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

**TITLE: FREEZE PROTECTION**

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## RECORD OF REVISIONS

Revision No.	Date	Description
0	08/ 27/ 98	Initial Issue. Replaces 3.7-600, Rev. 0. Deleted Forward, Statement of Authority, Maintenance Standard Update, 1.0 General Requirement, and 2.0 Los Alamos National Laboratory (LANL) Maintenance Policy Documents.
1	01/ 08/ 02	This revision includes the addition of a Table of Contents, the use of Basis Statements in Sections 6 and 7 further clarification based on the new Criterion Writer's Guide, incorporates a review of Occurrence Reporting Processing System (ORPS) & Nuclear Regulatory Commission (NRC) lessons learned 1/ 1/ 95 to 6/ 2000, and reinstates requirements based on Type B Accident Investigation Board Report, Chiller Line rupture at Technical Area 35, Building 27. This revision also incorporates the comments and rewording requested by the Facility Maintenance Coordinator (FMC) Maintenance Subcommittee.
	02/ 26/ 02	Incorporation of comment and rewording requested by the Maintenance Subcommittee.
	5/ 15/ 02	Incorporation of comments from review by Maintenance Subcommittee.
	7/ 25/ 02	Incorporation of comments Section 6.2.1 from Facility Management (FM) Council
2	01/ 14/ 05	Incorporate United States Department of Energy (DOE) definition of freezing conditions. Update DOE references
3	05/ 05/ 10	Update references, acronyms, etc.



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## CRITERION 401 FREEZE PROTECTION

### 1.0 PURPOSE

The purpose of this Criterion is to ensure a program is in place to prevent damage to buildings and equipment during cold weather.

This document addresses the requirements of P315, *Conduct of Operations Manual*, and P950, *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

Numerous incidents and several occurrences have been recorded involving the failure of, or the lack of, a freeze protection program. The reports from each of these occurrences established corrective actions requiring LANL to develop and implement an institutional freeze protection program. This criterion is established as an institutional requirement to satisfy those corrective actions.

This document requires each Facility Operations Director (FOD) to establish a freeze protection plan for each applicable facility. Building applicability will need to be determined by the FOD Team. A tool that may be used to help determine applicability is the Risk Based Priority Matrix Table (AP-WORK-001.2) found in AP-WORK-001, "Work Initiation, Screening, and Acceptance". The requirements stated below are based on the United States Department of Energy (DOE) Maintenance Management Program Guidelines (DOE O 433.1A *Maintenance Management Program for DOE Nuclear Facilities* and DOE G 433.1-1, *Nuclear Facility Maintenance Management Program Guide for Use with DOE O 433.1* which are mandatory for nuclear facilities), but shall be applied to all LANL facilities in a graded approach.

This Criterion does not address corrective maintenance actions required to repair or replace equipment or failures due to conditions beyond design limitations of the subject system.

### 3.0 ACRONYMS AND DEFINITIONS

#### 3.1 Acronyms

AHJ	Authority Having Jurisdiction
CFR	Code of Federal Regulations
CRE	Condenser Refrigerated Evaporative
CWE	Chiller Water Evaporative
DOE	United States Department of Energy
DOE/ AL	Department of Energy/ Albuquerque Office
DOE/ EH	Department of Energy/ Office of Environmental, Safety, and Health
ESS	Equipment Surveillance System
FM	Facility Management
FMC	Facility Maintenance Coordinator
FOD	Facility Operations Director
GFEP	Ground Fault Equipment Protection
LANL	Los Alamos National Laboratory
LA SO	Los Alamos Site Office
ML	Management Level
MM	Maintenance Manager
MSS	Maintenance and Site Services
MSS-MP	Maintenance and Site Services – Maintenance Programs
NRC	Nuclear Regulatory Commission
NEC	National Electrical Code (NFPA 70)
NFPA	National Fire Protection Association
OM	Operations Manager
O&M	Operations and Maintenance
ORPS	Occurrence Reporting Processing System
PMI	Preventative Maintenance Instruction
SAR	Safety Analysis Report
SFPP	Seasonal Facility Preservation Plan
SSC	Structure, System, and Component
TSR	Technical Surveillance Requirement

#### 4.0 DEFINITIONS

**Drip Leg.** A section of pipe which gathers steam-condensate, dirt, and corrosion products in a steam line and allows the solids to separate to the bottom so they will not clog the strainers and steam traps.

**Cold Weather Conditions.** Temperatures  $\leq 35^{\circ}\text{F}$ . Routine freeze protection surveillance commence when these conditions occur.

**Freeze Stat.** Temperature sensing device placed near coil or heating surface to place a unit in a safe configuration to prevent freeze damage.

