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

TITLE: FIRE PROTECTION WATER SUPPLY SYSTEMS

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RECORD OF REVISIONS

Revision No.	Date	Description
0	10/02/02	Initial Issue
1	03/11/2010	Complete revision, including: • Changes reflect current LANL organizations • Change reference to reflect P950, *Conduct of Maintenance* • Remove DOE O 430.1B references from Section 1 • Incorporate 2008 edition of NFPA 25, *Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems* • Incorporate 2010 edition of NFPA 72, *National Fire Alarm and Signaling Code* • Incorporate LASO approval of Equivalency to NFPA 25 for water supply system block valves under the ownership of the LANL utilities organization (DOE-ORDER-420.1B-EQ-2009-005). • Incorporate LASO action on cancellation and modification of 1999-era equivalencies to portions of NFPA 25 and 72 (LASO Memorandum No. SO:21WF-203741, *National Fire Protection Association 25 and National Fire Protection Association 72 Equivalency Cancellation/Modification*, January 19, 2010) • Incorporate DOE *Interim Guidance on Design and Operational Criteria for Water Supply Systems Supporting Safety Class and Safety Significant Wet Pipe Sprinkler Systems* (November 2009)

TABLE OF CONTENTS

Figures

CRITERION 722

FIRE PROTECTION WATER SUPPLY SYSTEMS

1.0 PURPOSE

The purpose of this Criterion is to establish the minimum requirements and best practices for operation and maintenance of fire protection water supplies 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 (SSCs) that it covers. The criterion lists requirements that are based on codes, standards, contract commitments, lessons learned and LASO direction on previous equivalencies to some NFPA 25 and 72 inspection, testing and maintenance (ITM) requirements (Ref. 10.9). Furthermore, this criterion includes requirements and recommendations contained in DOE interim guidance for the operation of safety class (SC) and safety significant (SS) wet pipe sprinkler systems and supporting water supply systems – developed in response to DNFSB Recommendation 2008-1, *Safety Classification of Fire Protection Systems* (January 29, 2008) (Ref. 10.10). It also lists recommendations based on industry practices, operational experience or business case – where appropriate. Guidance for implementation of the requirements and recommendations is also provided.

Implementation of this Criterion satisfies LANL PD 1220, *Fire Protection Program* (Ref. 10.12), 10 CFR 851, *Worker Safety and Health Program*, Appendix A.2 "Fire Protection" (Ref. 10.1), and DOE Order 420.1B, *Facility Safety* (Ref. 10.2), Chapter II "Fire Protection" ITM requirements for the subject equipment / system. Compliance with 10 CFR 815 and DOE Order 420.1B are required by the LANL Prime Contract (DOE Contract No. DE-AC52-06NA25396).

2.0 SCOPE

The scope of this Criterion includes the routine inspection, testing and preventive and predictive maintenance of fire protection water supply systems at all nuclear and non-nuclear LANL facilities, including fire main piping, fire hydrants, block valves, mainline strainers, pressure reducing valves, and water storage tanks. The requirements contained within this criterion are graded based in-part on the safety function assigned to the wet pipe fire sprinkler system, facility hazard categorization, and mission importance or "fire loss risk" associated with the facility. This Criterion does not address post indicator valves in fire mains, nor does it address fire department connections, since these are considered part of the associated fire sprinkler systems. This Criterion does not address corrective maintenance actions required to repair or replace equipment. This Criterion does not address Fire Pumps, which are covered by Criterion

723. This Criterion does not address backflow prevention devices, which are covered by Criterion 406.

3.0 ACRONYMS AND DEFINITIONS

3.1 Acronyms

AHJ	Authority Having Jurisdiction
CFR	Code of Federal Regulations
DACS	Digital Alarm Communicator System
DOE	Department of Energy
DSA	Documented Safety Analysis
EOC	Emergency Operations Center
FOD	Facility Operations Director
FP-DO	Fire Protection Division Office
IFC	International Fire Code, 2009 edition
ITM	Inspections, Testing, and Maintenance
ML	Management Level
MM	Maintenance Manager
MSS	Maintenance and Site Services
OM	Operations Manager
O&M	Operations and Maintenance
PRV	Pressure Reducing Valve
SC	Safety Class
SCADA/ESS	Surveillance, Control and Data Acquisition/Equipment Surveillance System
SS	Safety Significant
SSC	Systems, Structures and Components
TSR	Technical Surveillance Requirement

3.2 Definitions

Anti-Vortex Plate - An anti-vortex plate, such as the one shown in Figure 3.2.1, is provided on a tank to reduce the likelihood of introducing air pockets into the fire pump suction line which could result in cavitation of the pump which in turn can damage the pump casing and cause a reduction in pump performance.

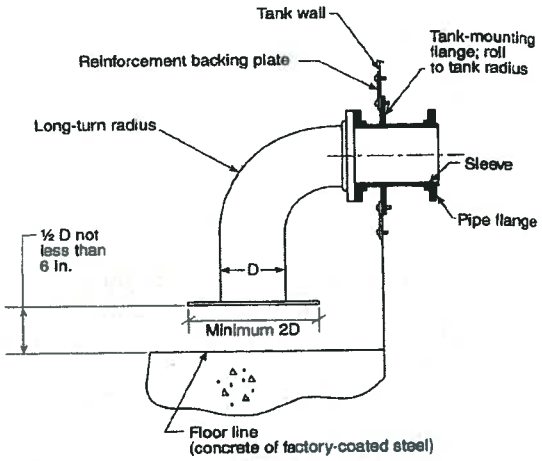

Figure 3.2.1 – Anti-Vortex Plate

Appurtenance - An accessory or attachment that enables the fire service main to perform its intended function. Appurtenances addressed in this document include. system control valves (including block valves), pressure reducing valves, and check valves, strainers, and backflow preventers.

