CRITERION 405

WATER HEATERS

SIGNATURES

Joe D. Gonzales Criterion Author	4-10-06 Date	FM-MSE Group	667-8380 Phone Number
Todd Siverling Maintenance Programs	4·11·06 Date	FM-MSE Group	667-3360 Phone Number
Don Shoemaker FM-MSE Group Leader	4/11/06 Date	FM-MSE Group	667-4917 Phone Number
Andrew Erickson FM Acting Division Leader	4/12/06 Date	FMD Group	667-6131 Phone Number

RECORD OF REVISIONS

Revision No.	Date	Description
0	09/10/98	Initial Issue. (Replaces 3.6-350 Rev. 0)
1	04/15/99	This revision reflects the conversion from a WordPerfect document into a Microsoft Word document.
2	01/08/02	This revision 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 ORPS & NRC lessons learned from 1/1/95 to 2/1/2000. This revision also incorporates the comments and rewording requested by the FMC Maintenance Subcommittee.
	7/9/02	Editorial Correction Section 7.2.2
	8/6/02	Editorial changes: • Addition of PMI number in Section 8.2.1 • Addition of Reference 10.13
3	04/03/06	This revision includes: • Update Facility Maintenance Division and FM-MSE Group information • Update Air Quality Group Information • Remove LIRs that have been rescinded or cancelled

TABLE OF CONTENTS

1.0 PURPOSE 1
2.0 SCOPE 1
3.0 ACRONYMS AND DEFINITIONS 1
3.1 Acronyms 1
3.2 Definitions 2
4.0 RESPONSIBILITIES 3
4.1 FM-MSE Maintenance Support and Engineering 3
4.2 Maintenance Manager 3
4.3 Group Leader 3
4.4 ENV-MAQ Air Quality 4
5.0 PRECAUTIONS AND LIMITATIONS 4
5.1 Precautions 4
5.2 LIMITATIONS 4
6.0 REQUIREMENTS 5
6.1 Operations Requirements 5
6.2 Maintenance Requirements 5
7.0 RECOMMENDations AND GOOD PRACTICES 5
7.1 Operations Recommendations 5
7.2 Maintenance Recommendations 5
8.0 Guidance 7
8.1 Operations Guidance 7
8.2 Maintenance Guidance 7
9.0 required documentation 8
10.0 REFERENCES 8
11.0 APPENDICES 9

CRITERION 405

WATER HEATERS

1.0 PURPOSE

The purpose of this Criterion is to establish the minimum requirements and best practices for operation and maintenance of water heaters at LANL.

This document addresses the requirements of LIR 230-05-01(Ref 10.1), "Operations and Maintenance Manual."

Implementation of the Criterion satisfies DOE Order 430.1B (Ref 10.2) for the subject equipment and system. It also satisfies DOE Order 430.1B (Ref 10.2) "Real Property Asset Management," Attachment 2 "Contractor Requirements Document," Section 5, "The contractor must maintain real property assets in a manner that promotes operational safety, worker health, environmental compliance, property preservation and cost-effectiveness while meeting the program missions."

2.0 SCOPE

The scope of this Criterion includes the routine inspection, testing, preventive and predictive maintenance of gas and electric water heaters. This Criterion does not address corrective maintenance actions required to repair or replace equipment.

3.0 ACRONYMS AND DEFINITIONS

3.1 Acronyms

AR	Administrative Requirements
BWS	Boiler, Water Supply
CFR	Code of Federal Regulations
CPSC	Consumer Product Safety Commission
DOE	Department of Energy
HWE	Heater, Water, Electric
HWG	Heater, Water, Gas
LIG	Laboratory Implementing Guidance
LIR	Laboratory Implementing Requirement
LPR	Laboratory Performance Requirement

MEL	Master Equipment List
NBIC	National Board Inspection Code
O&M	Operations and Maintenance
PPE	Personal Protective Equipment
PP&PE	Personal Property and Programmatic Equipment
RP&IE	Real Property and Installed Equipment
SSC	Structures, Systems, and Components
SSS	Support Services Subcontractor
UC	University of California
UL	Underwriters Laboratory

3.2 Definitions

Burner. A device for the final conveyance of a mixture of fuel and air to the combustion zone. (Reference 10.7)

Controls. Devices designated to regulate the fuel, air or electrical supply to a gas appliance. These devices include a shut-off valve, gas regulator and control valve between the burner and the source of gas. (Reference 10.7)

