1. INTRODUCTION

1.1 Purpose

This procedure provides instructions for performing leak testing (LT) examinations on the Fort St. Vrain (FSV) Fuel Storage Container (FSC) lid seals, Standby Storage Well (SSW) lid seals and the Three Mile Island (TMI-2) Dry Shielded Canister (DSC) filter housing seals to verify conformance to specified requirements.

1.2 Scope and Applicability

This procedure provides instructions for performing LT using the Gas Pressure Rise Test. This test involves evacuating the test cavity and measuring a pressure rise during a specified test period. This is not applicable for American Society of Mechanical Engineers (ASME) Section XI examinations.

NOTE: *This procedure has been demonstrated in accordance with management control procedure (MCP)-195, "NDE Equipment and Procedure Qualification," and documented in a Procedure Qualification Report (PQR) LT-29.*

Test methods conform to procedures described in ASME BPV Code 2001 Edition Section V Article 10 and American National Standards Institute (ANSI) N14.5-97 for pressure change vacuum rate of rise testing.

2. PRECAUTIONS AND LIMITATIONS

2.1 This method must not be used for the actual location of leak sites; it is intended to provide a measure of containment integrity.

NOTE: *Test sensitivity for this procedure is between the range of* 1×10^{-2} *to* 1×10^{-5} *std cc/sec leakage rate.*

2.2 Leakage rate must be calculated with a starting test pressure of less than 760 milli-Torr.

2.3 This procedure only provides hazard identification and mitigation associated with the performance of pressure rate of rise LT examination. The work controlling document for the task in which this procedure is referenced must identify and mitigate specific hazards associated with the work site.

2.4 A ground fault circuit interrupter (GFCI) must be used in accordance with program requirements document (PRD)-5099, "Electrical Safety," as follows:

A. When electrical equipment greater than 50 volts (that is, 110 volts AC power) is used outdoors

B. At construction sites

C. With temporary wiring, or in wet or damp areas.

2.5 Power and equipment cords must be visually inspected before use and replaced if found to be damaged.

2.6 General ergonomics guidelines must be followed when performing LT examinations (examples of this are proper body positioning, and periodic work breaks).

2.7 For LT operations, a 50 pound, or one-third of body weight, lifting limit must be followed for a single-person lift (See MCP-2692, "Ergonomics Program.")

2.8 Walking or working surfaces and tripping hazards (for example, icy or snow-covered surfaces) must be identified and mitigated. Examples of acceptable mitigation are wearing proper shoes or boots, clearing the area of ice or snow, or applying material such as sand to prevent slipping.

2.9 Vacuum grease must NOT be used on Leak Test Equipment.

3. PREREQUISITES

3.1 Planning and Coordination

3.1.1 The requesting organization must ensure the preparation of work/inspection instruction, which specifies the volume and acceptance criteria to be used for the examination.

3.1.2 The terms used in this procedure and this method must conform to ASME Section V, Article 10 and ANSI N14.5-97.

3.1.3 LT examinations must be performed within the provisions of this procedure using techniques, material, or equipment approved for use as specified in MCP-195, "NDE Equipment and Procedure Qualification."

3.1.4 The work or inspection planning or referencing work procedure for LT must include the following:

A. Specify use of this LT procedure and identify the applicable appendix

B. Extent of LT

C. Acceptable test sensitivity or leakage rate must include single and/or multiple leak specification where applicable unless identified by the referenced Appendix

D. Report requirements

E. Retention of records.

3.2 Personnel performing this procedure must have the following safety training:

A. General Ergonomics Awareness Training (00TRN1017)

B. ICP Personal Protective Equipment (00ICP288).

3.3 Personnel assigned to perform LT examinations must be certified in accordance with MCP-535, "NDE Personnel Certification," in appropriate methods and to qualification levels as follows:

3.3.1 Acceptable qualification methods/codes must include ONE of the following:

A. Leak Testing Level II (QCLT0001)

B. Leak Test Pressure Change Limited Level I or II (QCLTPC01 or QCLTPC02)

C. Equivalent qualifications.

3.3.2 Personnel performing LT evaluations and acceptance must be certified as Level II or III.

3.3.3 Level I personnel must only be used to evaluate, report and accept results if permitted in the specific appendix identified for performing testing.

3.3.4 Personnel performing set-up, calibration and operation of LT equipment/systems, must be certified as Level I, II or III.

3.3.5 Trainee personnel must only be used to assist in LT operations when directly supervised by certified personnel.

4. INSTRUCTIONS

4.1 LT Examiner: Perform the examination using the general requirements of this section, specific testing method application appendix and specific acceptance criteria identified in the associated work/inspection planning.