Block Valve - A non-indicating gate valve installed below grade in water distribution systems to allow segments of the system to be shut off for repair or extensions without reducing protection over a wide area. Such valves are normally a non-rising-stem-type which requires a key wrench to operate. A valve box is located over the valve with a cover located at grade to keep dirt and debris from the valve and to provide access for the valve wrench to the valve nut.

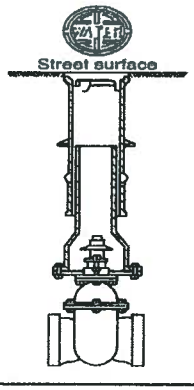

Figure 3.2.2 - Non-indicating/block valve

DACS - The Digital Alarm Communicator System is the monitoring station for fire alarm signals (as opposed to the security alarm monitoring station) and is located at the EOC.

Inspection - A visual examination of a fire protection system or portion thereof to verify that it appears to be in operating condition and is free of physical damage.

Maintenance - In water based fire protection systems, maintenance is work performed to keep equipment operable or to make repairs.

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 for definitions of each ML level.

Pressure Reducing Valve - A valve designed for the purpose of reducing the downstream water pressure under both flowing (residual) and non-flowing (static) conditions

Master Pressure Reducing Valve - A pressure reducing valve installed to regulate pressures in an entire fire protection water distribution system.

Testing - A procedure used to determine the status of a system as intended by conducting periodic physical checks on water-based fire protection systems. These tests follow up on the original acceptance test at specified intervals.

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 (MP)

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

4.3 Fire Protection Division Office (FP-DO)

FP is responsible for the technical content of this Criterion and monitoring the applicability and proper implementation of this Criterion. FP-DO will assist organizations that are not applying or meeting implementation expectations of this Criterion or will elevate concerns to the appropriate level of LANL management.

FP-shall provide technical assistance to support implementation of this Criterion.

4.4 Utilities and Infrastructure Division Office (UI-DO)

UI-DO is responsible for the water utility system, with the exception of the TA-55 dedicated fire protection loop. UI is also responsible for the assignment of numbers to

hydrants and auxiliary valves, for stamping the top on the hydrant operating nut and the lid of the valve box, and for maintaining a database tracking the hydrants and valves locations and numbers.

4.5 Facility Operations Director (FOD)

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

4.6 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.

4.7 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.

4.8 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 is an approval authority for all exceptions and variances to this Criterion. The LANL Fire Marshal cannot approve deviations or exemptions to CFR, DOE Orders or NFPA Codes and Standards - the fire protection AHJ for these matters is the LASO Manager per DOE O 420.1B (see PD 1220).

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.

Adequate water supplies for fire protection systems and fire hydrants for manual fire fighting are fundamental to provide effective fire protection for Laboratory facilities. Measures outlined in O & M Criterion 733, "Fire Protection System Impairment Control" shall be initiated during maintenance, inspection and testing activities that impair the operation of these fire protection systems and hydrants.

Discharge of water through fire hydrants may cause personnel injury, property damage, or environmental damage. Verify water discharge locations are physically safe and will not cause property or environmental damage prior to discharge. The discharge of large quantities of water (>5,000 gallons) from a fire hydrant or other fire protection system may require the issuance of a Notice of Intent (NOI) to discharge this and greater quantities of water up to 3 weeks prior to the evolution to meet LANL commitments with the New Mexico Environmental Department (NMED). NOIs must be coordinated with the LANL Environmental Protection Division.

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 Criterion 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.

The requirements specified in this section are presented in a graded approach based on codes and standards (primarily NFPA 25), contract commitments, lessons learned and LASO direction on previous equivalencies to some NFPA 25 ITM requirements. Furthermore, this criterion includes requirements and recommendations contained in

DOE interim guidance for the operation of safety class (SC) and safety significant (SS) wet pipe sprinkler systems and supporting water supply systems – developed in response to DNFSB Recommendation 2008-1, *Safety Classification of Fire Protection Systems* (January 29, 2008) (Ref. 10.10).

In negotiation with LASO, FP-DO maintains the list of facilities designated as "high value" facilities for the purposes of this Criterion.

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 Baseline Operations Checklist

A fire protection water supply system is considered operational when the following conditions are met:

- The system supply piping (main) is filled with water.
- Control valves are in the appropriate position (normally open).
- Fire hydrants in the system are operational.
- There is adequate water pressure and quantity available.
- The system's piping and fittings are in good repair.

6.1.2 Marking of Hydrants and Auxiliary Valves

Utilities and Infrastructure (UI-DO) is responsible for the assignment of numbers to hydrants and control valves, for stamping the top on the hydrant operating nut and the lid of the valve box, and for maintaining a database tracking the hydrants and valves locations and numbers. UI-DO personnel or their designee shall notify FP-DO and the fire department of any changes made to the database.