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**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.

**Structure, System, and Component (SSC).** Structure is an element or a collection of elements that provides support or enclosure such as a building, freestanding tank, basin, dike, or stack. System is a collection of components assembled to perform a function such as piping, cable trays, conduits, or heating, ventilation, and air conditioning. Component is an item of equipment such as a pump, valve, or relay, or an element of a larger array such as a length of pipe, elbow, or reducer.

**Steam Trap.** A device which passes condensate and stops steam from passing into the condensate return system.

**Vacuum Breaker.** A device which prevents fluids from creating a vacuum allowing the fluid to drain by gravity and therefore prevents freezing in a system which is correctly configured.

## 5.0 RESPONSIBILITIES

### 5.1 MSS-Division Leader

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.

### 5.2 MSS- Maintenance Programs (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.

### 5.3 Facility Operations Director (FOD)

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

### 5.4 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.

### 5.5 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

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Operations Manager at the conclusion of maintenance activities. The MM with concurrence of the FOD will prioritize implementation within budget allocations.

## 5.6 Authority Having Jurisdiction (AHJ)

The AHJ(Point of Contact for the Mechanical Chapter of the LANL Engineering Manual) is responsible for providing a decision on specific technical questions regarding the systems or equipment relevant to this criterion.

## 6.0 PRECAUTIONS AND LIMITATIONS

### 6.1 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.

### 6.2 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, 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 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) identified above.

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

## 7.0 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,

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engineering judgment, safety matters, and operations and maintenance experience drive the requirements contained in this section.

## 7.1 Operations Requirements

- 7.1.1 Operations staff shall support the implementation of the Seasonal Facility Preservation Plan (SFPP) as needed. Support may include inspections/ surveillances and reporting of abnormal conditions to the deployed Maintenance Manager.

## 7.2 Maintenance Requirements

- 7.2.1 A SFPP shall be prepared for each facility in accordance with the requirements set forth in AP-MNT-002, Seasonal Facility Preservation. The SFPP will detail the actions and requirements to be imposed on the facility to ensure protection of SSCs from severe weather and environmental conditions. The SFPP will ensure that, in all cases, the actions and requirements imposed to provide severe weather protection comply with the facility configuration management procedures and are reviewed by facility operations and safety personnel to assure that the facility will be maintained in a safe condition to protect the health and safety of the public. For purposes of the SFPP, “facility” may be defined as a group of buildings and related infrastructure.
- 7.2.2 The SFPP shall include details on inspections, preventive maintenance, and corrective maintenance imposed to ensure continued safe facility operations. Inspections and self-assessments of freeze protection programs shall be appropriately scheduled to assure correction of deficiencies and preparation of other compensatory measures to protect the facilities prior to the beginning of cold weather conditions. Facilities and equipment subject to inspections shall be determined by the FOD Team and identified in their SFPP. The SFPP shall also identify the frequency at which inspections shall take place. In this case the frequencies shall be based upon daily temperature readings. Actions to be taken if conditions warrant could include placing air handling systems in recirculation mode, addition of temporary heat, etc. As a minimum, address the following during plan preparation:
- A. Heating systems will be cleaned, serviced, and functionally tested.
  - B. Antifreeze used in cooling systems and fire protection systems will be checked and replaced as necessary.
  - C. Heating system power and temperature controls will be protected against inadvertent deactivation.
  - D. All air intakes, windows, doors, and others access ways that could provide abnormal inflows of cold air shall be secured. Automatically controlled systems of this type will be functionally tested.
  - E. When temperatures fall below design conditions (5°F at Los Alamos), the need for increased surveillance is addressed.
  - F. Facility personnel will inspect, test, and stage portable auxiliary heaters and have identified sources to obtain more, if needed.

- G. The main water supply cutoffs for each facility will be identified, tested (i.e., inspection to confirm functional), and readily accessible to personnel (e.g., Facility Supervisor, Facility Coordinators, individuals on call familiar with the Facilities equipment, etc.) responding to a freeze/ thaw incident.
- H. Outside storage pads and unheated storage areas will be inspected to ensure that there are no materials susceptible to freeze damage.
- I. Employees will be aware of the need to identify and report any suspected problem with heating or other cold weather protection equipment.
- J. Provisions are made to remove temporary cold weather protection features after the cold weather season or freezing period is over.
- K. Wet-pipe sprinkler systems will be reviewed for areas susceptible to freezing, and appropriate actions planned, such as provisions for auxiliary heat; draining and posting a fire watch/ etc.
- L. For steam systems: blow down drip legs, clean strainers, test freeze stat actuation of control valves and dampers, check steam traps, control actuators/ valves, face and bypass dampers, linkages, and temperature controllers. Ensure that a vacuum breaker is installed and in working order on all preheat and heating coils which may be exposed to freezing conditions.
- M. For ventilation systems: test and calibrate all freeze stats, and check operation of valves, dampers, linkages, control actuators, and temperature controllers.
- N. Drain and remove water from all seasonal cooling systems (unless protected by antifreeze or heat tape) and yard watering systems. Leave all vents and drain valves open.
- O. Inspect conditions of all heat tapes, basin heaters and contact heaters. Verify operations and temperature settings and test ground-fault equipment protection.
- P. Check Equipment Surveillance System (ESS) alarm functionality for critical heating equipment.
- Q. Validate ESS alarm call out list for critical heating equipment.

