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CONDUCT OF MAINTENANCE (P950)

OPERATIONS AND MAINTENANCE MANUAL

OPERATIONS & MAINTENANCE CRITERION

TITLE: CROSS-CONNECTION CONTROL FOR POTABLE WATER SYSTEMS

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RECORD OF REVISIONS

Revision No.	Date	Description
0	08/ 27/ 98	Initial Issue
1	09/ 06/ 01	Includes the addition of a Table of Contents, the use of Basis Statements in Section 6 and 7; further clarification based on the new criterion 101 Writer's Guide as well as the incorporation of Occurrence Reporting Processing System (ORPS) & Nuclear Regulatory Commission (NRC) lessons learned from 1/ 1/ 95 to 2/ 1/ 2000. This revision reflects the conversion from a WordPerfect document into a Microsoft Word document.
2	10/ 28/ 03	Qualification of certification and qualification of personnel performing backflow prevention device testing and repair. Additional definitions. Additions to Sections 1.0, 5.0, 7.0 and 8.0.
3	10/ 27/ 05	Updated Facility Maintenance Division Information
4	03/ 09/ 10	Updated Division information, and references.

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CRITERION 406

CROSS-CONNECTION CONTROL FOR POTABLE WATER SYSTEMS

1.0 PURPOSE

The purpose of this Criterion is to establish the minimum requirements and best practices for the operation and maintenance of backflow prevention assemblies and cross-connection control.

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

Cross-connection control and backflow prevention are mandatory requirements under the New Mexico Administrative Code, Title 20 Environmental Protection – 20.7.10 NMAC Wastewater and Water Supply Facilities – Drinking Water, 12/ 04/ 2002; and Sections 602 “Unlawful Connections” & 603 “Cross-Connection Control” of the Uniform Plumbing Code (UPC).

These regulations are designed to:

- Protect the potable water supply of LANL from the possibility of contamination or pollution by isolating within LANL’s internal distribution system(s) such contaminants or pollutants that could backflow, due to back pressure or back siphonage, into the potable water system.
- Promote the elimination or control of existing cross connections, actual or potential, between LANL’s in-plant potable water system(s), non-potable water systems, and plumbing fixtures.

2.0 SCOPE

The scope of this Criterion shall apply to the repair, replacement, and use or maintenance of plumbing systems of LANL facilities where potable or non-potable water systems are involved and are subject to compromise through cross connection. See Engineering Standards Manual PD342, Chapter 6, Section D20 for installation, modification, or alteration requirements. The LANL complex has over 1200 buildings with connections to the water distribution system. This criterion applies to all building plumbing systems and modifications, repairs and alterations to building plumbing systems. Landscape watering systems and outside hose bibs are part of building plumbing systems.

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3.0 ACRONYMS AND DEFINITIONS

3.1 Acronyms

AASE	American Association of Sanitary Engineers
AHJ	Authority Having Jurisdiction
AWWA	American Water Works Association
CFR	Code of Federal Regulations
DOE	US Department of Energy
IAPMO	International Association of Plumbing and Mechanical Officials
LANL	Los Alamos National Laboratory
LANS	Los Alamos National Security
MM	Maintenance Manager
MSS	Maintenance & Site Services Division
MSS-MP	Maintenance & Site Services – Maintenance Programs
NMAC	New Mexico Administrative Code
NRC	Nuclear Regulatory Commission
O&M	Operations and Maintenance
ORPS	Occurrence Reporting Processing System
PMI	Preventive Maintenance Instruction
POC	Point-of-Contact
PPE	Personal Protection Equipment
PP&PE	Personal Property and Programmatic Equipment
RP&IE	Real Property and Installed Equipment
RPP-BFP	Reduced Pressure Principle-Backflow Preventer
SAR	Safety Analysis Report
SSC	Structures, Systems, and Components
TSR	Technical Safety Requirement
UPC	Uniform Plumbing Code
USC/FCCC&HR	University of Southern California/ Foundation for Cross-Connection Control and Hydraulic Research

3.2 Definitions

Air-Gap Separation. A physical separation between the free flowing discharge and of a potable water supply pipeline and an open or non pressure receiving vessel. The air-gap shall be at least double the diameter of the supply pipe measured vertical above the top over flow rim of the vessel, in no case less than one inch.

