S

SEP 08 2000

ENGINEERING DATA TRANSMITTAL

1. EDT 628541

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Process Engineering	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: Spent Nuclear Fuel Project	6. Design Authority/ Design Agent/Cog. Engr.: R. A. Sexton	7. Purchase Order No.: N/A
8. Originator Remarks: For Release USQ: CSB-00-1194		9. Equip./Component No.: N/A 10. System/Bldg./Facility: N/A
11. Receiver Remarks:	11A. Design Baseline Document? [] Yes [X] No	12. Major Assm. Dwg. No.: N/A 13. Permit/Permit Application No.: N/A 14. Required Response Date: N/A

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	SNF-5536		0	Multi-Canister Overpack Monitoring Plan	S^N, Q	1	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN	(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN
1	1	Design Authority MCO L. H. Goldmann [signature] 9/1/2000 R3-86	3		SNF Project File R3-11
1	1	Design Authority CSB ~~G. D. Bazinet~~ S. A. Krieg [signature] 9/8/00 S8-06	1	1	C. M. Serrano [signature] S2-44
1	1	Cog.Eng. R. A. Sexton [signature] 2-29-00 R3-86			
1	1	Cog. Mgr. J. R. Frederickson [signature] 3/1/2000 8/31/00 R3-86			
1	1	QA S. S. Moss [signature] 3-2-2000 R3-11			
1	1	Safety ~~R. L. Garrett~~ CT Miller [signature] R3-26 9/6/00			
		Env.			

18. [signature] R. A. Sexton 2-29-00 Signature of EDT Originator / Date	19. J. R. Frederickson [signature] 9/6/00 Authorized Representative for Receiving Organization / Date	20. J. R. Frederickson [signature] 9/6/00 Design Authority/ Cognizant Manager / Date	21. DOE APPROVAL (if required) Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (05/96) GEF097

SNF-5536
Revision 0

MCO Monitoring Plan

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

Fluor Hanford
P.O. Box 1000
Richland, Washington

SNF-5536
Revision 0
EDT 628541

MCO Monitoring Plan

R. A. Sexton
Technical Resources Inc.

Date Published
September 2000

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

Fluor Hanford
P.O. Box 1000
Richland, Washington

9/7/00
Release Approval Date

DATE:
STA: 4
HANFORD RELEASE
ID: 2
SEP 08 2000
Release Stamp

Approved for public release; further dissemination unlimited

Total Pages: 14

SNF-5536, REV 0

TABLE OF CONTENTS

TABLE OF FIGURES

List of Acronyms

CBD	Commerce Business Daily
CSB	Canister Storage Building
CVD	Cold Vacuum Drying
MCO	Multi-Canister Overpack
MSW	Multi-Canister Overpack Sampling/Weld
OCRWM	Office of Civilian Radioactive Waste Management
RL	U.S. Department of Energy, Richland Operations Office
SNF	Spent Nuclear Fuel
TAG	Technical Advisory Group
RVI	Remote Visual Inspection

MCO MONITORING PLAN

1.0 INTRODUCTION

The basis for development of the Multi-Canister Overpack (MCO) Monitoring Plan was established in HNF-3312, *MCO Monitoring Activity Description* (Sexton 1998), with the following specific objectives:

> "The safety of Spent Nuclear Fuel (SNF) Project processes for retrieving, packaging, handling, conditioning, and storing the N Reactor spent nuclear fuel has been demonstrated by conservative analyses, as compiled in the project safety basis and licensing documentation. Appropriate quality assurance and independent checking of engineering, fabrication, and construction are being applied, and there will be in-process monitoring and verification of MCO loading and conditioning actions. Once the MCOs have been placed in storage, there is no safety requirement, regulatory requirement, or precedent to monitor them.
>
> Although not required, a monitoring program which would acquire data for use by Process Engineering is considered valuable for several reasons (Sexton 1998):
>
> Good engineering practice--Acquiring data at a reasonable cost that may be useful in developing a fuller understanding of the behavior of an engineered system is good engineering practice.
>
> Actual data on full scale MCOs is otherwise unavailable--Previous investigations have been limited to small fuel samples or simulant prototypes and have been relatively short in duration. MCO monitoring can provide data on large loads of actual fuel, in full-scale configuration, over longer time periods. Additional knowledge of the fuel type may prove valuable in future analyses or applications."