**Note:** A Ground Fault Equipment Protector (GFEP) may be required per National Electric Code (NEC) 427-22 depending upon the date of system installation

*Basis* Type B Accident Investigation Board Report, *Chiller Line Rupture at Technical Area 35*, Building 27 Los Alamos National Laboratory:

- **INTERPRETATION OF SIGNIFICANCE**

The large property loss of \$3.2 million at Los Alamos National Laboratory on November 17, 1997, was a result of failure by the University of California to protect the Department of Energy's assets. A chiller line ruptured because of freezing temperatures, and the water collected in the sub-basement of a building because of the failure of the sump system. As

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a result of the flooding, there was a total loss of the contents in the sub-basement and damage to the building. Inadequacies in the Laboratory's maintenance program and lessons learned program contributed heavily to this incident.

Although the facilities and equipment were considered by line management to be old and deteriorating, adequate assessments were not made to determine the consequences to mission(s) should equipment fail. Even though there were institutional maintenance standards, they were guidance and were not required to be implemented by line management. As a result, a freeze protection plan was not implemented. A complete approach to maintenance by the Laboratory is needed that emphasizes implementation of requirements and procedures, individual and line responsibility and accountability, effective training, and through oversight and feedback to management.

To prevent recurrence, line management must learn from previous incidents. Although information concerning other freeze protection incidents was known by the laboratory, they did not ensure that the applicable lessons Learned were implemented institutionally.

- **CASUAL FACTORS**

The direct cause of the incident was the improper setting of the reservoir setpoint temperature, which caused the dampers to remain open during subfreezing temperatures.

The root causes were: (1) failure by LANL to implement an effective institutional lessons learned program, (2) failure by LANL to ensure the facility management organization was knowledgeable of the operations of the mechanical systems, (3) failure by LANL to ensure the roles and responsibilities of the facility management organizations were clear and understood, (4) failure by LANL to establish maintenance requirements, and (5) failure by LANL, to provide oversight of facility management maintenance activities.

The contributing causes were: (1) maintenance categorization of equipment was incorrect, (2) maintenance was not conducted more frequently based on established criteria, (3) legacy design features were not reevaluated after the facilities and mission changed, (4) failure by US Department of Energy/ Albuquerque (DOE/ AL) and the Los Alamos Area Office (LAAO) to provide oversight of the FM maintenance activities, and (5) radiological source control was not completely developed and implemented.

Requirements for freeze protection are derived from DOE G 433.1-1, Section 4.18.3.2 *Cold Weather Preparation*.

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## 8.0 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.

### 8.1 Operations Recommendations

8.1.1 The average number of days in which the temperature drops below freezing in Los Alamos is 208 days (Data derived from Los Alamos Climatology, LA-11735-MS). Anticipating freeze conditions and protecting buildings, equipment and grounds against freeze damage is a vital part of a Facility Maintenance Program. Good practices in freeze protection are:

- Develop a checklist for each applicable facility, complete with signature blocks for the responsible person performing the inspection and for the responsible manager to review and ensure that deficiencies have been corrected.
- Perform a root cause investigation of all freeze damage incidents, utilize the results to improve the freeze protection plans program, and forward the results to the institutional lessons learned program.
- The plans should target full utilization of engineering controls such as; equipment surveillance system alarms, antifreeze, heat tracing, vacuum breakers, freeze stats and fluid temperature sensing valves.
- Perform an annual review of the facilities to document facility additions and modifications, and add appropriate measures in the freeze protection plans to protect the new equipment or structures.
- Steam systems must be designed, installed, and maintained correctly to prevent freezing occurrences. Consider having a competent steam system specialist evaluate the systems periodically and ensure that recommended modifications are installed correctly, that procedural changes are implemented, and that the maintenance staff is properly trained.