Approved. The term "APPROVED" within these procedures refers to approval of a device by the authority having jurisdiction (AHJ) based on test data from the University of Southern California Foundation for Cross-Connection Control and

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Hydraulic Research (USC/ FCCC&HR).

Backflow Connection. Any arrangements whereby backflow can occur, including cross-connection, back siphons, pumping systems, etc.

Back Pressure. Backflow due to an elevation of pressure in the downstream piping system (by pump, elevation of piping, or steam and/ or air pressure) above the supply pressure at the point of consideration which would cause, or tend to cause, a reversal of the normal direction of flow.

Back-Siphonage. A form of backflow due to a reduction in system pressure which causes a sub-atmospheric pressure to exist at a site in the water system.

Backflow Prevention Assembly. Any effective assembly used to prevent backflow into a potable water system.

Contaminant. Any substance that could, if introduced into the potable water supply, cause death, illness, spread disease, or has a high probability of causing such effects. Also defined as “high hazard.”

Cross Connection. Any unprotected actual or potential connection between a potable water system used to supply water for drinking purposes and any source or system containing unapproved water or a substance that is not or cannot be approved as safe, wholesome and potable. Bypass arrangements, jumper connections, removable sections, swivel or changeover devices, or other devices through which backflow could occur, shall be considered to be cross connections.

Pollutant. Any substance that generally would not be a health hazard, but would constitute a nuisance, or be aesthetically objectionable, if introduced into the potable water supply. Also defined as “low hazard.”

Potable Water. Water, which is satisfactory for drinking, culinary, and domestic purpose and meets the federal and state regulatory requirements.

Reduced Pressure Principle-Backflow Preventer (RPPBFP). An approved device incorporating two or more check valves and an automatic differential relief valve located between the two check valves including operating shut off gate valve or ball valves on each side of the assembly and suitable test cocks for testing.

Vacuum Breaker. An approved non-pressure anti-siphon device located on the discharge side of the last control shut off valve. To prevent back siphoning or an approved pressure anti-siphon device used in a supply line to prevent back siphoning.

4.0 RESPONSIBILITIES

MSS-MP is 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.

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- 4.1 **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.
- 4.2 **MSS- Maintenance Programs (MP)**
Responsible for 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 **Facility Operations Director (FOD)**
Responsible for implementation of this O&M Criterion for identified systems/ equipment within their facility boundaries.
- 4.4 **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.
- 4.5 **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 Operations Manager at the conclusion of maintenance activities. The MM with concurrence of the FOD will prioritize implementation within budget allocations.
- 4.6 **Authority Having Jurisdiction (AHJ)**
The AHJ(Point of Contact for (Insert 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.

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.
- 5.1.1 **Backflow devices which have been de-listed by USC/ FCCC & HR can remain in service as long as the device satisfactorily passes the required annual testing and**

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spare parts are available.

5.1.2 Water should not be shut off to a building without notification to occupants.

5.2 Limitations

The intent of this Criterion is to identify the minimum requirements and recommendations for Structures, Systems, and Components (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 should implement the requirements of the United States Department of Energy (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.

6.0 REQUIREMENTS

6.1.1 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.

6.2 Operations Requirements

6.2.1 Ensure that there is no cross-connecting piping arrangement or connection by which an unsafe substance may enter the drinking water supply.

Basis: PD342, "LANL Engineering Standards Manual", Chapter 6 – Mechanical, Section D20 "Plumbing/ Piping/ Vessels", 2.0 "Cross-Connection Control" which invokes the UPC, International Association of Plumbing and Mechanical Officials (IAPMO)(Section 602).

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6.3 Maintenance Requirements

6.3.1 The replacement of the backflow prevention assemblies shall comply with the requirements of the UPC.

- A. The backflow prevention assembly shall be tested and/ or repaired by a certified backflow assembly technician at the time of installation, repair or relocation and at least on an annual schedule thereafter or more frequently as defined in the facility authorization basis.

NOTE: Training and certification by an American Society of Sanitary Engineers (ASSE) approved school will be recognized by the LANL AHJAs meeting the requirements for certified backflow preventer tester.