4.2 LT Examiner: Ensure technique, material, or equipment has been qualified in accordance with MCP-195.

4.3 LT Examiner: Document the results of the LT on Form 414.A81, "Pressure Change Leak Test Report."

4.4 LT Examiner: Seal all openings using plugs, covers, sealing wax, or other suitable material that can be readily and completely removed after completion of the test.

4.5 LT Examiner: Test temperature (temperature of item being tested) must be above 32°F and below 112°F.

4.6 LT Examiner: Perform the visual examinations used in LT in accordance with the accessibility and lighting requirements of technical procedure (TPR)-4981, "Visual Examination."

4.7 LT Examiner: Ensure the equipment is set up as follows:

4.7.1 Ensure gages used are capable of indicating vacuum pressure in milli-Torr from 100 to atmospheric pressure.

4.7.2 Ensure gages used are connected to the component, with the pressure indicator readily visible to the examiner.

NOTE: *It is preferred the vacuum pump be capable of vacuum pressures in the range of 100 milli-Torr to allow for drift after isolating the test volume and starting the timed test period.*

4.7.3 Ensure vacuum pumps or other vacuum apparatus are capable of evacuating the test volume to 760 milli-Torr or a milli-Torr less than 760 as specified by the applicable appendix.

4.7.4 Ensure the test apparatus is equipped with a means of isolating the test volume during the test time and of venting to atmosphere the system between the isolation point and the vacuum source during the test period.

4.8 LT Examiner: Ensure equipment is calibrated as follows:

4.8.1 Ensure all vacuum gages used provide results accurate to within 1% of full scale and are recalibrated at any time there is reason to believe they are in error.

4.8.2 Ensure all temperature measuring devices are calibrated in accordance with MCP-2391, "Control of Measuring and Test Equipment."

5. RECORDS

Form 414.A81, "Pressure Change Leak Test Report"

NOTE: *MCP-557, "Records Management," the INL Records Schedule Matrix, and associated NRC record types list provide current information on the storage, turnover, and retention requirements for these records.*

6. REFERENCES

Form 414.A81, "Pressure Change Leak Test Report"

MCP-195, "NDE Procedure and Equipment Qualification"

MCP-535, "NDE Personnel Certification"

MCP-557, "Records Management"

MCP-2391, "Control of Measuring and Test Equipment"

MCP-2692, "Ergonomics Program"

PRD-5099, "Electrical Safety"

TPR-4981, "Visual Examination"

TPR-5598, '' FSV ISFSI Storage Well O-Ring Leak Test"

TPR-5604, "FSV ISFSI Fuel Storage Container O-Ring Vacuum Leak Test"

TPR-7066, "Periodic HSM Monitoring, DSC Sampling, and Filter Housing Leak Tests"

7. APPENDIXES

Appendix A, TMI-2 Dry Shielded Canister Purge/Vent Filter Housing Seal Leak Test.

Appendix B, FSV ISFSI FSC Leak Testing

Appendix C, Leak Detection Equipment Assembly and Bill of Materials

Appendix D, Procedure Basis

Appendix A

TMI-2 Dry Shielded Canister Purge/Vent Filter Housing Seal Leak Test

This appendix describes the LT method for determining the leak integrity of the TMI-2 Dry Shielded Canister (DSC) Purge/Vent Filter Housing seals. The LT is a pressure change LT that measures the change in vacuum pressure between two seals.

This procedure appendix has been demonstrated in accordance with MCP-195, "NDE Procedure and Equipment Qualification," and documented in a Procedure Qualification Report (PQR).

Level I LT personnel are permitted to perform evaluations, reporting and acceptance when using this appendix.

If at any time LT personnel suspect excessive leakage of leak test equipment seals or connections the procedure can be terminated, LT personnel may check all connections and then restart the procedure.

The acceptable leakage rate must not exceed $1x10^{-2}$ std cc/sec.

Appendix C shows the Leak Test Equipment Assembly and bill of materials

1. SYSTEM LEAK TEST

1.1. Perform the valve line-up below.

V-1 Test System Isolation Valve	V-2 Reference Volume Isolation Valve	V-3 Vent Valve	V-4 Pump Isolation Valve
OPEN	OPEN	CLOSE	OPEN

1.2. Ensure that the test item is connected to the leak test equipment using a standard ¼-inch VCO to 1/8-inch NPT connector (facility supplied).

