**OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
ANALYSIS/MODEL COVER SHEET**

1. QA: N/APage: 1 of: 17

Complete Only Applicable Items

2. ☒ Analysis Check all that apply	3. ☐ Model Check all that apply												
<table style="width:100%;"> <tr> <td style="width:20%;">Type of Analysis</td> <td> ☒ Engineering ☐ Performance Assessment ☐ Scientific </td> </tr> <tr> <td>Intended Use of Analysis</td> <td> ☐ Input to Calculation ☐ Input to another Analysis or Model ☒ Input to Technical Document ☐ Input to other Technical Products </td> </tr> <tr> <td colspan="2">Describe use: Contributing to the Site Recommendation Report</td> </tr> </table>	Type of Analysis	☒ Engineering ☐ Performance Assessment ☐ Scientific	Intended Use of Analysis	☐ Input to Calculation ☐ Input to another Analysis or Model ☒ Input to Technical Document ☐ Input to other Technical Products	Describe use: Contributing to the Site Recommendation Report		<table style="width:100%;"> <tr> <td style="width:20%;">Type of Model</td> <td> ☐ Conceptual Model ☐ Abstraction Model ☐ Mathematical Model ☐ System Model ☐ Process Model </td> </tr> <tr> <td>Intended Use of Model</td> <td> ☐ Input to Calculation ☐ Input to another Model or Analysis ☐ Input to Technical Document ☐ Input to other Technical Products </td> </tr> <tr> <td colspan="2">Describe use:</td> </tr> </table>	Type of Model	☐ Conceptual Model ☐ Abstraction Model ☐ Mathematical Model ☐ System Model ☐ Process Model	Intended Use of Model	☐ Input to Calculation ☐ Input to another Model or Analysis ☐ Input to Technical Document ☐ Input to other Technical Products	Describe use:	
Type of Analysis	☒ Engineering ☐ Performance Assessment ☐ Scientific												
Intended Use of Analysis	☐ Input to Calculation ☐ Input to another Analysis or Model ☒ Input to Technical Document ☐ Input to other Technical Products												
Describe use: Contributing to the Site Recommendation Report													
Type of Model	☐ Conceptual Model ☐ Abstraction Model ☐ Mathematical Model ☐ System Model ☐ Process Model												
Intended Use of Model	☐ Input to Calculation ☐ Input to another Model or Analysis ☐ Input to Technical Document ☐ Input to other Technical Products												
Describe use:													

4. Title:

Repository Closure and Sealing Approach

5. Document Identifier (including Rev. No. and Change No., if applicable):

ANL-SCS-MG-000001 REV 00

6. Total Attachments:

None

7. Attachment Numbers - No. of Pages in Each:

	Printed Name	Signature	Date
8. Originator	A. T. Watkins		06/28/00
9. Checker	T. Lahnalampi		06/28/00
10. Lead/Supervisor	J. Steinhoff		06/28/00
11. Responsible Manager	D.G. McKenzie		6/23/00

12. Remarks:

**OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
ANALYSIS/MODEL REVISION RECORD**

Complete Only Applicable Items

1. Page: 2 of 17

2. Analysis or Model Title:

Repository Closure and Sealing Approach

3. Document Identifier (including Rev. No. and Change No., if applicable):

ANL-SCS-MG-000001

4. Revision/Change No.

5. Description of Revision/Change

00

Initial Issue

CONTENTS

	Page
ACRONYMS.....	6
1. PURPOSE.....	7
2. QUALITY ASSURANCE.....	7
3. COMPUTER SOFTWARE AND MODEL USAGE.....	8
4. INPUTS.....	8
4.1 DATA AND PARAMETERS.....	8
4.2 CRITERIA	8
4.2.1 Caps/Covers.....	8
4.2.2 Environment	8
4.2.3 Performance Requirement	8
4.2.4 Structural Loads.....	9
4.2.5 Borehole Sealing.....	9
4.2.6 Human Intrusion	9
4.3 CODES AND STANDARDS	9
5. ASSUMPTIONS.....	9
5.1 EQUIPMENT.....	9
6. ANALYSIS/MODEL	10
6.1 CLOSURE AND SEALING APPROACH	10
6.1.1 General Conditions	10
6.1.2 Constructability.....	11
6.1.3 Materials	13
6.1.4 Human Intrusion	14
7. CONCLUSIONS.....	14
8. INPUTS AND REFERENCES.....	15
8.1 DOCUMENTS CITED	15
8.2 CODES, STANDARDS, REGULATIONS, AND PROCEDURES	16