On that basis, a program with two components was planned:

- The pressure/temperature/gas composition relationships will be observed in a limited number of MCOs during the first two years in storage.
- The remaining MCOs will incorporate a simple means to confirm at any time in the future, that internal pressure of the MCO is not high enough to threaten its structural integrity.

The MCOs are likely to be stored for 40 years or longer. While routine checking of high pressure indication is not required or anticipated, the capability would always be available and is likely to be used prior to MCO handling and transport.

Monitoring is to be kept practical and cost effective such that it will not interfere with the fundamental project objective of putting the spent fuel in a safe configuration away from the river. Significant work has be done to implement these objectives, and this MCO Monitoring Plan will describe the results of this and provide the basis to complete its integration into all required SNF Project documentation.

2.0 SCOPE

The purpose of this document is to summarize the program that has resulted in the development of pressure, temperature, and gas monitoring to satisfy the requirements of Sexton (1998) and to define the steps to implement the monitoring equipment into the SNF Project. The terms, definitions, scope, and plans will provide a common basis and language for others to use and understand.

3.0 DEVELOPMENT

The observation program and monitoring equipment selected satisfies the following key programmatic objectives (Sexton 1998):

- Obtains the required data using cost effective data acquisition methods that do not jeopardize the function of the MCO,
- Minimizes the impacts to Canister Storage Building (CSB) Operations staffing and throughput and to the project cost and schedule baseline, and
- Introduces no new activities outside the current authorization.

The high pressure monitoring equipment has the following additional programmatic goals:

- It is not developmental,
- It requires no maintenance or routine inspection,
- It is unaffected by radiation, and
- It does not diminish the MCO pressure capability

3.1 MCO PRESSURE MONITORING

A search for available technologies was conducted by solicitation through the Commerce Business Daily (CBD). A total of nine concepts were received and reviewed by a group of key SNF personnel representing Engineering, MCO design, CSB design, Operations, and Technical Operations Management. A final recommendation was made and reviewed with the U.S. Department of Energy, Richland Operations Office (RL) and their Technical Advisory Group (TAG).

The *MCO Monitoring Activity Description*, (Sexton 1998) also defined the scope of the limited observation as to applying to four to six MCOs, with the potential for adding one or two if there are loadings of special interest. See HNF-3635, *Spent Nuclear Fuel Removal Campaign Plan*, (Pajunen, and Sexton 2000) for a description of the types of MCOs being considered.

For pressure monitoring of the MCOs, the selected approach uses a magnetically coupled gauge approach submitted by Vista Research, Inc. This concept takes advantage of the non-magnetic properties of the stainless steel shell of the MCO. A pressure gauge, consisting of a standard Bourdon tube with the standard indicating needle replaced by a magnetic couple, housed within a helium filled and sealed canister, will be installed in one of the MCO shield plug ports. An external readout device, a compass with its indicating face modified to reflect pressure, mounted outside the MCO will detect the position of this magnetic couple and thus provide a direct reading of MCO internal pressure. Mounting in this manner and installing the existing designed port cover eliminates any impact to the MCO pressure boundary. The external readout will be on the surface of the port cover for the low pressure and on the cover cap for the high pressure. Figure 1 depicts the configuration for the 100-psig pressure monitoring. Viewing of this readout can be accomplished with the MCO in its storage position using Remote Visual Inspection (RVI) techniques from the deck of the CSB.

The same magnetically coupled gauge is used for the long-term pressure indication on the MCOs over the 40-year storage time, with one exception. With the gauge mounted in the MCO shield plug, a method to internally transmit the magnetic flux from the top of the shield plug to the underside of the cover cap was designed. In this manner, any impacts to the MCO pressure boundary are eliminated and the external readout will be on the surface of the cover cap. Figure 2 depicts this configuration. Viewing can be done using the same RVI technique.

Note that Figure 1 and Figure 2 show index pins for the pressure gauge and readout units to the outside of the centerline of these units. The index pins will actually be on the inside, toward the MCO centerline.

Detailed design and prototype testing of these concepts has been completed. Fabrication of the final units has been initiated.