### 8.1.2 Cold Weather Programs for Fire Protection Systems

#### **8.1.2.1 Provide the following inspections to Fire Protection Systems.**

- Maintain extra building heat during periods of extreme cold, especially during idle periods, to keep sprinkler piping from freezing. Check the heating system to ensure that it is delivering sufficient heat to all areas, particularly at night.
- Search for isolated drafts or air leaks, particularly in infrequently visited areas and in spaces where sprinkler pipes are installed. Look specifically for places where cold air could enter and eliminate even small openings. Keep all doors, especially large shipping doors, tightly closed.

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- After a prolonged period of abnormally cold weather, perform drain tests of sprinkler risers wherever possible to determine if underground mains are frozen. Open the drain wide, let it run for 30 seconds or more, then shut it off. If the pressure fails to return to normal promptly clear the mains of ice as soon as possible.

*Basis:* DOE/ EH-0213 *Cold Weather Protection*, October 1991, Office of Environment, Safety and Health, Bulletin 91-4.

### **8.1.3 Cold Weather Programs Related to Hazardous Materials**

#### **8.1.3.1 Perform the following inspections for Hazardous Materials.**

- Ensure that all containers used for hazardous or toxic materials are properly stored, and inspect them for deterioration prior to handling. If containers become brittle (due to combination of chemical attack, freezing temperatures, and ultraviolet light) they may break when moved.
- Liquids should not be permitted to remain in unheated process lines during periods when production has been stopped. All lines should be drained and purged to prevent future line breakage due to freezing temperatures.
- Ensure that piping and valves (particularly check valves and dump valves) in systems that carry hazardous or toxic substances are properly insulated. Install insulators such as heat blankets, heat tape, or frost boxes, as appropriate.
- Inspect all anti-freeze loop valves to ensure that they are in the open position. Chain and lock them in the open position if possible.

*Basis:* DOE/ EH-0213 *Cold Weather Protection*, October 1991, Office of Environment, Safety and Health, Bulletin 91-4.

## **8.2 Maintenance Recommendations**

### **8.2.1 General Guidelines**

- 8.2.1.1 During Extreme Temperature Excursions perform a walk down inside heated buildings of components located in out of the way areas like closets, stairwells, attics, and vestibules, or located very close to exterior walls and determine the temperature using a laser aimed temperature measuring device for equipment and materials.

*Basis:* Extended periods of severe cold weather temperatures can exceed capabilities of normal Cold Weather Protection Programs. Lessons Learned Database, *Freeze Protection During Extreme Weather Excursions*, Identifier: 1996-RL-WHC-0026.

- 8.2.1.2 When performing work in the vicinity of heat tracing tape, one should look for damaged insulation on all exposed portions of the cord. If possible, check both ends of the cord for loose connections. Ensure the heat tracing is protected by a GFEP.

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*Basis:* An exposed conductor may come in contact with maintenance personnel during maintenance activities resulting in sparks or injury. Lessons Learned Database, *Personnel Contact with Energized Heat Tracing*, Identifier: Y-1996-OR-LIMESPAN-0101.

8.2.1.3 Verify that deficiencies identified during the previous cold weather season have been corrected and that modifications to correct or enhance freeze protection capabilities are appropriately prioritized and scheduled before the beginning of the cold weather season.

*Basis:* Lessons Learned Database, Operating Experience Weekly Summary 98-34, *Freeze Protection Reminder*. Lessons Learned Database, Operating Experience Weekly Summary 2000-03, *Freeze Protection Problems Cause Damage and Loss of Fire Protection*.

8.2.1.4 Inspect, remove debris, and patch/ repair (if needed): roof drains, scuppers, canales, gutters, and down spouts before the first frost. Also, remove from roofs any items that could impede the normal flow of water or ice.

*Basis:* DOE G 433.1-1 4.18.3.2 *Cold Weather Preparations*

8.2.1.5 Provide Guidance for planning and decommissioning activities to manage the risks posed to the facility from freeze damage in partially unoccupied or unoccupied buildings by the following measures:

- Conduct weekly walk downs in unoccupied parts of the building
- Conduct daily walk downs during frigid temperatures

*Basis:* Lessons Learned Database, Operating Experience Weekly Summary 95-50, *Fire Protection Sprinkler Line Freeze* DOE/ EM-014P, *Decommissioning Handbook*.

8.2.1.6 Provided it has been approved by MSS-MP, for fire protection systems, particularly those wet pipe systems exposed to cold temperatures, craftsman should comply with Preventive Maintenance Instruction (PMI) 40-35-092, Wet Automatic Sprinkler Systems Annual Inspection and Testing.