FIGURES

	Page
Figure 1. Conceptual Arrangement of Shaft Plug.....	11
Figure 2. Conceptual Arrangement of Closure Backfilling.....	12
Figure 3. Conceptual Arrangement - Backfilling Shaft.....	13

TABLES

Not Used

Page

ACRONYMS

CRWMS M&O	Civilian Radioactive Waste Management System Management and Operating Contractor
CQ	Conventional Quality
PTn	Paintbrush Tuff non-welded
SDD	System Description Document
SR	Site Recommendation
TBD	to be determined
TBV	to be verified
TCw	Tiva Canyon welded

1. PURPOSE

The scope of this analysis will be to develop the conceptual design of the closure seals and their locations in the Subsurface Facilities. The design will be based on the recently established program requirements for transitioning to the Site Recommendation (SR) design as outlined by "Approach to Implementing the Site Recommendation Baseline" (Stroupe 2000) and the *Monitored Geologic Repository Project Description Document* (CRWMS M&O 1999b).

The objective of this analysis will be to assist in providing a description for the Subsurface Facilities System Description Document, Section 2 and finally to document any conclusions reached in order to contribute and provide support to the SR. This analysis is at a conceptual level and is considered adequate to support the SR design.

The final closure barriers and seals for the ventilation shafts, and the north and south ramps will require these openings to be permanently sealed to limit excessive air and water inflows and prevent human intrusion.

The major tasks identified with closure in this analysis are:

- Developing the overall subsurface seal layout and identifying design and operational interfaces for the Subsurface Facilities.
- Summarizing the general site conditions and general rock characteristic with respect to seal location and describing the seal selected.
- Identify seal construction materials, methodology of construction and strategic locations including design of the seal and plugs.
- Discussing methods to prevent human intrusion

2. QUALITY ASSURANCE

In accordance with Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O) procedure QAP-2-0, *Conduct of Activities* this analysis has been determined to be non quality affecting, and therefore, is not subject to the requirements of the Quality Assurance Requirements and Description (QARD) document (DOE 2000).

This evaluation is documented in *Repository Closure and Sealing Approach* (WP# 12012124M8). Activity Evaluation. (CRWMS M&O 2000b).

QAP-2-3 *Classification of Permanent Items* determined that Systems, Structures, and Components relevant to closure seals to be Conventional Quality (CQ). This classification is subject to closing out TBV 1345 by verifying the assumption that the borehole seals, repository drift and shaft seals are not relied on to meet proposed 10CFR63 performance objectives. Inability to verify this assumption could result in a reclassification of the subsurface closure and seal system from CQ to QL-1. The classification analysis to this document is the *Classification of the MGR Subsurface Closure and Seal System* (CRWMS M&O 1999c)

This document was prepared in accordance with AP-3.10Q, *Analyses and Models* and the *Development Plan* (CRWMS M&O 2000c) which was prepared in accordance with AP-2.13Q, *Technical Product Development Planning*. No electronic data was gathered, developed, or transmitted for this document; therefore, the requirements of AP-SV-1Q, *Control of the Electronic Management of Data*, do not apply.

3. COMPUTER SOFTWARE AND MODEL USAGE

No unqualified software program was used in the preparation of this report

4. INPUTS

All technical product input and sources of the input used in the development of this analysis are documented in this section. The qualification status of the input is indicated, as well as the documentation for to be verified (TBV) or to be determined (TBD), in accordance with AP-3.15Q, *Managing Technical Product Inputs*.

4.1 DATA AND PARAMETERS

Not used. No data and parameters applicable to this document.

4.2 CRITERIA

The criteria for this analysis will include those outlined in the *Monitored Geologic Repository Project Description Document* (CRWMS M&O 1999b) as applicable.

The primary source of criteria for this analysis is the *Subsurface Closure & Seal System Description Document* (CRWMS M&O 1999a).

Selection of criteria from the System Description Document (SDD) is based on the level of conceptual design and not every SDD requirement is addressed. In addition the re-classification to CQ identified by *Classification of the MGR Subsurface Closure and Seal System* (CRWMS M&O 1999c) will delay the revision and completion of SDDs in the CQ category. It is anticipated that this analysis will help formulate the direction for the future revision of the SDD.