1.3. Evacuate system to approximately 100 milli-Torr.

1.4. Close the V-1 test system isolation valve.

1.5. Close the V-4 pump isolation valve.

1.6. Open the V-3 vent valve.

1.7. Allow the system to stabilize for approximately 30 seconds and then start the test by recording the current temperature as (T1) and current pressure as (P1) and begin timing the test. Record temperature in degrees Kelvin (Centigrade + 273) and pressure in milli-Torr.

T1 = _____ degrees Kelvin

P1= _____ milli-Torr

1.8. After 60 seconds record the current temperature as (T2) and current pressure as (P2).

T2 = _____ degrees Kelvin

P2= _____ milli-Torr

2. CALCULATE RESULTS

2.1. Calculate the Test System Leak Rate (Lr) on Form 414.A81, "Pressure Change Leak Test Report" using a Test Assembly Volume (V_T = 130 cc) and record the result below.

Lr = _____ cc/sec

Appendix B

FSV ISFSI FSC/SSW Leak Testing

This appendix describes the Leak Test (LT) method for determining the leak integrity of the Fort St. Vrain (FSV) Independent Spent Fuel Storage Installation (ISFSI) Fuel Storage Container (FSC) or Standby Storage Well (SSW) lid seals. The LT measures the change in vacuum pressure between two seals over a measured time period.

This Appendix has been demonstrated in accordance with MCP-195, "NDE Procedure and Equipment Qualification," and documented in a Procedure Qualification Report (PQR) LT-29.

A Level I LTE may perform evaluations, reporting and acceptance when using this Appendix.

If at any time LT personnel suspect excessive leakage of leak test equipment seals or connections the procedure can be terminated, LT personnel may check all connections and then restart the procedure. The acceptable leakage rate must not exceed $1x10^{-3}$ std cc/sec.

Appendix C shows the Leak Test Equipment flow diagram and bill of materials.

1. SYSTEM VOLUME TEST (with test blank installed on probe)

Configuration: The leak test equipment should be attached to the probe and the probe attached to the test blank.

1.1. Perform the valve line-up below and record pressure indicated as atmospheric pressure (P_{atm}).

All pressure values should be in milli-Torr.

Patm = _____ milli-Torr

V-1 Test System Isolation Valve	V-2 Reference Volume Isolation Valve	V-3 Vent Valve	V-4 Pump Isolation Valve
OPEN	OPEN	OPEN	CLOSED

1.2. Perform the valve line-up below;

V-1 Test System Isolation Valve	V-2 Reference Volume Isolation Valve	V-3 Vent Valve	V-4 Pump Isolation Valve
OPEN	OPEN	CLOSED	OPEN

1.3. IF NOT already done,
THEN connect the Leak Test Equipment to the probe with test blank installed.

1.4. Evacuate system to approximately 100 milli-Torr.

1.5. Close the V-1 test system isolation valve.

1.6. Close the V-4 pump isolation valve.

1.7. Open the V-3 vent valve.

1.8. Close the V-2 reference volume (Vref) isolation valve.

1.9. Record the pressure reading as Pressure of the Test Volume (PTV) just prior to opening V-1.

PTV = _____milli-Torr

1.10. Open the V-1 test system isolation valve (allows the test and reference volume pressures to equalize).

1.11. As soon as the pressure indicator stabilizes, record the pressure reading as the Mixed Pressure (PMIX) of the test and reference volumes.

(If the pressure indicator does not stabilize then there is an apparent gross leak, check system and restart at Step 1.)

PMIX = _____milli-Torr

1.12. Calculate the Volume of the Test Volume (VTV) using the following formula:

Vref = 12cc

$VTV = V_{ref} * [(P_{atm} – PMIX) / (PMIX – PTV)]$

VTV = _____ * [(_____ – _____) / (_____ – _____)]

VTV = _____ cc

2. SYSTEM VOLUME TEST (with probe attached to FSC or SSW)

Configuration: The leak test equipment should be attached to the probe and the probe attached either to the FSC or SSW.

2.1. Perform the valve line-up below and record pressure indicated as atmospheric pressure (P_{atm}).

All pressure values should be in milli-Torr.

Patm = _____ milli-Torr

V-1 Test System Isolation Valve	V-2 Reference Volume Isolation Valve	V-3 Vent Valve	V-4 Pump Isolation Valve
OPEN	OPEN	OPEN	CLOSED

2.2. Perform the valve line-up below;

V-1 Test System Isolation Valve	V-2 Reference Volume Isolation Valve	V-3 Vent Valve	V-4 Pump Isolation Valve
OPEN	OPEN	CLOSED	OPEN

2.3. IF NOT already done
THEN connect the Leak Test Equipment to the probe installed to the FSC or SSW and indicate below which configuration is used.

