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**CONDUCT OF MAINTENANCE (P950)
OPERATIONS AND MAINTENANCE MANUAL
OPERATIONS & MAINTENANCE CRITERION**

TITLE: FIRE PUMPS

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Classification

The information in this document is within the Construction and Facilities Engineering (CONST) Designated Unclassified Subject Area (DUSA); therefore, this document is Unclassified.



RECORD OF REVISIONS

Revision No.	Date	Description
0	04/30/98	Initial Issue
1	06/19/02	<p>This revision reflects the conversion from a WordPerfect document into a Microsoft Word document and additional clarification on how to develop criteria. This revision includes:</p> <ul style="list-style-type: none"> • The addition of a Table of Contents, • The use of basis statements in Sections 6, 7, and 9. • Revision to Section 9, "Required Documents," and <p>Further clarification in the use of references.</p>
2	08/13/02	Comment incorporation from FMC Subcommittee
3	4/13/10	Revised document to incorporate updated references and align requirements to current standards in NFPA 25 Edition 2008, NFPA 13, 2007 Edition, and NFPA 20 2007 Edition.

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CRITERION 723

FIRE PUMPS

1.0 PURPOSE

The Purpose of this criterion is to establish the minimum requirements and best practices for operation and maintenance of Fire Pumps at LANL.

This document addresses the requirements of P 315, *Conduct of Operations Manual*, and P 950, *Conduct of Maintenance*, by defining the minimum operations and maintenance criteria for structures, systems, and components that it covers. The criterion lists requirements that are based on codes, standards, contract commitments, lessons learned, or business case. It also lists recommendations based on industry practices, operational experience, or business case. Guidance for implementation of the requirements and recommendations is also provided.

2.0 SCOPE

The scope of this Criterion includes the routine inspection, testing and preventive and predictive maintenance of Fire Pumps.

Initial acceptance tests and corrective maintenance actions required to repair or replace equipment are not within the scope of this Criterion but are contained within the PD 342 LANL Engineering Standards Manual.

3.0 ACRONYMS AND DEFINITIONS

3.1 Acronyms

AHJ	Authority Having Jurisdiction
CFR	Code of Federal Regulations
DOE	Department of Energy
FOD	Facility Operations Director
ITM	Inspections, Testing, and Maintenance
LANL	Los Alamos National Laboratory
LANS	Los Alamos National Security
MM	Maintenance Manager
MSS	Maintenance and Site Services
MSS-MP	Maintenance and Site Services – Maintenance Programs
NFPA	National Fire Protection Association
OM	Operations Manager
O&M	Operations and Maintenance

3.2 Definitions

Fire Pump - A pump that is a provider of liquid flow and pressure dedicated to fire protection. (NFPA 25 2008, Section 3.6.2)

Jockey Pump - A pump installed on a fire protection water system designed to maintain a constant pressure on the system.

Note: Per NFPA 20 2007, Section 5.7.1, Fire Pumps shall be dedicated to and listed for fire protection service.

Control Valve - A valve controlling flow to water-based fire protection systems. Control valves do not include hose valves, inspectors test valves, drain valves, trim valves for dry pipe, pre-action and deluge valves, check valves, or relief valves. (NFPA 25 2008, Section 3.5.1)

Management Level (ML1, ML2, ML3, ML4) - ML designation is used to grade the structures, systems, equipment, and components and associated activities based on their importance to the protection of the public, environment, and workers, security, and the Laboratory mission. See AP 341-502, *Management Level Determination* for definitions of each ML level.

4.0 RESPONSIBILITIES

4.1 MSS-Division Leader (MSS-DL)

Receives and approves or rejects, in conjunction with the AHJ, requests for variances from this criterion. Maintains the record of decision for all variance requests.

4.2 MSS- Maintenance Programs (MSS-MP)

Responsible for the technical content, monitoring the applicability and the implementation status of this Criterion. MSS-MP will assist organizations that are not applying or meeting implementation expectations or will elevate concerns to the appropriate level of LANL management.

