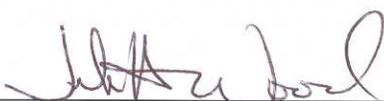
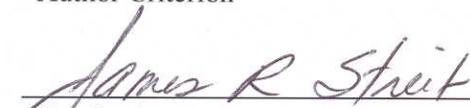


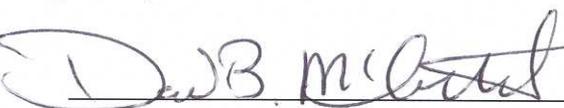
CRITERION 722

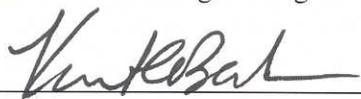
FIRE PROTECTION WATER SUPPLY SYSTEMS

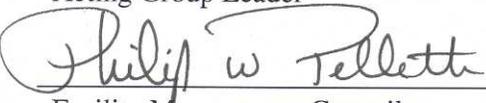
SIGNATURES

	<u>10/9/02</u>	<u>FWO-SEM</u>	<u>665-8279</u>
Julie Wood Author Criterion	Date	Group	Phone Number

	<u>10/9/2002</u>	<u>FWO-FIRE</u>	<u>667-9045</u>
Jim Streit Group Leader	Date	Group	Phone Number

	<u>10-9-02</u>	<u>FWO-SEM</u>	<u>667-3616</u>
David McIntosh Maintenance Engineering Team	Date	Group	Phone Number

	<u>10/11/02</u>	<u>FWO-SEM</u>	<u>667-6261</u>
Kurt Beckman Acting Group Leader	Date	Group	Phone Number

	<u>10/9/02</u>	<u>FMC</u>	<u>665-4854</u>
Philip W. Pelletti Facility Management Council Committee Chairperson	Date	Group	Phone Number

RECORD OF REVISIONS

Revision No.	Date	Description
0	10/02/02	Initial Issue

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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 LIR 230-05-01(Ref 10.1), "Operations and Maintenance Manual."

Implementation of this Criterion satisfies DOE Order 430.1A (Ref 10.2) for the subject equipment/system. DOE Order 430.1A (Ref 10.2), "Life Cycle Asset Management," Attachment 2 "Contractor Requirements Document," Paragraph 2, Sections A through C, which in part requires UC to "...maintain physical assets in a condition suitable for their intended purpose," and employ "preventive, predictive, and corrective maintenance to ensure physical asset availability for planned use and/or proper disposition." Compliance with DOE Order 430.1A is required by Appendix G of the UC Contract.

This criterion establishes the requirements to ensure fire protection water supply systems are properly maintained per NFPA 25 and to ensure an accurate record keeping system is used. The document addresses the requirements of LIR 230-05-01.

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 LANL, including fire main piping, fire hydrants, block valves, mainline strainers, pressure reducing valves, and water storage tanks. 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.

3.0 ACRONYMS AND DEFINITIONS

3.1 Acronyms

AHJ	Authority Having Jurisdiction
DOE	Department of Energy
ITM	Inspections, Testing, and Maintenance
LIR	Laboratory Implementing Requirement
LPR	Laboratory Performance Requirement
O&M	Operations and Maintenance
PP&PE	Personal Property and Programmatic Equipment
RP&IE	Real Property and Installed Equipment
SCADA/ESS	Surveillance, Control and Data Acquisition/Equipment Surveillance System
SSC	Structures, Systems, and Components
SSS	LANL's Support Service Subcontractor
UC	University of California

3.2 Definitions

Management Level Determination (ML1, ML2, ML3, ML4)-A classification system for determining the degree of management control applied to facility work. See LIR 230-01-02 for definitions of each ML level.

4.0 RESPONSIBILITIES

4.1 FWO-Systems, Engineering and Maintenance (SEM)

4.1.1 FWO-SEM is responsible for the administrative content of this Criterion and monitoring the applicability and the implementation status of this Criterion and either assisting the organizations that are not applying or meeting the implementation expectations contained herein or elevating their concerns to the director(s).