*Basis:* Anticipating Freeze conditions and protecting buildings, equipment, and grounds is a vital part of a Facility Maintenance Program.

## 9.0 GUIDANCE

### 9.1 Operations Guidance

None

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## 9.2 Maintenance Guidance

### 9.2.1 *Anti-Freeze Sprinkler System Inspection and Testing*

Provided it has been reviewed by MSS-MP, an acceptable maintenance program that covers those fire suppression systems which are protected with anti-freeze similar to PMI 40-35-092, *Wet Automatic Sprinkler Systems Annual Inspection and Testing*, may be used.

### 9.2.2 *Dry Sprinkler System Inspection and Testing*

Provided it has been reviewed by MSS-MP, an acceptable program that covers dry sprinkler systems similar to PMI 40-35-062, *Dry Sprinkler System Three-Year Inspection and Testing*, may be used. This only covers draining low points after testing, but does not address freeze protection of flooded parts of the system.

### 9.2.3 *Water Treatment Program*

Provided it has been reviewed by MSS-MP, an acceptable program that covers the freeze protection of Cooling Water Evaporators (CWE) and Condenser Refrigerated Evaporators (CRE) similar to PMI 44-40-004, *Cooling Unit Maintenance & Water Treatment Manual*, may be used.

**NOTE:** Freeze protection for air wash systems and cooling towers is not addressed in this document.

### 9.2.4 *Steam Traps*

Provided it has been reviewed by MSS-MP, an acceptable program that tests steam traps similar to PMI 40-40-009, *Steam Trap Testing and Maintenance*, may be used. This only covers steam traps and does not check vacuum breakers or ensure that strainers are clean.

## 10.0 REQUIRED DOCUMENTATION

### 10.1 **Seasonal Facility Preservation Plan (SFPP)**

A SFPP will be prepared for each facility in accordance with the requirements set forth in this O&M Manual and AP-MNT-002, *Seasonal Facility Preservation*.

*Basis:* See Section 6.2.1 and AP-MNT-002, *Seasonal Facility Preservation*.

### 10.2 **Maintenance History**

Maintenance history information shall be maintained in accordance with the requirements set forth in AP-MNT-010, *Maintenance History*. The information should include the details of and results derived from the work performed to satisfy the Freeze Protection requirements set forth in the Facility's SFPP.

*Basis:* AP-MNT-010, *Maintenance History*.

## 11.0 REFERENCES

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

- 10.1 P315, *Conduct of Operations Manual*
- 10.2 P950, *Conduct of Maintenance*
- 10.3 DOE O 433.1A, *Maintenance Management Program for Nuclear Facilities*
- 10.4 DOE G 433.1-1 *Nuclear Facility Maintenance Management Program Guide for Use with DOE O 433.1*, Section 4.18.3.2 *Cold Weather Preparations*.
- 10.5 AP-341-502, *Management Level Determination*
- 10.6 AP-MNT-002, *Seasonal Facility Preservation*
- 10.7 AP-Work-001, *Work Initiation, Screening, and Acceptance*
- 10.8 NFPA 70 National Electric Code 2008.
- 10.9 Type B Accident Investigation Board Report, *Chiller Line Rupture at TA-35, Building 27*, Los Alamos National Laboratory, Final Report dated February 1998.
- 10.10 Los Alamos Climatology, LA-11735-MS.
- 10.11 PMI Number 40-35-092, *Wet Automatic Sprinkler Systems Annual Inspection and Testing*.
- 10.12 DOE/ EH-0213 *Cold Weather Protection*, October 1991, Office of Environment, Safety and Health, Bulletin 91-4.
- 10.13 Lessons Learned I.D. 1996-RL-WHC-0026: *Freeze Protection During Extreme Weather Excursions*.
- 10.14 Lessons Learned I.D. Y-1996-OR-LIMESPAN-0101: *Personnel Contact with Energized Heat Tracing*.
- 10.15 Lessons Learned Operating Experience Weekly Summary 98-34: *Freeze Protection Reminder*.
- 10.16 Lessons Learned Operating Experience Weekly Summary 95-50: *Fire Protection Sprinkler Line Freeze*
- 10.17 DOE/ EM-014P, *Decommissioning Handbook*.
- 10.18 PMI Number 40-35-062, Rev. 1, *Dry Sprinkler Systems Three-Year Inspection and Testing*.
- 10.19 PMI Number 44-40-004, Rev. 5, *Cooling Unit Maintenance & Water Treatment Manual*.
- 10.20 PMI Number 40-40-009, *Steam Trap Testing and Maintenance*
- 10.21 AP-MNT-010, *Maintenance History*.

## 12.0 APPENDICES

None