4.3 Fire Protection (FP-DO)

Fire Protection is responsible for reviewing the technical content of this Criterion and monitoring the proper implementation across the Laboratory.

Provide technical review support to MSS Division Leader and AHJ for variance requests.

Fire Protection shall provide technical assistance to support implementation of this Criterion.

4.4 Facility Operations Director (FOD)

Responsible for implementation of this O&M Criterion for identified systems/equipment within their facility boundaries.

4.5 Operations Manager (OM)

Responsible to the FOD for implementing operation portions of this Criterion and for coordinating transfer of systems/equipment to the Maintenance Manager for maintenance activities. The OM with concurrence of the FOD will prioritize implementation within budget allocations.

4.6 Maintenance Manager (MM)

Responsible to the FOD and the MSS-Division Leader for implementing the maintenance portions of this Criterion and for coordinating the transfer of systems/equipment to the Operations Manager at the conclusion of maintenance activities. The MM with concurrence of the FOD will prioritize implementation within budget allocations.

4.7 Authority Having Jurisdiction (AHJ)

The AHJ (LANL Fire Marshal) is responsible for providing a decision on specific technical questions regarding the systems or equipment relevant to this criterion.

The LANL Fire Marshal in conjunction with the MSS Division Leader is the approval authority for all exceptions and variances to this Criterion.

Provides administrative assistance to support implementation of this Criterion.

5.0 PRECAUTIONS AND LIMITATIONS

5.1 Precautions

This section is not intended to identify all applicable precautions necessary for implementation of this Criterion. However, all applicable precautions should be contained in the implementing procedure(s) or work control authorization documents. The following precautions are intended only to assist the author of a procedure or work control document in the identification of hazards and precautions that may not be immediately obvious.

5.2 Limitations

The intent of this Criterion is to identify the minimum requirements and recommendations for SSC operation and maintenance across the Laboratory. Each user is responsible for the identification and implementation of additional facility specific requirements and recommendations based on their authorization basis and unique equipment and conditions, (e.g., equipment history, manufacturer warranties, operating environment, manufacturer O&M requirements and guidance, etc.).

Nuclear facilities and moderate to high hazard non-nuclear facilities will typically have additional facility-specific requirements beyond those presented in this Criterion.

Nuclear facilities should implement the requirements of DOE Order 433.1A as the minimum programmatic requirements for a maintenance program. Additional requirements and recommendations for SSC operation and maintenance may be necessary to fully comply with the current DOE Order or the Code of Federal Regulations (CFR) as applicable.

Nuclear facilities, certain high hazard facilities and explosives facilities may have additional facility specific requirements beyond those presented in this Criterion which are contained in the Documented Safety Analysis (DSA), Technical Safety Requirements (TSR), or facility safety plans, as applicable.

6.0 REQUIREMENTS

Minimum requirements for all users are specified in this section. Requested variances to these requirements shall be prepared and submitted to MSS-MP for review and approval. The MSS Division Leader approves or denies variances. The Criterion users are responsible for analysis of operational performance and SSC replacement or refurbishment based on this analysis. Laws, codes, contractual requirements, engineering judgment, safety matters, and operations and maintenance experience drive the requirements contained in this section.

Note: Discovery of SSC with a degraded or non-conforming condition is a triggering input to the Operability Determination and Functional Assessment process defined in AP-341-516. Degraded or non-conforming conditions include, but are not limited to, failed equipment or components, unsatisfactory readings, code or standard violations and fire protection impairments. Personnel performing tests or inspections under this O&M Criterion are not responsible nor authorized to perform the Operability Determination. Any degraded or non-conforming condition discovered under this O&M Criterion shall be communicated to the FOD Representative for input to the AP-341-516 process. While that process may not apply in Low Hazard Non-Nuclear and Office facilities, the same concept applies. The FOD organization is responsible to determine the response (taking equipment out of service, establishing fire watches, limiting operations, etc.) to SSC degraded and non-conforming conditions.