Basis: LIR 301-00-01.11; Issuing and Managing Laboratory Operations Implementation Requirements and Guidance, Section 5.4, OIC Implementation Requirements.

4.1.2 FWO-SEM shall provide technical assistance to support implementation of this Criterion.

4.2 FWO-Fire Protection (FWO-FIRE)

4.2.1 FWO-FIRE is responsible for the technical content of this Criterion and monitoring the proper implementation across the Laboratory.

4.2.2 FWO-FIRE shall provide technical assistance to support implementation of this Criterion.

4.3 Facility Manager

4.3.1 Responsible for operations and maintenance of institutional, or Real Property and Installed Equipment (RP&IE) under their jurisdiction, in accordance with the requirements of this document.

4.3.2 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document that may be assigned to the FM in accordance with the FMU-specific Facility/Tenant Agreement.

4.4 Group Leader

4.4.1 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document, which are under their jurisdiction.

4.4.2 Responsible for system performance and subsequent replacement or refurbishment of assigned PP&PE.

4.5 FWO-UI (Utilities and Infrastructure)

FWO-UI is responsible for the water utility system. FWO-UI, typically via the SSS, 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.

4.6 Authority Having Jurisdiction (AHJ) – LANL Fire Marshal

4.6.1 The AHJ is responsible for providing a decision on a specific technical question regarding this Criterion.

4.6.2 The LANL Fire Marshal is the approval authority for all exceptions and variances to this Criterion.

4.7 Support Services Subcontractor (SSS)

4.7.1 Is responsible for providing ITM of the fire protection systems addressed in this Criterion at the request of the responsible Facility Manager.

- 4.7.2 Is responsible for coordinating work with operating group and Facility Manager to conduct ITM in the affected area.

5.0 PRECAUTIONS AND LIMITATIONS

5.1 Precautions

This section is not intended to identify all applicable precautions necessary for implementation of this Criterion. A compilation of all applicable precautions shall 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/precautions that may not be immediately obvious.

5.2 Limitations

The intent of this Criterion is to identify the minimum generic 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, vendor 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 shall implement the requirements of DOE Order 4330.4B (Ref. 10.4) 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 identified above.

6.0 REQUIREMENTS

Minimum requirements that Criterion users shall follow are specified in this section. Requested variances to these requirements shall be prepared and submitted to FWO-SEM in accordance with LIR 301-00-02 (Ref. 10.5), "Variances and Exceptions to Laboratory Operations Requirements," for review and approval. The Criterion users are responsible for analysis of operational performance and SSC replacement or refurbishment based on this analysis. Laws, codes, contractual requirements, engineering judgement, safety matters, and operations and maintenance experience drive the requirements contained in this section.

6.1 Operations Requirements

6.1.1 Operations Checklist

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

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

6.1.2 Marking of Hydrants and Auxiliary Valves

FWO-Utilities and Infrastructure, typically via the SSS, 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. FWO-UI personnel or their designee shall notify FWO-FIRE and the fire department of any changes made to the database. Facility managers shall have access to the database.

6.1.3 Inspection

6.1.3.1 Daily Inspections

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

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 9. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.1.3.2 Weekly Inspections

Water storage tank heating systems installed on tanks equipped with a supervised low water temperature alarm that are connected to a constantly attended location (e.g., SCADA/ESS) shall be inspected weekly during the heating season, and the water temperature recorded. (Water temperature shall not be less than 40° F.)

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 9. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.1.3.3 Monthly Inspections

Water storage tanks that are not equipped with water level alarms connected to a constantly attended location shall be inspected monthly.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 9. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.1.3.4 Quarterly Inspections

(a) Fire main pressure reducing valves shall be inspected quarterly to verify they are in the open position, are not leaking, are maintaining downstream pressures in accordance with design criteria, and are in good condition, with handwheels installed and unbroken.