- B. New or repaired backflow prevention assemblies on potable water systems shall be disinfected, as per LANL Master Specification 22 0816 “*Disinfection of Potable Water Piping*”, prior to use and shall comply with the requirements of the UPC.

Basis: PD342, “*LANL Engineering Standards Manual*”, Chapter 6 Mechanical, Section D20 “Plumbing/ Piping/ Vessels”, 2.0 “Cross-Connection Control” which invokes the UPC IAPMO.

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

7.1.1 Potable water systems should be surveyed for cross-connections. Frequencies of surveys are generally based on risk to water supply from building operations. For example:

- Nuclear Chemistry Facilities - every two years
- Waste Treatment Facilities - every two years
- Transportable Office Buildings - every seven years

7.1.2 Connections or modifications to a building’s potable water system should be reviewed, permitted, and approved by the Engineering Manager.

7.2 Maintenance Recommendations

7.2.1 Craft should comply with the most recent version of Preventive Maintenance Instruction “(PMI 40-40-002, Backflow Prevention Assembly Inspection and Testing” procedure.

8.0 GUIDANCE

8.1 Operations Guidance

8.1.1 The AWWA Manual M14 “Recommended Practice for Backflow Prevention and Cross-Connection Control,” the “Uniform Plumbing Code”, Section 603 and the USC “Manual of Cross-Connection Control” (USC/ FCCC&HR) may be used as guides.

8.2 Installation Guidance

8.2.1 **Installation** -The installation of the backflow prevention assembly shall comply with the requirements of the UPC and PD 342 “LANL Engineering Standards Manual”. The type of backflow prevention device used shall be determined by the degree of hazard. Refer to PD342, “LANL Engineering Standards Manual”, Chapter 6 – Mechanical, Section D20 “Plumbing/ Piping/ Vessels”, 2.0 “Cross-Connection Control” for installation guidance.

8.3 Maintenance Guidance

8.3.1 The most recent version of Preventive Maintenance Instruction “(PMI) 40-40-002, “Backflow Prevention Assembly Inspection and Testing” procedure may be used to meet the assembly, inspection, and test requirements.

9.0 REQUIRED DOCUMENTATION

Maintenance history shall be maintained for the cross-connection program 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
Maintenance Activities				
Backflow Preventer Assembly Repair/Adjustments	X	X	X	X
PM: Backflow Preventer Assembly testing	X	X	X	X
Installation Assemblies	X	X	X	X
Inspection Results				
Survey/Inspection Date	X	X	X	X
Master Equipment List	X	X	X	X

Basis: Documentation of the parameters listed in Table 9-1 above satisfies the requirements of AP-MNT-010, “Maintenance History”, which states; “A maintenance history and trending program will be maintained to document data, provide historical information and support maintenance and performance analysis and trending of facility SSCs.”

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10.0 REFERENCES

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

- 10.1 LANL Operation 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 LANS Contract
- 10.3 DOE Order 433.1A, Maintenance Management Program for DOE Nuclear Facilities
- 10.4 PD311, “Requirements System Hierarchy”
- 10.5 AP-MNT-010. “Maintenance History”, Revision 4
- 10.6 American Water Works Association (AWWA) Manual M14, Recommended Practice for Backflow Prevention and Cross-Connection Control, 2004
- 10.7 New Mexico Administrative Code, Title 20 Environmental Protection – 20.7.10 NMAC, Wastewater and Water Supply Facilities – Drinking Water. 12/ 04/ 2002
- 10.8 Procedure PMI 40-40-002, Backflow Prevention Assembly Inspection and Testing” .
- 10.9 Uniform Plumbing Code (UPC), 2006
- 10.10 University of Southern California/ Foundation for Cross-Connection Control and Hydraulic Research (USC/ FCCC & HR) “Manual of Cross-Connection Control”, Ninth Edition
- 10.11 PD342, “LANL Engineering Standards Manual”, Chapter 6 “Mechanical”, Section D20, “Plumbing/ Piping/ Vessels”, 2.0 “Cross-Connection Control”, Rev. 4, 9/ 29/ 09
- 10.12 LANL Master Specification 22-0816, “Disinfection of Potable Water Piping”, Revision 2, August 13, 2009

11.0 APPENDICES

None