. The fuel oil purifiers are not included in the CMRS vibration analysis program.
5. Oil analysis
 - a. The fuel oil purifiers are not part of the oil analysis program.

H. Fire Detection System

R/V Armstrong is protected by a Consilium Fire Alarm system.

1. Operation procedures
 - a. Maintained and monitored on the bridge.
 - b. System is a supervised system that checks for faults.
2. Periodic Tests
 - a. Monthly testing of alarms in specific zones.
 - b. Annual servicing by qualified fire detection system personnel.
3. Preventative Maintenance
 - a. None
4. Vibration Analysis
 - a. The fire detection system is not included in the vibration analysis program.



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5. Oil analysis
 - a. The fire detection system is not included in the oil analysis program.

 4. **Recording**

Maintenance activities are to be recorded in NS5. Each department head must ensure that the maintenance performed by the department is entered in NS5.