3.2 MCO TEMPERATURE MONITORING

Temperature monitoring is included for the limited number of MCOs to provide a means to correlate changes in ambient air temperature within the CSB storage tube with a corresponding change in internal pressure. Measurement of temperature at one position on the top surface of the MCO shield plug was selected based upon the following considerations:

- No single point within the MCO could be chosen that reflected the temperature throughout the MCO any better than the shield plug because of the non-uniform heat sources present and lack of gas circulation. Note: Helium has a high conductivity, so different densities in gas are not prevalent. With this situation, convective flow is not a large contributor to heat transport.
- Obtaining data from either multiple or single points within the MCO was judged to not meet the objectives of being non-intrusive and cost effective. Thermal analysis using various MCO loading configurations and ambient temperature changes within the CSB storage tube indicated that using the temperature of the MCO shield plug would correlate adequately with pressure measurements, given the accuracy of the pressure measurement.

Figure 1. MCO Shield Plug – Units Without Weld Cap Sender and Readout Unit (100 psi)

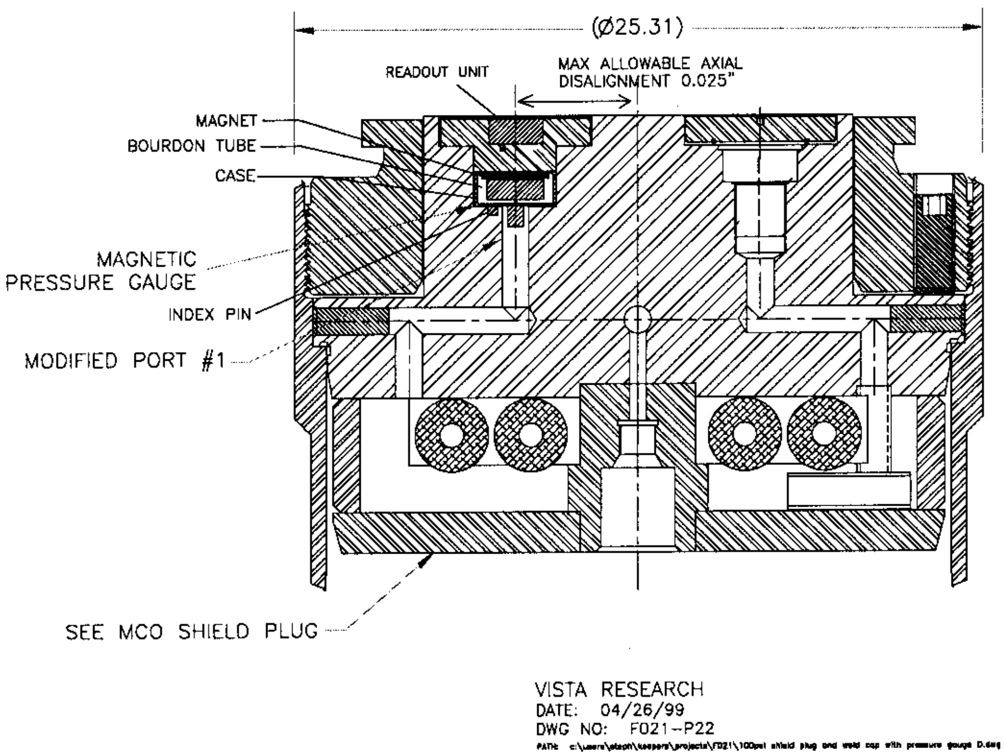
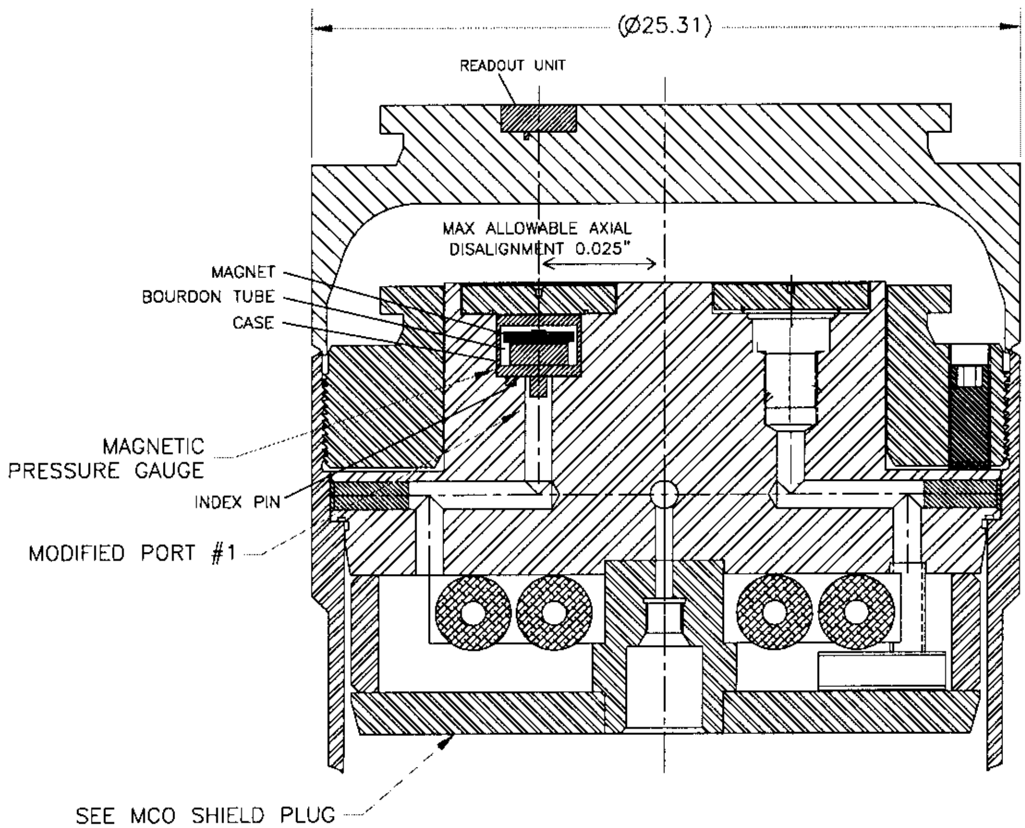


