



SAFETY MANAGEMENT MANUAL

KNR 10.2 MAINTENANCE OF CRITICAL SYSTEMS

Originator:	Approved By:
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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 Knorr.

2. Reference

Safety Management Manual Procedure 10.2

3. General

The ISM Code requires (1) the identification of equipment and technical systems that are considered critical, (2) that procedures are set in place to ensure that these systems are adequately maintained and (3) that 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 NS5. 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 this maintenance software. Repairs and unscheduled work are recorded in Work Orders. The record of all maintenance activities is located in the NS5 software.

R/V Knorr is equipped with the Predict-DLI vibration monitoring system. Most of the major pieces of equipment on the vessel are included in the vibration monitoring system. In general, the monitoring is run once each quarter unless special circumstances develop that warrant increased frequency of monitoring. A list of the monitored equipment can be found in the Predict-DLI software.

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



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Critical Equipment or Systems

Main Propulsion
Thruster Systems
Ship's Service System
Emergency Electrical Power System
Steering Systems
Fire Pump
Bilge System
Fuel Oil Purification System
Fire Detection System

4. **Specific Details**

A. Main Propulsion/Ship's Service System

This system consists of three (3) Caterpillar 3516 diesel electric generators and one 3508 diesel electric generator 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 two motor cooling pumps, either of which is capable of providing adequate cooling water.

1. Operation procedures
 - a. At least two generator sets are to be on line in restricted maneuvering situations.
 - b. Generator sets are rotated to be on line to spread running hours and ensure dependability.
 - c. Motor cooling pumps shall be rotated weekly
 - d. Motor cooling pumps are set up for the stand by 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 the NS5 software
4. Vibration Analysis
 - a. Vibration analysis is contained in the Predict-DLI program
5. Oil analysis
 - a. All diesel engines are part of the oil analysis program

B. Thruster System

The thruster system consists of two independent z-drive thrusters directly attached to DC motors in the propulsion system. Both thrusters are operating when the vessel is underway. The thrusters are provided with cooling pumps that are redundant.



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1. Operation procedures
 - a. Cooling pumps are set up for stand by to automatically start with 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 the NS5 software
 4. Vibration Analysis
 - a. Vibration analysis is contained in the Predict-DLI program
 5. Oil analysis
 - a. The thruster hydraulic system is subject to the oil analysis program
 - b. The thruster lube oil system is subject to the oil analysis program
- C. Emergency Electrical Power System
The emergency electrical power system consists of a 3406 Caterpillar generator set, starting system, emergency switchboard and distribution system.
1. Operation procedures
 - a. Set on stand by.
 2. Periodic Tests
 - a. Started 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 software
 4. Vibration Analysis
 - a. Vibration analysis is contained in the Predict-DLI program
 5. Oil analysis
 - a. The diesel engines are subject to the oil analysis program
- D. Steering System
The steering system is integral to the thruster systems. It includes four steering motors on each thruster; one azimuth pump per thruster, and a cooling system.
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 software
 4. Vibration Analysis
 - a. Vibration analysis is contained in the Predict-DLI program



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5. Oil analysis
 - a. The hydraulic oil system is subject to the oil analysis program
 - E. Fire pump

R/V Knorr has two fire pumps. One is located in the engine room and the other in the auxiliary machinery room.

 1. Operation procedures
 - a. None
 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 (vibration)
 - b. Annual standard job on fire pumps
 - c. 5 year standard job on fire pumps
 4. Vibration Analysis
 - a. The fire pumps are 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 Knorr has a bilge pump and a bilge and ballast pump. The system also consists of bilge level sensors.

 1. Operation procedures
 - a. Used regularly to dewater bilges and on the ballast system.
 2. Periodic Tests
 - a. Annual operation tests on pumps and alarms
 3. Preventative Maintenance
 - a. Annual standard job on pumps
 - b. 5 year standard job on pumps
 4. Vibration Analysis
 - a. Both pumps in the bilge system are included in the vibration analysis program
 5. Oil analysis
 - a. The bilge system is not subject to the oil analysis program
 - G. Fuel Oil Purification System

R/V Knorr has two fuel oil purifiers. These purifiers are not 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



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3. Preventative Maintenance
 - 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 included in the vibration analysis program
 5. Oil analysis
 - a. The fuel oil purifiers are not subject to the oil analysis program
- H. Fire Detection System
R/V Knorr is protected by a Cerbus Pyrotronics 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. 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
 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**.