6.1 Operations Requirements

6.1.1 Fire pumps must remain operational at all times. A fire pump shall be considered operational when the following conditions are met:

- Water supply and discharge piping paths to the pump are available, open, and in operational condition: suction/discharge valves are open, piping is free of leaks, pump suction and discharge pressure gauges are reading normal, suction water supply reservoir is at least half full and provided with operable freeze protection if needed.

- Normal and back-up power supplies to the pump are available and functioning normally.
- Adequate quantity of diesel fuel is available (for a diesel pump).
- Pump controller is in operational condition and functioning normally.
- Batteries are in operational condition and functioning normally:
 - Voltage, charging current, and power indications are normal.
- Pump, engine and batteries and associated subcomponents are in operational condition and are functioning normally.
- System condition supervision is in operational condition and functioning normally (alarm and trouble conditions are appropriately relayed to central alarm station).

6.1.2 Weekly Inspection

Verify that the fire pump is operational by performing system inspection—see Appendix A, Fire Pump Visual Inspection Checklist for complete list of weekly operational requirements.

Basis: NFPA 25, 2008 Edition Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems, Chapter 8.

All valves shall be inspected weekly.

The valve inspection shall verify that the valves are in the following condition:

- In the normal open or closed position.
- Properly sealed, locked or supervised.
- Accessible.
- Provided with appropriate wrenches.
- Free from external leaks.
- Provided with appropriate identification.

Basis: NFPA 25, 2008 Edition, Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. (NFPA 25 2008, Sections 13.3.2.1, 13.3.2.2)

6.2 Maintenance Requirements

6.2.1 Control Valves

- Internal components shall be cleaned/ repaired as necessary in accordance with the manufacturer instructions. (NFPA 25 2008, Section 13.4.1.3.1)

6.2.2 Annually

- The operating stems of outside screw and yoke valves shall be lubricated annually. (NFPA 25 2008, Section 13.3.4.1)
- The valve then shall be completely closed and reopened to test its operation and distribute the lubricant (NFPA 25 2008, Section 13.3.4.2)

Basis: NFPA 25, 2008 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems Section 13.3.4

6.2.3 Check Valves

- Valves shall be inspected internally every 5 years to verify that all components operate correctly, move freely, and are in good condition.

Basis: NFPA 25, 2008 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Section 13.4.2

6.3 Testing Requirements

6.3.1 Fire Pump

6.3.1.1 Weekly

- A weekly test of fire pump assemblies shall be conducted without flowing water.
- The weekly tests shall be conducted by starting the pump automatically.
- The electric pump shall run a minimum of 10 minutes.
- The diesel pump shall run a minimum of 30 minutes.
- A valve installed to open as a safety feature shall be permitted to discharge water.

Basis: NFPA 25, 2008 Edition Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems, Chapter 8, Section 8.3.

- Qualified operating personnel shall be in attendance during the weekly pump operation.
- The pertinent visual observations or adjustments specified in the following checklist shall be conducted while the pump is running:

(1) Pump system procedure:

- (a) Record the system suction and discharge pressure gauge readings.
- (b) Check the pump packing glands for slight discharge.
- (c) Adjust gland nuts if necessary.
- (d) Check for unusual noise or vibration.
- (e) Check Packing boxes, bearings, or pump casing for overheating.
- (f) Record the pump starting pressure.

- (2) Electrical system procedure:
 - (a) Observe the time for motor to accelerate to full speed.
 - (b) Record the time controller is on first step (for reduced voltage or reduced current starting).
 - (c) Record the time pump runs after starting (for automatic stop controllers).