(___probe to FSC No.:____) (___probe to SSW No.:____)

2.4. Evacuate system to approximately 100 milli-Torr.

2.5. Close the V-1 test system isolation valve.

2.6. Close the V-4 pump isolation valve.

2.7. Open the V-3 vent valve.

2.8. Close the V-2 reference volume (Vref) isolation valve.

2.9. Record the pressure reading as Pressure of the Test Volume (PTV) just prior to opening V-1.

PTV = _____milli-Torr

2.10. Open the V-1 test system isolation valve (allows the test and reference volume pressures to equalize).

2.11. As soon as the pressure indicator stabilizes, record the pressure reading as the Mixed Pressure (PMIX) of the test and reference volumes.

(If the pressure indicator does not stabilize then there is an apparent gross leak, check system and restart at Step 2.)

PMIX = _____milli-Torr

2.12. Calculate the Volume of the Test Volume (VTV) using the following formula:

Vref = 12cc

$VTV = V_{ref} * [(P_{atm} - PMIX) / (PMIX - PTV)]$

VTV = _____ * [(_____ – _____) / (_____ – _____)]

VTV = _____ cc (___FSC) (____SSW)

3. SYSTEM LEAK TEST

3.1. Perform the valve line-up below.

V-1 Test System Isolation Valve	V-2 Reference Volume Isolation Valve	V-3 Vent Valve	V-4 Pump Isolation Valve
OPEN	OPEN	CLOSED	OPEN

3.2. Ensure that the test item is connected to the leak test equipment.

3.3. Evacuate system to approximately 100 milli-Torr.

3.4. Close the V-1 test system isolation valve.

3.5. Close the V-4 pump isolation valve.

3.6. Open the V-3 vent valve.

3.7. Allow the system to stabilize for approximately 30 seconds and then start the test by starting a stopwatch and recording the current temperature as (T1) and current pressure as (P1) Record temperature in degrees Kelvin (Centigrade + 273) and pressure in milli-Torr.