6.2 Inspections of Fire Protection Water Storage Tanks

Basis: NFPA 25, 2008 edition. Compliance with this Code is required per 10 CFR 851, Appendix A.2, and DOE O 420.1B Chapter II "Fire Protection," both of which are required per the LANL Prime Contract as part of implementing a comprehensive fire protection program.

6.2.1 Daily Inspections

Water Tank Heaters. Water storage tank heating systems installed on tanks not equipped with a supervised low water temperature alarm connected to a constantly attended location are inspected during the heating season, and the water temperature is recorded. The water temperature shall not be less than 40°F.

6.2.2 Weekly Inspections

Water Tank Heaters. Water storage tank heating systems installed on tanks with a supervised low water temperature alarm monitored at a constantly attended location (e.g. SCADA/ESS) are inspected.

Water Temperature. The temperature of water in tanks without low temperature alarms monitored at a constantly attended location are inspected and recorded during the heating season when the mean temperature is below 40°F. The water temperature in the tanks should not be less than 40°F.

Tank Fill Valves. Automatic tank fill valves are inspected to ensure that the OS&Y isolation valves are in the normal open position.

6.2.3 Monthly Inspections

Water Temperature. The temperature of water in tanks are inspected and recorded monthly during the heating season when the mean temperature is below 40°F . The temperature of the water in the tanks should not be less than 40°F.

Tank Water Level. Water storage tanks that are not equipped with supervised water level alarms monitored at a constantly attended location are inspected to verify the water level in the tank is at an acceptable level.

6.2.4 Quarterly Inspections

Tank Water Level. Water storage tanks equipped with supervised water level alarms (SCADA/ESS) that are monitored at a constantly attended location are inspected quarterly to verify the water level in the tank is at an acceptable level.

Tank Exterior. The exterior of the tank including the supporting structure, foundation vents, and catwalks or ladders are inspected quarterly for signs of obvious damage or weakening.

Tank Exterior. Lightning protection systems, if provided, are inspected in accordance with NFPA 780, *Standard for the Installation of Lightning Protection Systems.*

Tank Exterior. The area around the tank and supporting structure are inspected to ensure the following conditions are met:

- The area is free of combustible storage, trash, debris, brush or material that could present a fire exposure hazard.
- The area is free of accumulation of material on or near parts that could result in accelerated corrosion or rot.
- The tank and support are free of ice buildup.

Tank Fill Valves. Strainers, filters, and orifices of automatic tank fill valves shall be inspected and cleaned quarterly.

6.2.5 *Annual Inspections*

Expansion Joints. Expansion joints, where provided, are inspected for leaks and cracks.

Tank Exterior. Exterior painted, coated, or insulated surfaces at the tank and supporting structure, where provided, are inspected for signs of degradation.

6.2.6 *Three-Year Inspections*

Tank Interiors. The interior of steel tanks without corrosion protection are inspected for signs of pitting, corrosion, spalling, rot, other forms of deterioration, waste materials and debris, aquatic growth, and local or general failure of interior coating.

- Steel tanks exhibiting signs of interior pitting, corrosion, or failure of coating shall be tested in accordance with Section 6.3.3 of this criterion.
- Where the interior inspection is made by means of underwater evaluation, silt shall be first removed from the tank floor.
- Tanks on ring-type foundations with sand in the middle shall be inspected for evidence of voids beneath the floor.
- The heating system and components including piping shall be inspected.
- The anti-vortex plate shall be inspected for deterioration or blockage.

6.2.7 *Five-Year Inspections*

Tank Interiors. The interior of all types of tanks other than steel shall be inspected.

6.3 Testing of Fire Protection Water Storage Tanks

Basis: NFPA 25, 2008 edition (Ref. 10.15). Compliance with this *Code* is required per 10 CFR 851, Appendix A.2, and DOE O 420.1B Chapter II "Fire Protection," both of which are required per the LANL Prime Contract as part of implementing a comprehensive fire protection program.

6.3.1 *Monthly Testing*

- Low water temperature alarms in water storage tanks are tested in accordance with manufacturer's instructions.
- High water temperature limit switches on water storage tank heating systems where provided, are tested whenever the heating system is in service. Tests are performed in accordance with the manufacturer's instructions.

6.3.2 *Semi-Annual Testing*

High and low water level alarms are tested for proper alarm activation and transmission.

6.3.3 *Annual Testing*

Water storage tank heating systems are tested prior to the start of the heating season to verify they are in proper working order.

Steel tanks exhibiting signs of interior pitting, corrosion, or failure of coating shall be drained and the following tests conducted:

- Evaluation of tank coatings shall be made in accordance with ASTM D3359, *Standard Test Method for measuring Adhesion by Tape Test,* generally referred to as the "cross-hatch test".
- Dry film thickness measurements shall be taken at random locations to determine the overall coating thickness.
- Nondestructive ultrasonic readings shall be taken to evaluate the wall thickness where there is evidence of pitting or corrosion.
- Interior surfaces shall be spot wet-sponge tested to detect pinholes, cracks, or other compromises in the coating. Special attention shall be given to sharp edges such as ladder rungs, nuts, and bolts.
- Tank bottoms shall be tested for metal loss and/or rust on the underside by use of ultrasonic testing where there is evidence of pitting or corrosion. Removal, visual inspection, and replacement of random floor coupons shall an acceptable alternative to ultrasonic testing.
- Tanks with flat bottoms shall be vacuum-box tested at bottom seams in accordance with test procedures found in NFPA 22, *Standard for Water Tanks for Private Fire Protection.*

Automatic Tank Fill Valves. Automatic tank fill valves are tested. The valve shall be actuated automatically by lowering the water level in the tank. The refill rate shall be measured and recorded.