Draft Hood. A nonadjustable device built into an appliance, or made part of the vent connector from an appliance that is designed to (1) provide for the ready escape of the flue gases from the appliance in the event of no draft, backdraft, or stoppage beyond the draft hood, (2) prevent a backdraft from entering the appliance, and (3) neutralize the effect of stack action of the chimney or gas vent during the operation of the appliance. (Reference 10.7)

Pilot. A small flame that is utilized to ignite the fuel at the burner. (Reference 10.7)

Temperature-Pressure Safety Relief Valve (T&P). A temperature and pressure safety relief valve is a pressure relieving device used on hot water heaters, which also incorporates a thermal sensing relief element, which is actuated by up stream water temperature. It is set at 210 degrees F or lower. (Reference 10.10, 10.12)

Venting System. A continuous open passageway from the draft hood of a gas-burning appliance to the outside atmosphere for the purpose of removing flue or vent gases. (Reference 10.7)

Water Heater. An appliance for supplying hot water for domestic or commercial purposes other than for space heating. (Reference 10.7) These units are designated as BWSs, HWGs and HWEs at LANL. **Note:** The ordinary domestic-type hot water heater directly fired with oil, gas or electricity may be classified as a hot water supply boiler, depending on the state. LANL uses the BWS classification on some of its bigger water heaters. It becomes a hot water supply boiler if any of the following is exceeded: (1) heat input over 200/000 BTU/hr, (2) water temperature over 200°F, and (3) nominal water-containing capacity of 120 gallons. (Reference 10.9) Most of the BWSs at LANL are of the latter classification.

4.0 RESPONSIBILITIES

4.1 FM-MSE Maintenance Support and Engineering

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

4.1.2 FM-MSE shall provide technical assistance to support implementation of this Criterion.

4.2 Maintenance Manager (MM)

4.2.1 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.

4.2.2 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 MM in accordance with the RDL-specific Customer Service Agreement.

4.3 Group Leader

4.3.1 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.

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

4.4 ENV-MAQ Air Quality

4.4.1 Responsible for air quality compliance and ambient air monitoring. For gas water heater replacements or upgrades, the state of New Mexico stipulates Air Quality Requirements for activities that increase air emissions. As a result, it is necessary to contact ENV-MAQ to ensure compliance with state regulations and the Air Quality LIR 404-10-01 (Ref. 10.6) if a gas water heater(s) upgrade or replacement is planned.

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 Ensure that the area around gas fired water heaters are free of all combustible materials.

Note: Do not use water heater closets as storage areas. Do not block the combustion air inlet(s).

5.1.2 Hot water at temperatures desired for automatic dishwasher and laundry use can cause painful scalding with possible serious and permanent injury. Temperature at which injury occurs varies with the person's age and the length of exposure. The slower response time of children, aged or handicapped persons, increases the hazard to them. It is recommended that lower water temperatures be used where possibility of exposure such as the above may exist. The CONSUMER PRODUCT SAFETY COMMISSION recommends hot water temperatures be set at 130^{o} F for general use.

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 433.1 (Ref. 10.3) 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 CFR identified above.

6.0 REQUIREMENTS

Minimum requirements that Criterion users shall follow are specified in this section. 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.

6.1 Operations Requirements

6.1.1 No requirements beyond those stated in Section 5.2, Limitations.

6.2 Maintenance Requirements

6.2.1 No implementing maintenance requirements available.

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 Maintain positive air pressure in the room where gas-fired water heaters are in operation.

Basis: This will prevent the possibility of "spillage" of flue gases in the building, through the draft hood, causing an unsafe condition.

7.2 Maintenance Recommendations

7.2.1 Maintenance of gas-fired water heaters should only be performed by personnel holding a current New Mexico gas license.

Basis: Personnel safety due to risk of explosion and fire.

7.2.2 The following preventative maintenance activity should be performed once a year on all water heaters.

- Operational test of temperature and pressure safety relief valve. Manually open the valve by lifting up on the handle. Water should flow freely from the valve when this is done and should shut off completely when released. The valve should operate freely. Replace valve if it does not seal properly.

Basis: *The above maintenance recommendation is based on a personnel safety issue, the NBIC and recommendations from various manufacture's operations and maintenance manuals. The NBIC (Section RB-3500) (Ref. 10.11) states that periodic inspection and maintenance of these important safety devices is critical to ensure their continued functioning and to provide assurance that they will be available when called upon to operate. In January 19, 1982, in Spencer, Oklahoma, an explosion that killed six children and a teacher in an elementary school cafeteria was caused by a water heater that malfunctioned. The explosion was caused by the over heating of an eighty-five gallon gas water heater that was equipped with an inoperable Temperature & Pressure Safety Relief Valve. A video, "Portrait of A Disaster," is available for viewing. Call 7-8380.*

- Observe the general condition of unit. Inspect the main burner and pilot assembly. Clean if necessary.