(b) Water storage tanks equipped with supervised water level alarms (SCADA/ESS) that are connected to a constantly attended location shall be inspected quarterly.

(c) The exterior of water storage tanks, supporting structure, vents, foundation, and catwalks or ladders, where provided, shall be inspected quarterly for signs of obvious damage or weakening.

(d) The area surrounding water storage tanks and supporting structure, where provided, shall be inspected quarterly to ensure that 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 the accumulation of material on or near parts that could result in accelerated corrosion or rot.
- The tank and support are free of ice buildup.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 9. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.1.3.5 Annual Inspections

- Inspect hydrants regularly, at a minimum annually and after each operation (see Appendix A).
- Inspect mainline strainers (if installed) annually and after each significant flow (system flow exceeding that of a 2-inch orifice). See Appendix A.
- Inspect exposed piping (if any) annually. See Appendix A.

- Water storage tank expansion joints, where provided, shall be inspected annually for leaks and cracks.
- Exterior painted, coated, or insulated surfaces of water storage tanks and supporting structure (where provided) shall be inspected annually for signs of degradation.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 7, Table 7.1. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.1.3.6 Water Storage Tank Interior Inspections

- (a) The interior of steel tanks without corrosion protection shall be inspected every three years.
- (b) The interior of steel tanks with corrosion protection shall be inspected every five years.
- (c) Where interior inspection is made by means of underwater evaluation, silt shall first be removed for the tank floor.
- (d) Steel tanks exhibiting signs of interior pitting, corrosion, or failure of coating shall be tested as described in Appendix B of this Criterion.
- (e) Tanks on ring-type foundations with sand in the middle shall be inspected for evidence of voids beneath the floor.
- (f) The heating system and components including piping shall be inspected.
- (g) The anti-vortex plate shall be inspected for deterioration of blockage.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 9. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.2 Testing Requirements

6.2.1 Monthly Testing

- 6.2.1.1** Low water temperature alarms in water storage tanks shall be tested monthly during the tank heating system.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 9. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.2.1.2 High water temperature limit switches on water storage tank heating systems shall be tested monthly whenever the heating system is in service.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 9. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.2.2 Semi-Annual Testing

6.2.2.1 High and low water level alarms shall be tested semi-annually.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 9. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.2.3 Annual Testing

6.2.3.1 Water storage tank heating systems shall be tested prior to the heating season to make certain they are in proper working order.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 9. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.2.3.2 Hydrants shall be tested annually to ensure proper functioning. A maintenance database shall be established and maintained to document hydrant testing and maintenance history.

- (a) Each hydrant shall be opened fully and waterflowed until all foreign material has cleared.
- (b) Flow shall be maintained for not less than 1 minute.
- (c) After operation, dry barrel and wall hydrants shall be observed for proper drainage from the barrel.
- (d) Full drainage shall take no longer than 60 minutes.
- (e) 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.
- (f) 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.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 7. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.2.4 5-Year Testing

6.2.4.1 Pressure reducing valves shall be subject to a full-flow test, with results compared to previous test results for trending purposes.

6.2.4.2 Water storage tank instrumentation:

(a) Level indicators shall be tested every 5 years for accuracy and freedom of movement.

(b) Water storage tank pressure gauges shall be tested every 5 years 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.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 9. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.2.4.3 Underground and exposed piping shall be flow tested to determine the internal condition of the piping at minimum 5-year intervals.

(a) Flow tests shall be 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.

(b) Any flow test results that indicate deterioration of available water flow and pressure shall be investigated to the complete satisfaction of the authority having jurisdiction to ensure that the required flow and pressure are available for fire protection.

(c) Where underground piping supplies individual sprinkler systems and there are no means to conduct full flow tests, tests generating the maximum available flows shall be permitted.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 7. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.3 Maintenance Requirements

All equipment shall be maintained in proper working condition, consistent with the manufacturer's recommendations.