6.3.4 *Five Year Testing*

- Level indicators are tested for accuracy and freedom of movement.

- Electronic water level indicators shall be tested in accordance with the manufacturer's instructions.
- Water storage tank pressure gauges are tested with a calibrated gauge in accordance with the manufacturer's instructions. Gauges not accurate to within 3% of the scale of the gauge being tested shall be recalibrated or replaced.

6.4 Water Storage Tank Maintenance

- Voids discovered beneath the floors of tanks are filled by pumping in grout or accessing the sand and replenishing.
- The tank is maintained full or at the designed water level.
- The hatch covers in the roofs and the door at the top of the frost-proof casing shall always be kept securely fastened with substantial catches as a protection against freezing and windstorm damage.
- No waste materials such as boards, paint cans, trim, or loose material, are left in the tank or on the surface of the tank.
- Silt is removed during interior inspections or more frequently as needed to avoid accumulation to the level of the tank outlet.
- Maintenance of automatic tank fill valves is conducted by a qualified person in accordance with the manufacturer's instructions.
- Rubber parts are replaced in accordance with the manufacturer's instructions.

6.5 Inspection, Testing, and Maintenance (ITM) of Fire Hydrants

Basis: NFPA 25, 2008 edition (Ref. 10.15). Compliance with this *Code* is required per 10 CFR 851, Appendix A.2, and DOE O 420.1B Chapter II "Fire Protection," both of which are required per the LANL Prime Contract as part of implementing a comprehensive fire protection program.

6.5.1 Annual Inspection of Fire Hydrants

Fire hydrants shall be inspected to confirm that (see Appendix A):

- Hydrants are visible and unobstructed and quickly accessible to responding fire fighters;
- The hydrant barrel is free of water or ice (the presence of water or ice could indicate a faulty drain or a leaky hydrant valve);
- There are no visible leaks from the hydrant outlets or barrel;
- The barrel is free from cracks or other damage;

- The outlet caps are present and tight;
- The outlet threads are in good condition; and
- The operating nut is in good condition and is not worn.

6.5.2 *Annual Testing of Fire Hydrants*

Hydrants shall be tested to ensure proper functioning:

- Each hydrant shall be opened fully and water flowed until all foreign material has cleared. Flow shall be maintained for not less than 1 minute.
- After operation, dry barrel and wall hydrants shall be observed for proper drainage from the barrel. Full drainage shall take no longer than 60 minutes.
- Where soil conditions or other factors are such that the hydrant barrel does not drain within 60 minutes, or where the groundwater level is above that of the hydrant drain, the hydrant drain shall be plugged and the water in the barrel shall be pumped out.
- Dry barrel hydrants that are located in areas subject to freezing weather and that have plugged drains shall be identified clearly as needing pumping after operation.

6.5.3 *Annual Maintenance of Fire Hydrants*

- Hydrants are lubricated annually to ensure that all stems, caps, plugs, and threads are in proper operating condition.

6.5.4 *Other As-Needed Maintenance of Fire Hydrants*

- Fire hydrants are maintained in proper working condition with the manufacturer's recommendations.
- Hydrants are kept free of snow, ice, or other materials and protected against mechanical damage so that free access is assured.
- A minimum 3-foot clear space is maintained around the circumference of fire hydrants. Posts, fences, vehicles, growth, trash, storage, or other materials or objects are not placed or kept near fire hydrants that prevent fire hydrants from being immediately discernable. The fire department shall not be deterred or hindered from gaining immediate access to fire hydrants (*International Fire Code* §'s 507.5.4 and 507.5.5).

6.6 ITM of Fire Service Mains and Appurtenances

6.6.1 *Nuclear Facilities, High-Hazard Non-nuclear Facilities, and "High Value" Facilities*

The following are ITM requirements for water supply systems supporting automatic fire sprinkler systems protecting LANL nuclear facilities (be they SC, SS or defense in-depth), high-hazard non-nuclear facilities, and other "high value" facilities.

Basis: NFPA 25, 2008 edition. Compliance with these Codes are required per 10 CFR 851, Appendix A.2, and DOE O 420.1B Chapter II "Fire Protection," both of which are required per the LANL Prime Contract as part of implementing a comprehensive fire protection program. See also LASO Memorandum No. SO:21WF-203741, *National Fire Protection Association 25 and National Fire Protection Association 72 Equivalency Cancellation/Modification*, January 19, 2010. See also DOE *Interim Guidance on Design and Operational Criteria for Water Supply Systems Supporting Safety Class and Safety Significant Wet Pipe Sprinkler Systems*, November 2009 .

6.6.1.1 Weekly Inspections

Master Pressure Reducing Valves. Master pressure reducing valves are inspected weekly to verify the following:

- The downstream pressures are maintained in accordance with the design criteria.
- The supply pressure is in accordance with the design criteria.
- The valves are not leaking.
- The valve and trim are in good condition.