Figure 2. MCO Shield Plug and Weld Cap Sender Readout Unit



VISTA RESEARCH
DATE: 04/26/99
DWG NO: F021-P21
PATH: c:\users\steph\keepers\projects\F021\drawings\shield plug and weld cap with pressure gauge D.dwg

Based upon this, machining a circular recess in the top of the MCO shield plug and inserting an off-the-shelf surface-mounted temperature gauge was selected. Obtaining readouts of temperature would be done using the same RVI system used for pressure readings. No special testing was deemed necessary to support detailed design.

3.3 GAS SAMPLING

Design of a special MCO sample cart to take gas samples from the MCOs that are part of the limited monitoring program has been completed. It interfaces with the MCO Sampling/Weld Station at the CSB. Using this system, MCO pressure and skin temperature can be checked and a sample of the internal gases taken for analysis with the cover cap off (not installed on) the MCO.

4.0 SYSTEM DESCRIPTION

4.1 PRESSURE AND TEMPERATURE MEASUREMENT

There are two separate monitoring programs: Limited Monitoring (Section 4.1.1) and Long Term Monitoring (Section 4.1.2). Limited Monitoring includes pressure, temperature, and gas sampling for a limited number of MCOs (i.e., 4 to 6). The Long Term Monitoring includes only MCO pressure measurement capability.

For both monitoring programs, the sealed canister containing the pressure gauge will be installed within Port #1 of the MCO shield plug and the port cover plate bolted in place before the shield plug is transferred to the fuel basin. A locating pin on the bottom of the pressure gauge mates with a machined hole in the bottom of the port to assure proper alignment. Controls will be required to assure that the MCOs that are part of the limited monitoring program receive the 0-100 psi gauge. Selection of these MCOs will be controlled by Process Engineering as defined in Pajunen and Sexton (2000).

Following MCO processing in cold vacuum drying (CVD) and transfer to CSB, different actions will take place depending on the type of MCO (limited monitoring or long term monitoring). The current MCO design includes all modifications required to implement both pressure and temperature measurement systems.

4.1.1 Limited Monitoring

MCOs in the limited monitoring program must first have the shield plug surface mounted temperature element installed in the recess machined in the shield plug surface. The MCO will be placed in a designated storage tube in the bottom position without another MCO above it or top position to facilitate in tube monitoring.

The expected behavior of an MCO from the inception of CVD to initial placement in the CSB is provided in Duncan & Plys (1998a). For a design basis MCO containing one scrap basket with 200 g of free water, the pressure within the MCO increases from a CVD Facility backfill pressure of approximately 1.5 atms to a pressure of about three atmospheres in 3 to 4 days.