T1 = _____ degrees Kelvin

P1= _____ milli-Torr

3.8. After 180 seconds (3 minutes) record the current temperature as (T2) and current pressure as (P2).

T2 = _____ degrees Kelvin

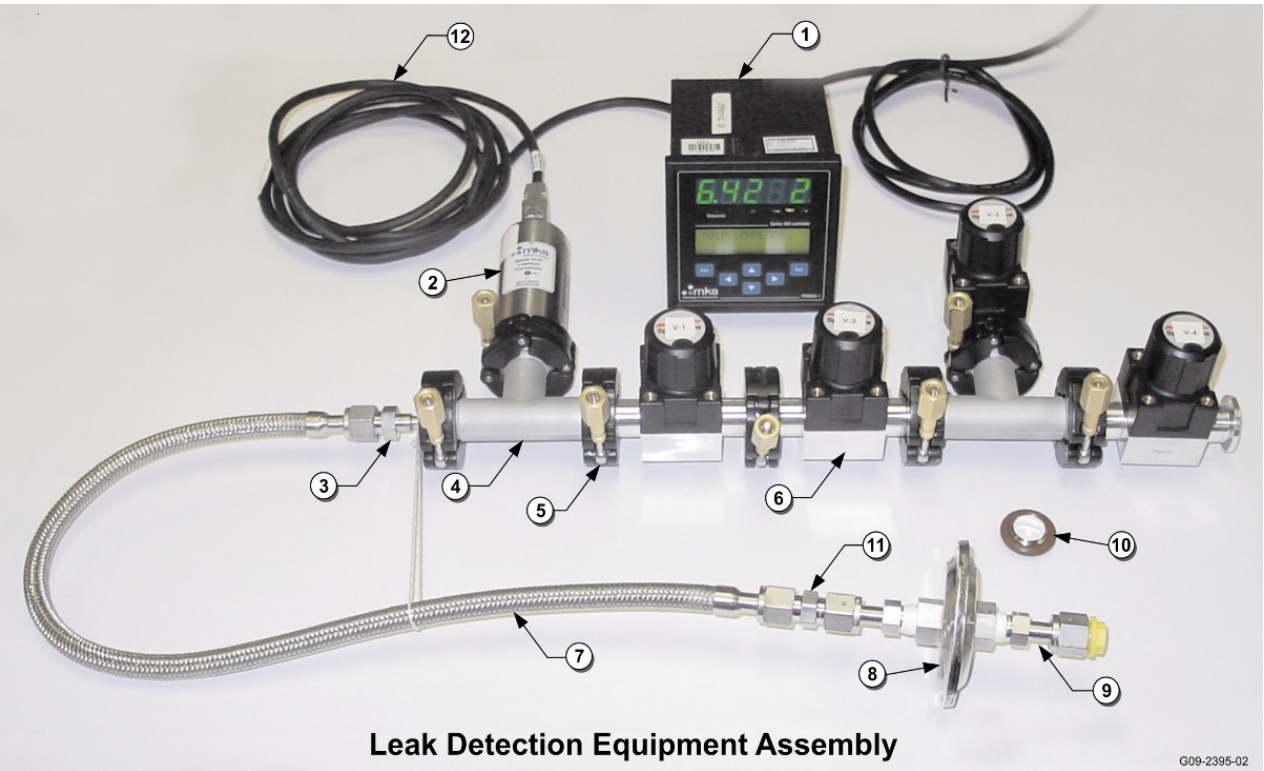
P2= _____ milli-Torr

4. CALCULATE RESULTS

4.1. Calculate the Test System Leak Rate (Lr) on Form 414.A81, "Pressure Change Leak Test Report" using a Test Assembly Volume (V_T) equal to the Volume of the Test Volume (VTV) recorded in Step 2.12 above, and record the result below.

Lr = _____ cc/sec.

Appendix C
Leak Detection Equipment Assembly and Bill of Materials



Item	Description	Manufacturer	Part Number	Qty
1	PDR900 single channel controller (power supply and readout unit)	MKS	PDR900-11-US	1
2	series 901P load lock transducer	MKS	901P-11	1
3	VCO to KF Adapter Flange – KF16 to ¼ inch male VCO	Kurt J. Lesker	QF16X4MVCO	1
4	KF Tee	Kurt J. Lesker	QF 16-075-TAL	2
5	Chain Clamps - KF16 (alum)	Kurt J. Lesker	QF 16-075-CCL	10
6	Speedivalve SP16K Manual Operation Isolation Valve, Nitrile Diaphragm, NW Flanges	Edwards	C33205000	4
7	FJ series low pressure hose – ¼ inch female VCO both ends – 24 inch length	Swagelok	SS-FJ4-VF4-VF4-24	1

8	In line HEPA	Nuclear Filter Technology	Dwg number IHF-001	1
9	Male NPT Connector – ¼ in VCO to ¼ inch NPT (female VCO)	Swagelok	SS-4-WVCO-1-4	2
10	Centering Ring – (SS with Viton O-ring)	Kurt J. Lesker	QF 16-075-SRV	10
11	¼ inch VCO union	Swagelok	SS-4-VCO-6	1
12	Cable, 15 pin, 10 feet	MKS	10013620	1

Appendix D

Procedure Basis

Procedure Review Table							
Review Discipline	Rev.	DFC Intent[b] Change	DFC Nonintent[c] Change	Review Discipline	Rev.	DFC Intent[b] Change	DFC Nonintent[c] Change
Operations Management	X[a]	X	X	Industrial Safety			
Qualified Operator	X	X	X	Engineering			
Radiological Engineering				Industrial Hygiene			
Environmental				Other			
Quality	X[a]	X	*				

a. X = review required.
b. Reviews for intent DFCs require the same discipline reviews required for a revision.
c. Reviews for nonintent DFCs can be performed with only Operations management and a qualified operator's review and then implemented for immediate use. However, the remaining discipline reviews, as indicated by an asterisk (*), must be obtained within two (2) weeks. See MCP-2985, "Chapter XVI – Operations Procedures," for definitions of intent and nonintent changes.

Step	Basis	Source	Citation
Entire procedure	Written procedures for special processes	QAPD Section 3, Work Processes	3.1.8, Special Processes
Entire procedure	Calibration Standards	ASME	Boiler and Pressure Vessel Code, Section V
Entire procedure	Leak Test Methods	ASME Boiler and Pressure Vessel Code 2001 Edition, Section V	
Appendix A, Step 2. Appendix B Step 4.	Calculation of leakage rate.	ANSI N14.5-97, American National Standard for Radioactive Materials, Leakage Tests on Packages for Shipment	

Step	Basis	Source	Citation
TPR-6304, 1.2 Scope Appendix A, intro. para. Appendix B, intro. para.	Qualification of Procedure and Equipment	(ASME) Boiler and Pressure Vessel Code	Section V, ANSI N14.5 and MCP-195
TPR-6304, Para. 2	Hazard Mitigation	JSA-661	