6.6.1.2 Monthly Inspections

Control Valves. All system control valves, with the exception of block valves, are inspected to verify that:

- The valve is secured in its normal open or closed position;
- The valve is properly supervised;
- The valve is visible and readily accessible;
- Appropriate wrenches are available;
- The valve is free from leaks or damage; and
- The valve is provided with appropriate identification.

Block Valves. Specific block valves (Valve List maintained by UI-DO) are inspected to verify that:

- The valve cover tack weld is intact;
- The valve cover annual inspection date stamp is current;
- The valve is visible and readily accessible;
- The valve is free from leaks or damage; and
- The valve is provided with appropriate identification.

NOTE: Upon discovery of a broken tack weld, the valve is verified to be in the proper configuration.

6.6.1.3 Quarterly Inspections

Pressure Reducing Valves. Fire main pressure reducing valves shall be inspected quarterly to verify:

- The valves are in the open position;
- The valves are not leaking;
- The valves are maintaining downstream pressures in accordance with design
- criteria; and
- The valves are in good condition, with hand wheels installed and unbroken.

6.6.1.4 Annual Inspections

Exposed Piping. Inspect exposed piping for leaks, physical damage, corrosion, and restraint methods. Exposed piping installed in areas that are inaccessible for safety considerations due to process operations shall be inspected during each scheduled shutdown.

Mainline Strainers. Mainline strainers are removed, inspected for damaged and corroded parts, and cleaned.

6.6.1.5 Five-year Inspections

Check Valves. Check valves are inspected internally to verify that all components operate correctly, move freely, and are in good condition.

6.6.1.6 *Semi-Annual Testing of Fire Service Mains and Appurtenances*

Control valve supervisory switches are tested to verify an off-normal signal is transmitted to the alarm monitoring station either during the first two revolutions of a hand wheel or when the stem of the valve has moved one-fifth of the distance from its normal position.

6.6.1.7 *Annual Testing of Fire Service Mains and Appurtenances*

Control Valves. All valves are operated through their full range and returned to its normal position.

Block Valves. Specific block valves (Valve List maintained by UI-DO) are tested by operating through their full range and returned to their normal position. Upon completion of the test:

- The valve cover tack weld is re-installed; and

- The valve cover receives a new annual inspection date stamp;

Post Indicator Valves. Post indicator valves are opened until spring or torsion is felt in the rod, indicating that the rod has not become detached from the valve.

Pressure Reducing Valves. A partial flow test adequate to remove the valve from its seat is conducted annually to exercise the valve and ensure that it is not obstructed and will re-seat.

Backflow Preventers. Where provided, backflow prevention assemblies shall be tested as follows:

- A forward flow test is conducted at the design flow rate of the water supply system to verify the pressure loss through the device is consistent with design assumptions.
- A backflow performance test is conducted upon completion of the forward flow test.

6.6.1.8 *Five-Year Testing of Fire Service Mains and Appurtenances*

Internal Condition of Piping. Underground and exposed piping is flow-tested through fire hydrants to determine the internal condition of the piping.

- Flow tests are made at flows representative of those expected during a fire for the purpose of comparing the friction loss characteristics of the pipe with hose expected for the particular type of pipe involved, with due consideration given to the age of the pipe and to the results of the previous flow tests.
- Any flow test results that indicate deterioration of available water flow and pressure are investigated to the complete satisfaction of the authority having jurisdiction to ensure that the required flow and pressure are available for fire protection.
- Where underground piping supplies individual sprinkler systems and there are no means to conduct full flow tests, tests generating the maximum available flows are be permitted.

Pressure Reducing Valves. A full flow test through down-stream fire hydrants is conducted on each pressure reducing valve. The flow test results shall be recorded on appropriate forms and maintained on file. Current PRV flow test results shall be compared to previous flow test results. Adjustments shall be made according to manufacturer's instructions.

6.6.1.9 *Annual Maintenance of Fire Service Mains and Appurtenances*

The operating stems of OS&Y valves are lubricated. The valve shall be completely closed and reopened to test its operation and distribute the lubricant.

Gauges shall be either replaced or tested for calibration every 5 years. Gauges not accurate to within 3% of the full scale are recalibrated or replaced. Records of gauge testing are maintained.

6.6.1.10 Five-Year Maintenance of Fire Service Mains and Appurtenances

Check Valves. Internal components are cleaned, repaired, or replaced as necessary in accordance with the manufacturer's instructions.

6.6.2 Balance of LANL Facilities

The following are ITM requirements for water supply systems supporting fire sprinkler systems protecting LANL facilities that are not nuclear facility, high-hazard non-nuclear facility, and designated as "high value" facilities.

Basis: NFPA 25, 2008 edition. Compliance with these Codes are required per 10 CFR 851, Appendix A.2, and DOE O 420.1B Chapter II "Fire Protection," both of which are required per the LANL Prime Contract as part of implementing a comprehensive fire protection program. See also LASO Memorandum No. SO:21WF-203741, *National Fire Protection Association 25 and National Fire Protection Association 72 Equivalency Cancellation/Modification*, January 19, 2010.

6.6.2.1 Weekly Inspections

Master Pressure Reducing Valves. Master pressure reducing valves are inspected weekly to verify the following:

- The downstream pressures are maintained in accordance with the design criteria.
- The supply pressure is in accordance with the design criteria.
- The valves are not leaking.
- The valve and trim are in good condition.