Following this initial pressure rise, the MCO pressure slowly increases, with a total increase over 40 years of approximately 1 atm (Duncan & Plys 1998b). The actual pressure of an MCO over a longer time interval depends upon the actual vault storage temperatures, the relative rates of radiolysis of the remaining uranium oxide hydrate and any cladding film versus the rate of oxygen and hydrogen gettering. The response behavior of the zero and two scrap basket case shows a similar initial rate of pressure rise followed by a corresponding slow pressure increase (Duncan & Plys 1998b). The maximum pressure for the bounding MCO (two scrap baskets) is predicted to be less than 6 atm. Changes in MCO temperature and pressure will be driven primarily by the seasonal variation in the vault inlet air temperature.

As the identified supporting documentation demonstrates, the expected increase in MCO pressure will occur over the first few days after shipment from CVD, due primarily to the temperature difference between CSB and CVD Facility and any residual free water left in the MCO. Therefore, it is recommended that the in tube monitoring of pressure and temperature of the first of these MCOs be taken weekly for the first month. Assuming any pressure increase has stabilized by the end of the first month, the pressure measurements should be taken monthly up to the first gas sampling. Following this, quarterly readings should be taken for the duration of the monitoring program.

The MCO pressure is read remotely using the RVI system. This requires the removing of the storage tube shield plug cover plate to gain access to one of the penetrations in the plug and insertion of the RVI viewing probe (boroscope). The RVI viewing system will be provided as a stand-alone system that is portable and can be hand carried. The monitoring frequency of subsequent MCOs in the limited monitoring program will be reassessed based on actual data. Installation of the cover cap and its seal welding to the MCO will involve the same steps as covered below for the long term monitored MCOs. It has been shown through testing that the magnet used in this configuration will not have any impact on the welding process nor will welding impact the magnet.

The 100-psig sender does not have the potential to be read through the cover cap, and therefore the capability to read the pressure for the limited number of monitored MCOs is lost when the cover cap is welded to the MCO. Loss of the capability of long term pressure monitoring for the limited number of MCOs is not considered significant since they have been sampled and characterized during the two year monitoring program

4.1.2 Long Term High Pressure Detection Capability

All MCOs equipped with the 0-600 psi gauge will utilize the readout for this gauge contained in the top of the cover cap. The correct orientation of the readout unit relative to the pressure unit is assured by the use of locating pins on the bottom of both the gauge and readout housings and positioning of the cover cap before welding.

When a given MCO is staged for welding of the cover cap, checks to confirm the presence of the gauge within Port #1 is recommended before positioning the cover cap for welding. As noted above, proper orientation of cap to MCO must be checked also. This will be done using a special tool to be developed by the MCO Tooling Project. This tool will have a dual function; first to assure proper alignment of the cap relative to the valve in Port #2, and second to assure alignment of the gauge with the readout unit. Following welding, the readout unit should be installed permanently in the cover cap recessed counter bore and secured in place.

Storage of the MCO following cover cap welding will be done to existing procedures. There are no requirements to monitor the internal pressure on a given frequency, nor are there any requirements to be able to read the MCO in the lower storage position without removing the one above it. No temperature monitoring is done for these MCOs.

4.2 GAS SAMPLING

For the MCOs that are a part of the limited monitoring program, monitoring over the two-year period will be done at the weld station using the MCO Sampling/Weld (MSW) System. Several activities are involved: The MCO skin temperature is checked using an infrared pyrometer; the MCO gas pressure and temperature are checked; and the MCO gas stream is sampled for hydrogen, oxygen, and radiological gases. This operation is described in more detail in the MSW System Design Description (Fluor 1999).

There is an increased risk of leakage from a failure to seal of a process port valve every time the valve is cycled, (e.g. during the process of a gas sample). To minimize the risk, the number of samples will be limited to less than five. Therefore, unless unusual circumstances dictate otherwise, the following sampling schedule is proposed.