- Fire and cycle unit. The burner should start smoothly without unusual noises. Observe condition of flame. Adjust if necessary.

- Test for spillage at the draft hood relief opening after five minutes of main burner operation. Use the flame of a match or candle.

- Inspect the venting system. Look for obstructions or deterioration.

- Inspect the fuel supply system and gas control equipment. Leak check the gas controls and associated gas piping with a gas detector or bubble test.

- Check combustion air supply openings to ensure that they are not closed or stopped up.

Basis: *The above maintenance recommendations are based on NFPA 54 (Ref. 10.7) (National Fuel Gas Code, Appendix B.3 & H) and recommendations from various manufacturer's operations and maintenance manuals. Yearly attention to gas and electric water heaters helps ensure safe, efficient and reliable operation.*

Note: *Electric water heater maintenance consists of checking circuitry and controls, draining the tank (after turning off the electrical supply to heater) and removing scale from the heating element, which restricts heat transfer. Procedures for draining the tank are listed below.*

- It is also recommended to drain the water heater to remove lime or scale deposits through a garden hose attached to the drain valve. Prior to this shut off gas or electrical supply and cold water supply to the water heater. Open the drain valve on the tank and a hot water faucet. Allow tank to drain until tank is empty. When refilling tank, turn on water slowly and allow it to run out of the open hot water faucet, keeping the hot water faucet open until it is running smoothly and is free of entrapped air. Turn on electrical supply or gas to water heater and relight pilot.

Basis: *If these sediments are not removed, a resulting rumbling and boiling noise will be heard. If lime or scale is allowed to accumulate excessively it can cause tank failure due to restricted heat transfer.*

8.0 GUIDANCE

8.1 Operations Guidance

8.1.1 No implementing guidance available.

8.2 Maintenance Guidance

8.2.1 Provided it has been reviewed and approved by FM-MSE, an acceptable program for gas and electric water heater inspection may be found in the SSS preventative maintenance instruction (PMI) 40-40-018, Inspection of Gas/Electric Water Heaters. (Ref.10.13)

9.0 REQUIRED DOCUMENTATION

Maintenance history shall be maintained for gas/electric water heaters 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**
Manufacturer's Name Plate Data	**X**	**X**	**X**	**X**
Maintenance Activities				
Repair / Adjustments	**X**	**X**	**X**	**X**
PM Activities	**X**	**X**	**X**	**X**
Replacement (includes dates)	**X**	**X**	**X**	**X**
Equipment Problems				
Failure Dates	**X**	**X**	**X**	
Failure Root Cause	**X**	**X**	**X**	
Inspection Results				
Inspection Date(s)	**X**	**X**	**X**	**X**
SSC Condition	**X**	**X**	**X**	
Test temperature-pressure safety relief valve	**X**	**X**	**X**	

Basis: Documentation of the parameters listed in Table 9-1 above satisfies the requirements of AP-MNT-010, Maintenance Equipment List and Maintenance History (Ref. 10.4).

10.0 REFERENCES

10.1 LIR 230-05-01.0, Operation and Maintenance Manual.

10.2 DOE O 430.1B, Real Property Asset Management.

10.3 DOE Order 433.1, Maintenance Management Program for DOE Nuclear Facilities, Sections 4.e and 5.b.

10.4 AP-MNT-010, Maintenance Equipment List and Maintenance History.

10.5 LIR 404-10-01.1, Air Quality Review.

10.6 NFPA 54, National Fuel Gas Code, 1999 (A work smart standard).

10.7 Various Manufacturer's Operation and Maintenance Manuals. Example: State Commercial Gas Water Heaters, OMSBGTT 5-85, Commercial Instruction Manual for Gas Water Heaters, OM0291268-02 & OM0290929-01 (no dates available), Dayton, Installation Instructions & Operating Manual for Electric Water Heaters, OM6510041, June 1988, and others.

10.8 Standard Heating and Power Boiler Plant Questions & Answers, Elonka & Kohan, 1984.

10.9 ANSI Z21.22-1999, (Relief Values for hot water supply systems).

10.10 National Board Inspection Code, 1998.

10.11 ASME Section VI. (Recommended Rules for the Care and Operation of Heating Boilers), 1998.

10.12 PMI 40-40-018, "Water Heater Inspection and Maintenance"

11.0 APPENDICES

None.