6.3.1 Annually

- (a) Lubricate hydrants to ensure all stems, caps, plugs, and threads are in proper operating condition.
- (b) Keep hydrants free of snow, ice, or other materials and protected against mechanical damage so that free access is ensured.
- (c) Mainline strainers (if installed) shall be cleaned annually and after each system flow exceeding that of a nominal 2-inch orifice. Inspect for failing, damaged and corroded parts. See Appendix A.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 7. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.3.2 5-Year Maintenance

Check valves shall be inspected internally every five years to verify that all components operate correctly, move freely, and are in good condition. Internal components shall be cleaned, repaired, or replaced as necessary in accordance with the manufacturer's instructions.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 12. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.3.3 Water Storage Tank Maintenance

- (a) Silt shall be removed during interior inspections or more frequently as needed to avoid accumulation to the level of the tank outlet.
- (b) The tank shall be maintained full or at the designed water level.
- (c) The hatch covers in the roofs and the door at the top of the frostproof casing shall always be kept securely fastened with substantial catches as a protection against freezing and windstorm damage.
- (d) No waste materials such as boards, paint cans, trim, or loose material, shall be left in the tank or on the surface of the tank.
- (e) Voids discovered beneath the floors of water storage tanks shall be filled by pumping in grout or accessing the sand and replenishing.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 9.

Compliance with this NFPA code is required per Appendix G of the UC contract.

6.4 Impairments and Modifications

If one or more of the operational requirements listed in Section 6.1.1 are not maintained, follow the actions outlined in Criterion 733, Fire Protection System Impairment Control Program.

6.4.1 Inspection (After an Impairment or Modification)

6.4.1.1 Visually inspect all affected portions of the system before returning it to service. See Attachment A.

6.4.1.2 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 6.4.2) for signs of leakage.

6.4.2 Testing (After an Impairment or Modification)

6.4.2.1 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).

6.4.2.2 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).

6.4.2.3 Following modification, maintenance or repair of a fire hydrant, perform the testing described in Section 6.2.1.1 above prior to returning the hydrant to service.

6.4.2.4 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.

- 6.4.2.5** Following modification, maintenance, or repair work on a water storage tank, verify that items identified in Section 6.3.3 of this Criterion have been appropriately addressed.

6.5 Personnel

Operational testing will be conducted by SSS personnel, in compliance with LIR 402-910-01, Section 6.0, except for piping flow tests (per Section 6.2.2 of this Criterion), which are currently conducted by the Los Alamos County Fire Department and the LANL Fire Protection Group.

Basis: LIR 402-910-01, LANL Fire Protection Program.

7.0 RECOMMENDATIONS 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 his/her unique application and operating history of the subject systems/equipment.

7.1 Operations Recommendations

None applicable.

7.2 Maintenance Recommendations

7.2.1 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:

- (a) 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.
- (b) 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.
- (c) 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.
- (d) 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 FWO-UI.

7.2.2 Block Valves Recommendations

It is recommended that block valves in the fire main system be inspected annually to ensure they are in the proper position (normally open). It is further recommended that each block valve in the fire main system be operated annually through its full range and returned to its normal position, to check its operation and to verify that it is in good repair.

8.0 GUIDANCE**8.1 Operations Guidance**

8.1.1 For additional guidance on conduct of operations at nuclear facilities, see DOE O 5480.19, Chapter VIII, Part 9 for Temporary Modification Control.

Basis: DOE O 5480.19, Conduct of Operations Requirements for DOE Facilities.

8.2 Maintenance Guidance

8.2.1 For additional guidance on conduct of operations at nuclear facilities, see DOE O 5480.19, Chapter VIII, Part 7 for Equipment Post Maintenance Testing and Return to Service.

Basis: DOE O 5480.19, Conduct of Operations Requirements for DOE Facilities.

9.0 REQUIRED DOCUMENTATION

Fire protection water supply system ITM shall be maintained by FWO-UI or their designee, except for piping flow test documentation (per Section 6.2.2 of this Criterion). Flow testing documentation is currently maintained by the Los Alamos County Fire Department. 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 LPR 230-07-00, Criteria 2, (Ref. 10.6) which states; “Maintenance activities, equipment problems, and inspection and test results are documented.”