MCO Type	Approximate MCO Sequence Range	Proposed Sampling Schedule		
The first MCO, good fuel, no scrap basket	1		1 year	2 years
The first MCO with a scrap basket	3 to 10	4 months	1 year	2 years
Selected from K West Pu Blend	147 to 155	6 months	1 year	2 years
Selected K West Other Mk IV, with $Al(OH)_3$	165 to 175	4 months	1 year	2 years
K East Pu Blend	205 to 215	6 months	1 year	2 years
SPR	204	4 months	1 year	2 years

5.0 OPERATIONS IMPACTS

A summary of the operational steps required to implement MCO monitoring is described below. Enough detail is provided to assess any impact to current planning and to modify procedures as required.

5.1 PRESSURE AND TEMPERATURE MONITORING

5.2 MCO SHIELD PLUG MAKE-UP

- Installation of pressure gauge housing in Port #1.
- Installation of port cover plate, including bolting and leak rate test.
- Inclusion of pressure gauge installation records in CP-70-001, Cold Component MCO Traveler. Included would be pressure range of gauge installed in the shield plug.

5.3 CVD—LIMITED MONITORING MCOS

- Installation of pressure readout unit and temperature monitor in machined recesses on shield plug top surface.

5.4 CSB – LIMITED MONITORING MCOS

- Identify specific storage location
- Monitor MCOs in-situ at the specified frequency. This is done by removal of storage tube shield plug cover plate to gain access to one of the penetrations in the plug and insertion of the RVI viewing probe (boroscope). The RVI viewing system will be provided as a stand-alone system that is portable and can be hand carried.
- Transfer the MCO to the weld station for monitoring and gas sampling.
- Weld cover cap on using alignment fixture that is provided for this purpose by the MCO Project. Once the cover cap is welded on an MCO with a 100-psig sender, it is no longer possible to monitor the MCO pressure.
- Store according to existing planning.

5.5 CSB—LONG TERM HIGH PRESSURE DETECTION CAPABILITY

- Weld cover cap on using alignment fixture that is provided for this purpose by the MCO Project. Pressure monitoring of an MCO with the 600-psig sender is possible only after the cover cap is welded on.
- Install and secure readout device in the cover cap.
- Store according to existing planning.

6.0 REGULATORY IMPACTS

6.1 PRESSURE AND TEMPERATURE MONITORING

Because the design selected has no impact to the MCO pressure boundary, and the current safety basis does not depend upon this monitoring, no specific safety analyses are required. The information provided in the plan can be used to provide common words and language and update Safety Analysis Reports to include descriptions as required.

By design, the pressure and temperature monitoring systems do not lend themselves to any maintenance or calibrations over their lifetimes. However, maintenance is possible while still in the shield plug only configuration. All data gathered during the monitoring program is considered as in-process data that will be provided to Process Engineering for evaluation. The monitoring is not required to support the safety basis or meet any regulatory requirement. For these reasons, this monitoring equipment and data gathered using it is not considered to be Office of Civilian Radioactive Waste Management (OCRWM) data.

6.2 GAS SAMPLING

The design and operation of the MSW System have already been analyzed in the current authorization basis as well as from an OCRWM standpoint. The necessary provisions were made in the design and fabrication of the system to support both.

7.0 REFERENCES

Ball, D. E., 1999, *MCO Magnetically Coupled Pressure Gauge Test Report,* SNF-5503, Rev. 0, December, 1999, Fluor Daniel Hanford, Richland, Washington.

Duncan, D. R. and M. G. Plys, 1998a, *Simulation of Normal and Off-Normal Multi-Canister Overpack Behavior,* HNF-2256, Rev. 2, Duke Engineering and Services, Richland, Washington.

Duncan, D. R. and M. G. Plys, 1998b, *MCO Internal Gas Composition and Pressure During Interim Storage*, HNF-SD-SNF-TI-040, Rev. 3, Duke Engineering and Services, Richland, Washington.

Flour Daniel, Inc, *MCO Sampling/Weld (MSW) System, System Design Descriptions,* FDI Contract 804460210, Duke Engineering and Services Hanford Contract TVW-SVV-370252, Rev. 2, February/March, 1999.

Pajunen, A. L., and R. A. Sexton, 2000, *Spent Nuclear Fuel Removal Campaign Plan,* HNF-3635, Rev. 0, Fluor Hanford, Richland, Washington.

Sexton, R. A., 1998, *MCO Monitoring Activity Description,* HNF-3312, Rev. 1, Duke Engineering and Services, Richland, Washington.