- (3) Diesel engine system procedure:
 - (a) Observe the time for engine to crank.
 - (b) Observe the time for engine to reach running speed.
 - (c) Observe the engine oil pressure gauge, speed indicator, water, and oil temperature indicators periodically while engine is running.
 - (d) Record any abnormalities.
 - (e) Check the heat exchanger for cooling waterflow.

Basis: NFPA 25, 2008 Edition Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems, Chapter 8, Section 8.3.2.

6.3.1.2 Annually

- An annual test of each pump assembly shall be conducted under minimum, rated, and peak flows of the fire pump by controlling the quantity of water discharged through approved test devices.
- If available suction supplies do not allow flowing of 150 percent of the rated pump capacity, the fire pump shall be permitted to operate at maximum allowable discharge.
- The annual test shall be conducted as follows:
 - 1) **Use of the Pump Discharge via the Hose Streams.** Pump suction and discharge pressures and the flow measurements of each hose stream shall determine the total pump output. Care shall be taken to prevent water damage by verifying there is adequate drainage for the high-pressure water discharge from hoses.
 - 2) **Use of the Pump Discharge via the Bypass Flow-meter to Drain or Suction Reservoir.** Pump suction and discharge pressures and the flowmeter measurements shall determine the total pump output.
 - 3) **Use of the Pump Discharge via the Bypass Flow-meter to Pump Suction (Closed-Loop Metering).** Pump suction and discharge pressures and the flowmeter shall determine the total pump output.

- Where Numbers 2) and 3) above is used, the flowmeter shall be adjusted immediately prior to conducting the test in accordance with the manufacturer's instructions. If the test results are not consistent with the previous annual test then Number 1) above, shall be used. If testing in accordance with Number 1) above is not possible, a flowmeter calibration shall be repeated.

- The pertinent visual observations, measurements, and adjustments specified in the following checklist shall be conducted annually while the pump is running and flowing water under the specified output condition:
 - (1) **At no-flow condition (churn):**
 - (a) Check the circulation relief valve for operation to discharge water.
 - (b) Check the pressure relief valve (if installed) for proper operation.
 - (c) Continue the test for ½ hour.
 - (2) **At each flow condition:**
 - (a) Record the electric motor voltage and current (all lines).
 - (b) Record the pump speed in rpm.
 - (c) Record the simultaneous (approximately) readings of pump suction and discharge pressures and pump discharge flow.

Note: LANL Fire Protection Division Office representative shall witness the annual Pump Test and record and track Data.

Basis: NFPA 25, 2008 Edition Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems, Chapter 8.

6.4 Impairments

If one or more of the operational requirements listed in Section 6.1.1 are not maintained, follow the actions outlined in O&M Criterion 733, Fire Protection System Impairment Control Program. Following maintenance/repair work but prior to returning the affected fire pump to service, perform visual inspections and annual pump test described above. If piping pressure boundary is breached during maintenance/repair work, flushing and hydrostatic testing per NFPA 24 is also required prior to returning it to service.

Basis: NFPA 25, 2008 Edition Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.

6.5 Personnel Qualifications

Service personnel shall meet the qualification and experience requirements of NPFA 72. LANL will use personnel certified by a nationally recognized fire alarm certification organization.

7.0 RECOMMENDED AND GOOD PRACTICES

The information provided in this section is recommended based on acceptable industry practices and should be implemented by each user based on the unique application and operating history of the subject systems/equipment.

7.1 Operations Recommendations

Operational testing and alarm verification should be conducted by MSS Fire Protection Maintenance personnel, in compliance with PD 1220 Fire Protection Program, Section 4.15.

Basis: PD 1220, Fire Protection Program

7.2 Maintenance Recommendations

Persons other than MSS Fire Protection Maintenance personnel may conduct visual inspection requirements identified in this document.