6.6.2.2 Semi-Annual Inspections

Control Valves. All system control valves, with the exception of block valves, are inspected to verify that:

- The valve is secured in its normal open or closed position;
- The valve is properly supervised;
- The valve is visible and readily accessible;
- Appropriate wrenches are available;
- The valve is free from leaks or damage; and

- The valve is provided with appropriate identification.

Block Valves. Specific block valves (Valve List maintained by UI-DO) are inspected to verify that:

- The valve cover tack weld is intact;
- The valve cover annual inspection date stamp is current;
- The valve is visible and readily accessible;
- The valve is free from leaks or damage; and
- The valve is provided with appropriate identification.

NOTE: Upon discovery of a broken tack weld, the valve is verified to be in the proper configuration.

Pressure Reducing Valves. Fire main pressure reducing valves shall be inspected quarterly to verify:

- The valves are in the open position;
- The valves are not leaking;
- The valves are maintaining downstream pressures in accordance with design
- criteria; and
- The valves are in good condition, with hand wheels installed and unbroken.

6.6.2.3 Annual Inspections

Exposed Piping. Inspect exposed piping for leaks, physical damage, corrosion, and restraint methods. Exposed piping installed in areas that are inaccessible for safety considerations due to process operations shall be inspected during each scheduled shutdown.

Mainline Strainers. Mainline strainers are removed, inspected for damaged and corroded parts, and cleaned.

6.6.2.4 Five-year Inspections

Check Valves. Check valves are inspected internally to verify that all components operate correctly, move freely, and are in good condition.

6.6.2.5 Semi-Annual Testing of Fire Service Mains and Appurtenances

Control valve supervisory switches are tested to verify an off-normal signal is transmitted to the alarm monitoring station either during the first two revolutions of a hand wheel or when the stem of the valve has moved one-fifth of the distance from its normal position.

6.6.2.6 Annual Testing of Fire Service Mains and Appurtenances

Control Valves. All valves are operated through their full range and returned to its normal position.

Block Valves. Specific block valves (Valve List maintained by UI-DO) are tested by operating through their full range and returned to their normal position. Upon completion of the test:

- The valve cover tack weld is re-installed; and
- The valve cover receives a new annual inspection date stamp;

Post Indicator Valves. Post indicator valves are opened until spring or torsion is felt in the rod, indicating that the rod has not become attached from the valve.

Pressure Reducing Valves. A partial flow test adequate to remove the valve from its seat is conducted annually to exercise the valve and ensure that it is not obstructed and will re-seat.

Backflow Preventers. Where provided, backflow prevention assemblies shall be tested as follows:

- A forward flow test is conducted at the design flow rate of the water supply system to verify the pressure loss through the device is consistent with design assumptions.
- A backflow performance test is conducted upon completion of the forward flow test.

6.6.2.7 Five-Year Testing of Fire Service Mains and Appurtenances

Internal Condition of Piping. Underground and exposed piping is flow-tested through fire hydrants to determine the internal condition of the piping.

- Flow tests are made at flows representative of those expected during a fire for the purpose of comparing the friction loss characteristics of the pipe with hose expected for the particular type of pipe involved, with due consideration given to the age of the pipe and to the results of the previous flow tests.
- Any flow test results that indicate deterioration of available water flow and pressure are investigated to the complete satisfaction of the authority having jurisdiction to ensure that the required flow and pressure are available for fire protection.
- Where underground piping supplies individual sprinkler systems and there are no means to conduct full flow tests, tests generating the maximum available flows are permitted (e.g., full flow through a sprinkler riser main drain).

Pressure Reducing Valves. A full flow test through down-stream fire hydrants is conducted on each pressure reducing valve. The flow test results shall be recorded on appropriate forms and maintained on file. Current PRV flow test results shall be

compared to previous flow test results. Adjustments shall be made according to manufacturer's instructions.

6.6.2.8 Annual Maintenance of Fire Service Mains and Appurtenances

The operating stems of OS&Y valves are lubricated. The valve shall be completely closed and reopened to test its operation and to distribute the lubricant.

Gauges shall be either replaced or tested for calibration every 5 years. Gauges not accurate to within 3% of the full scale are recalibrated or replaced. Records of gauge testing are maintained.

6.6.2.9 Five-Year Maintenance of Fire Service Mains and Appurtenances

Check Valves. Internal components are cleaned, repaired, or replaced as necessary in accordance with the manufacturer's instructions.

6.7 Impairments

Inspection, testing and maintenance activities that will cause a fire protection system to be incapable of performing its intended function shall be in accordance with Criterion 733, "Fire Protection Systems Impairment Program."

6.7.1 Inspection (After an Impairment or Modification)

Visually inspect all affected portions of the system before returning it to service.

For modified piping, inspect piping before hydrostatic testing, prior to covering of joints, to ensure it is in good condition and is appropriately installed. Also inspect joints during hydrostatic testing (see Section 6.7.2) for signs of leakage.

6.7.2 Testing (After an Impairment or Modification)

Following an impairment of a portion of the fire main, where the fire main has not been breached in any way, verify that block valves are in their correct positions prior to returning the fire main to service. Perform appropriate testing on all suppression systems affected by the impairment (refer to applicable Criteria for the affected systems).