10.0 REFERENCES

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

- 10.1** LIR 230-05-01.0, Operations and Maintenance Manual.
- 10.2** DOE O 430.1A, Attachment 2 “Contractor Requirements Document” (Paragraph 2, Sections A through C), a requirement of Appendix G of the UC Contract.
- 10.3** DOE O 5480.19, Conduct of Operations Requirements for DOE Facilities.
- 10.4** DOE Order 4330.4B, Maintenance Management Program, Section 3.4.9.
- 10.5** LIR 301-00-02.0, Variances and Exceptions to Laboratory Operation Requirements.
- 10.6** LPR 230-07-00, Maintenance History, Performance Criteria [2].
- 10.7** AWWA Manual M17, Installation, Field Testing, and Maintenance of Fire Hydrants
- 10.8** LANL O&M Manual, Criterion 301, Planned Utility Outages

- 10.9** LIR 402-910-01, LANL Fire Protection Program
- 10.10** NFPA 14, Standpipe, Private Hydrant, and Hose Systems, 2000 Edition
- 10.11** NFPA 24, Private Fire Service Mains and Their Appurtenances, 1995 Edition
- 10.12** NFPA 25, Inspection, Testing, and Maintenance of Water Based Fire Protection Systems, 2002 Edition
- 10.13** NFPA 291, Fire Flow Testing and Marking of Hydrants, 1995 Edition
- 10.14** Utilities Maintenance Instruction 74-00-010, "Fire Protection PRV Maintenance"
- 10.15** Utilities Maintenance Instruction 74-30-010, "Block Valve Inspection"
- 10.16** Utilities Maintenance Instruction 74-20-010, "Hydrant Flush"
- 10.17** "Fire Mains" portion of LANL Fire Protection Program Manual, dated 4/30/98

11.0 APPENDICES

Appendix A – Inspection, Testing, and Corrective Actions

Appendix B – Water Storage Tank Interior Inspection Tests

Appendix A – Inspection, Testing, and Corrective Actions

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

<i>Condition</i>	<i>Corrective Action</i>
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, Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, Chapter 7.

Appendix A – Inspection, Testing, and Corrective Actions

Exposed Piping (Annual Inspection)

<i>Condition</i>	<i>Corrective Action</i>
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, Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, Chapter 7.

Mainline Strainers (Annually and after significant flow)

<i>Condition</i>	<i>Corrective Action</i>
Plugging or fouling	Clean
Corrosion	Repair or replace

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

Appendix A – Inspection, Testing, and Corrective Actions**Water Storage Tank Inspections:**

- (a) The exterior of water storage tanks, supporting structure, vents, foundation, and catwalks or ladders, where provided, shall be inspected quarterly for signs of obvious damage or weakening.
- (b) The area surrounding water storage tanks and supporting structure, where provided, shall be inspected quarterly to ensure that 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 the accumulation of material on or near parts that could result in accelerated corrosion or rot.
 - The tank and support are free of ice buildup.

Appendix B – Water Storage Tank Interior Inspection Tests

Where a water storage tank exhibits signs of interior pitting, interior corrosion, or failure of interior coating, the following tests shall be conducted (tank must be drained):

- (a) Evaluation of tank coatings shall be made in accordance with the adhesion test of ASTM D 3359, *Standard Test Methods for Measuring Adhesion by Tape Test*, generally referred to as the “cross-hatch test”.
- (b) Dry film thickness measurements shall be taken at random locations to determine the overall coating thickness.
- (c) Nondestructive ultrasonic readings shall be taken to evaluate the wall thickness where there is evidence of pitting or corrosion.
- (d) 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.
- (e) 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 be an acceptable alternative to ultrasonic testing.
- (f) 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*.

Basis: NFPA 25, Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, Chapter 9.