8.0 GUIDANCE

8.1 Operations Guidance

None

8.2 Maintenance Guidance

8.2.1 PMI 40-35-002, TA-35 Building 0088 Fire Pump Inspection, Maintenance, and Testing Instructions

8.2.2 PMI 40-35-003, TA-53-Building 0054 Fire Pump Inspection, Maintenance, and Testing Instructions

8.2.3 PMI 40-35-100, TA-53-Building 0988 Fire Pump Inspection, Maintenance and Testing Instructions

9.0 REQUIRED DOCUMENTATION

Maintenance history shall be maintained for fire pumps to include, as a minimum, the parameters listed in the Table 9-1 below:



Table 9-1 Documentation Parameters

MAINTENANCE HISTORY DOCUMENTATION PARAMETERS				
PARAMETER	ML 1	ML 2	ML 3	ML 4
Fire Pump Maintenance Activities				
Repair / Adjustments	X	X	X	X
PM Activities	X	X	X	X
Fire Pump Equipment Problems				
Failure Dates	X	X	X	X
Failure Root Cause	X	X		
Fire Pump Inspection Results				
Inspection Date	X	X	X	X
SSC Condition	X	X	X	X

Basis: Documentation of the parameters listed in Table 9-1 above satisfies the requirements of P 950, Section 3.5.15 which states, "A maintenance history and trending program is maintained to document data, provide historical information for maintenance planning, and support maintenance and performance trending of facility systems and components."

10.0 REFERENCES

The following references, and associated revisions, were used in the development of this document.

- 10.1 P 315, Conduct of Operations Manual
- 10.2 P 950, Conduct of Maintenance
- 10.3 AP-MNT-010 Maintenance History
- 10.4 AP-341-502, Management Level Determination
- 10.5 PD 342 LANL Engineering Standards Manual
- 10.6 PD 1220, Fire Protection Program
- 10.7 NFPA 25, 2008 Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems
- 10.8 NFPA 20, 2007 Standard for the Installation of Stationary Pumps for Fire Protection
- 10.9 P 313, Roles, Responsibilities, Authorities, & Accountability
- 10.10 O&M Criteria 733, Fire Protection System Impairment Control Program

 <p>Los Alamos NATIONAL LABORATORY EST. 1943</p>	<p><i>Conduct of Maintenance (P 950)</i> Operations and Maintenance Manual Fire Pumps</p>	<p>Criterion 723 R3 Page 14 of 15</p>
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11.0 APPENDICES

Appendix A: Fire Pump Visual Inspection Checklist

Appendix A

Fire Pump Visual Inspection Checklist

The purpose of inspection shall be to verify that the pump assembly appears to be in operating condition and is free from physical damage.

The pertinent visual observations specified in the following checklists shall be performed weekly (NFPA 25 2008, Section 8.2.2 (1-5))

1.0 Pump House Condition

- Heat is adequate, not less than 40°F for pump room with diesel pumps without engine heaters and electric pumps.
- Ventilating louvers are free to operate.

2.0 Pump System Conditions

- Pump suction, discharge, and bypass valves are fully open.
- Piping is free of leaks.
- Suction line pressure gauge reading is within acceptable range.
- System line pressure gauge reading is within acceptable range.
- Suction reservoir is full.

3.0 Electrical System Conditions

- Controller pilot light (power on) is illuminated.
- Transfer switch normal pilot light is illuminated.
- Isolating switch is closed – standby (emergency) source.
- Reverse phase alarm pilot light is off or normal phase rotation pilot light is on.

4.0 Diesel Engine System Conditions

- Fuel tank is at least two-thirds full.
- Controller selector switch is in AUTO position.
- Battery (2) voltage readings are within acceptable range.
- Battery (2) charging current readings within acceptable range.
- Battery (2) pilot lights are on or battery failure (2) pilot lights are off.
- All alarm pilot lights are off.
- Engine running time meter is reading.
- Crankcase oil level is within acceptable range.
- Cooling water level is within acceptable range.
- Electrolyte level in batteries is within acceptable range.
- Battery terminals are free from corrosion.
- Water-jacket heater is operating (if installed).