Following modification or repair of any portion of fire main piping, perform a hydrostatic test of the modified piping in accordance with NFPA 24 requirements. Following successful completion of hydrostatic testing, flush the modified piping per NFPA 24. Verify block valves are in their correct positions prior to returning the fire main to service. Perform appropriate testing on all suppression systems affected by the modification (refer to applicable Criteria for the affected systems).

Following modification, maintenance or repair of a fire hydrant, perform the testing described in Section 6.5.2 above prior to returning the hydrant to service.

Following modification, maintenance or repair of water storage tank instrumentation (ex., water temperature alarms or switches, water level alarms, etc.), test all affected instrumentation prior to returning the tank to service.

Following modification, maintenance, or repair work on a water storage tank, verify that items identified in Section 6.4 of this Criterion have been appropriately addressed.

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

7.1.1 Pressure Reducing Valve (PRV) Recommendations

On a monthly basis, it is recommended that the following activities be performed to verify that fire main pressure reducing valves are in proper working order:

- Visually inspect the overall condition of the PRV and the valve pit in which it is installed. Check both the inside and the outside of the pit for debris, cracks, and evidence of leaks.
- Check the PRV pilot valve as follows:
  - Exercise the pilot valve on the PRV by opening the valve one turn.
  - Check the gauge on the pilot valve for indication of increasing or decreasing
  - pressure which will indicate a functional pilot valve.
  - Return the pilot valve to the original setting.
- Inspect the gauges for cracks and leaks. Verify gauge goes to zero when gauge root valve is isolated and gauge cap is removed. Re-open root valve and flush gauge. Replace cap.
- Check system gauges upstream and downstream of the PRV. Compare results to previous results. Significant changes from one month to the next should be brought to the immediate attention of UI-DO.

7.2 Maintenance Recommendations

None

8.0 GUIDANCE

8.1 Operations Guidance

The DOE *Interim Guidance on Design and Operational Criteria for Safety Class and Safety Significant Wet Pipe Sprinkler Systems,* November 2009, contains the following guidance relative to TSRs and LCOs for SC and SS wet pipe sprinkler systems –

> *The following is an example "operability statement" and additional guidance that can be used in developing TSR LCOs for both SS and SC wet pipe sprinkler systems:*
>
> > *"In order for a sprinkler system to be OPERABLE, the system must be supplied with an adequate water supply, with sufficient pressure and flow capability; distribution branches and sprinkler heads must be unobstructed so that the system is capable of controlling a fire as credited in the fire hazard analysis and Document Safety Analysis (DSA), and all sprinkler system TSR surveillance requirements must be current."*
>
> *For SC and SS (wet pipe) sprinkler systems, the requirements of NFPA 25 … should be used to establish TSR surveillance requirements. In addition, personnel performing the ITM should be appropriately qualified through activities such as the National Institute for Certification in Engineering Technologies (NICET) and/or AHJ or Fire Marshal approved vendor equipment training programs.*

The DOE *Interim Guidance on Design and Operational Criteria for Water Supply Systems Supporting Safety Class and Safety Significant Fire Suppression Systems,* November 2009, contains the following guidance relative to TSR s and LCOs for water supply systems support SC and SS wet pipe sprinkler systems -

In addition to the requirements of NFPA 25, the following are also required:

- An NFPA-allowed method to confirm that sufficient water control valves upstream of the system (e.g., wet pipe sprinkler system) control valve or PIV are fully open (i.e., locking, sealing or electronically monitoring);
- A means to ensure the underground piping remains free of obstructions and available to provide a clear path from the supply to the sprinkler riser. (One method might be post maintenance flow testing after disturbing any portion of the underground or any underground valve manipulation);
- A means to identify and accommodate (e.g., maintain system pressure) any unaccounted water supply system leakage, such as a pressure maintenance (jockey) pump where the water supply consists of fire pumps (to prevent inadvertent fire pump starting);
- Water supply conditions [e.g., chemical, and microbiological induced corrosion (MIC)] should be addressed through appropriate inspection, testing and maintenance activities. Such activities should include regular metallurgical

system tests (at a frequency deemed necessary to ensure no unacceptable system degradation).

8.2 Maintenance Guidance

8.2.1 Control Valves.

After any alterations or repairs, an inspection shall be made to ensure the system is in service and that all valves are in the proper position and are supervised.

8.2.2 System Control Valves.

Post indicator (PIV) and outside screw and yoke valves shall be backed a one-quarter turn from the fully open position to prevent jamming.

9.0 REQUIRED DOCUMENTATION

- Records shall be made for all inspections, tests and maintenance of the system and components.
- Records shall indicate the procedure performed, who performed the work, the results and the date.
- Records shall be maintained by the FOD and be made available to the AHJ upon request.
- Records of 5-year pipe flow testing (see Criterion Section 6.6.1.8) shall be maintained for comparison to allow determination of internal condition of piping.
- Records of 5-year pressure reducing valve flow testing (see Criterion Section 6.6.1.8) shall be maintained to allow comparison.
- Non-TA-55 fire loop fire protection water supply system ITM records shall be maintained by UI-DO, except for piping flow test documentation (per Section 6.6.1.8 of this Criterion). Flow testing documentation is currently maintained by the Los Alamos Fire Department. The TA-55 FOD maintains ITM records for the dedicated fire loop at TA-55.

Maintenance history shall be maintained for fire hydrants 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 Main Maintenance Activities				
Repair / Adjustments	X	X	X	X
PM Activities	X	X	X	X
Fire Main Equipment Problems				
Failure Dates	X	X	X	X
Failure Root Cause	X	X	X	X
Fire Main Inspection Results (per this Criterion)				
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-341-502, *Management Level Determination*

10.4 10 CFR 851, *Worker Safety and Health Program*, Appendix A.2 "Fire Protection."

10.5 DOE O 430.1B, *Real Property Asset Management.*

10.6 DOE Order 433.1A, *Maintenance Management Program for Nuclear Facilities.*

10.7 DOE Order 420.1B, *Facility Safety*, Chapter II "Fire Protection."

10.8 LANL PD 1220, *Fire Protection Program.*

10.9 LANL Equivalency to NFPA 25, consisting of: (a) LANL Memorandum No. FE-21-98-005, *Proposed Equivalency to NFPA Standard 25*, dated June 9, 1998; (b) DOE AOO/LAOO Memorandum No. LAAMFO:3TR-021, *Fire Protection Inspection, Test, and Maintenance Requirements*, dated 6/9/1998; and (c) DOE AOO Memorandum No. TASD:98-068:pc, *Disposition of LANL Equivalency Requests to NFPA 25 – Inspection, Testing, and Maintenance*

(ITM) Frequencies for Water-Based Fire Protection Systems, dated July 24, 1998.

10.10 LASO Memorandum No. SO:21WF-203741, *National Fire Protection Association 25 and National Fire Protection Association 72 Equivalency Cancellation/Modification*, January 29, 2010.

10.11 LANL Equivalency Request No. LANL-DOE-ORDER-420.1B-2009-005, *Request for Permanent Equivalency Approval to DOE Order 420.1B and NFPA 25 Requirements for the Inspection of Water System Block Valves at Los Alamos National Laboratory (LANL)*, Revision 0, 8/18/2009 (Transmittal Letter No. PCM:09-166, 8/19/2009).

10.12 DOE NNSA Memorandum for Thomas P. D'Agostino, Ines R. Triay and Steven E. Koonin, *Deliverable for Defense Nuclear Facilities Safety Board Recommendation 2008-1, Safety Classification of Fire Protection Systems*, dated December 9, 2009, including: (a) Attachment 2 – *Interim Guidance on Design and Operational Criteria for Safety Class and Safety Significant Wet Pipe Sprinkler Systems, Milestone 5.3.1 Deliverable, Defense Nuclear Facilities Safety Board Recommendation 2008-1, Safety Classification of Fire Protection Systems*, November 2009; and (b) Attachment 3 - *Interim Guidance on Design and Operational Criteria for Water Supply Systems Supporting Safety Class and Safety Significant Wet Pipe Sprinkler Systems, Milestone 5.3.1 Deliverable, Defense Nuclear Facilities Safety Board Recommendation 2008-1, Safety Classification of Fire Protection Systems*, November 2009.

10.13 NFPA 14, *Standard for Installation of Standpipe, Private Hydrant, and Hose Systems*, 2010 Edition

10.14 NFPA 24, *Standard for Private Fire Service Mains and Their Appurtenances*, 2010 Edition

10.15 NFPA 25, *Standard for Inspection, Testing, and Maintenance of Water Based Fire Protection Systems*, 2008 Edition

10.16 NFPA 291, *Recommended Practice for Fire Flow Testing and Marking of Hydrants*, 2010 Edition

10.17 Utilities Maintenance Instruction 74-00-010, "Fire Protection PRV Maintenance"

10.18 Utilities & Infrastructure Maintenance Procedure UI-PROC-74-30-010, "Block Valve Inspection"

10.19 Utilities Maintenance Instruction 74-20-010, "Hydrant Flush"

10.20 Utilities Maintenance Instruction 74-50-10, "Block Valve Operation"

11.0 APPENDICES

Appendix A – Inspection, Testing, and Corrective Actions

Appendix A – Inspection, Testing, and Corrective Actions

Dry Barrel and Wall Hydrants (Annually and after each operation)

Condition	Corrective Action
Inaccessible	Make accessible
Barrel contains water or ice (presence of water or ice could indicate a faulty drain, a leaky hydrant valve, or high groundwater table)	Repair drain; for high groundwater it could be necessary to plug the drain and pump out the barrel after each use; repair leaky hydrant valve
Improper drainage from barrel	Repair drain
Leaks in outlets or at top of hydrant	Repair or replace gaskets, packing, or parts as necessary
Cracks in hydrant barrel	Repair or replace
Tightness of outlets	Lubricate if necessary; tighten if necessary
Worn nozzle threads	Repair or replace
Worn hydrant operating nut	Repair or replace
Availability of operating wrench	Make sure wrench is available

Basis: NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, Chapter 7.

Appendix A – Inspection, Testing, and Corrective Actions

Exposed Piping (Annual Inspection)

Condition	Corrective Action
Leaks	Repair
Physical damage	Repair or replace
Corrosion	Clean or replace and provide corrosion protection
Restraint methods unsatisfactory (excessive corrosion, physical damage)	Repair or replace

Basis: NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, Chapter 7.

Mainline Strainers (Annually and after significant flow)

Condition	Corrective Action
Plugging or fouling	Clean
Corrosion	Repair or replace

Basis: NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, Chapter 7.