4.2.1 Caps/Covers

The system design shall include caps and/or covers for all exploratory boreholes, shafts, and ramps, (CRWMS M&O 1999a, Section 1.2.1.5, p. 8 of 18). (Used in Section 6.1.1, 6.1.2)

4.2.2 Environment

The closure and seal system components shall be designed and located to be mechanically, chemically, geologically, and thermally compatible with the subsurface environment (TBD-185), (CRWMS M&O 1999a, Section 1.2.3.1, p. 9 of 18). (Used in Section 6.1.3).

4.2.3 Performance Requirement

The seals shall be designed to meet the system performance requirements through the use of materials with different strengths, durability, and failure mechanisms. (CRWMS M&O 1999a, Section 1.2.1.7, p. 8 of 18). (Used in Section 6.1.3).

4.2.4 Structural Loads

The system shall be designed to withstand the structural loads from seal and fill materials, anticipated hydrostatic head, differential volumetric expansion or contraction, and other anticipated loads, as applicable. (CRWMS M&O 1999a, Section 1.2.1.8, p. 8 of 18). (Used in Section 6.1.1)

4.2.5 Borehole Sealing

The system shall seal all deep boreholes that are within the area which extends 400 meters beyond the repository perimeter (TBV-1036). (CRWMS M&O 1999a, Section 1.2.1.1, p. 7 of 18). (Used in Section 6.1.1).

4.2.6 Human Intrusion

Human intrusion occurs 100 years after permanent closure and takes the form of a drilling event that results in a single, nearly vertical borehole that penetrates a waste package, extends to the saturated zone, and is not adequately sealed. It shall be assumed that the effect of the drilling is no more severe than the creation of an enhanced groundwater flow path from the crest of Yucca Mountain through a waste package to the water table. (Dyer 1999, Section 113 d, p. 18). (Used in Section 6.1.4)

4.3 CODES AND STANDARDS

Not used. No codes and standards applicable to this document.

5. ASSUMPTIONS

An assumption is considered to be a statement or proposition that is taken to be true or representative in the absence of direct confirming data or evidence. The assumptions used in this analysis will be identified and explained in this section.

5.1 EQUIPMENT

In general, the equipment utilized for backfilling the ramps and shafts etc. will be easily available and of commercial standard.

All equipment will be self-powered and may include the use of temporary generators so that general demobilization is not delayed. However, power for the shaft ventilation fans will be maintained until the demobilization of each shaft commences. (Used in Section 6.1.2).

6. ANALYSIS/MODEL

6.1 CLOSURE AND SEALING APPROACH

The closure and decommissioning phase will include closure and sealing of the subsurface facilities including the shafts.

Seal components such as concrete plugs are commonly utilized for mine closures and other underground workings and are generally constructed using cast in place concrete. The barriers they create, along with backfill, prevent ramps and shafts from becoming preferential pathways for water inflow. There are multiple options for the shape and combination of plugs. (CRWMS M&O 2000e, Section 5.1.1, pp. 17,18).

Backfill will be utilized in closing the mains, ramps and shafts. Current design calls for other areas to be backfilled and will include the turnouts to the emplacement entries, crossblock drifts, Enhanced Characterization of the Repository Block (ECRB) drift and performance confirmation drifts.

6.1.1 General Conditions

It is anticipated that seals will be constructed during the final closure/demobilization phase from the repository. Seal design considerations include the ability to withstand the structural loads from seal and fill materials, anticipated hydrostatic head, differential volumetric expansion or contraction, and other anticipated loads, as applicable. (Section 4.2.4).

Closing boreholes (4.2.5) and the underground openings will include final backfilling throughout the ramps, shafts, and main service drifts as part of the repository closure, construction of concrete plugs and caps (Section 4.2.1). These operations will require removal of equipment, rails, utilities and extraneous materials from the subsurface facility. Temporary utilities and support features, such as ventilation ducts will be installed during backfilling, and sealing, and removed as closure progresses. Demobilization of certain facilities on surface can proceed concurrently, however, demobilization of the main shafts will not proceed until utilization is no longer required for that shaft to supply air to the work areas being backfilled.

Features, Events, and Processes in UZ Flow and Transport (CRWMS M&O 2000a, Section 6.2.1, pp. 23,24) has identified the location and depths of boreholes used to site characterize. Conventional methods, including grouting and fill will be employed in sealing.

During construction of the emplacement drifts, boreholes located in proximity to potential tunnel alignments will be noted and addressed. If specific provisions are required to seal boreholes these will be addressed prior to construction.

The potential water inflow into the ramps and shafts is considered to be minimal and does not affect repository performance. Backfill will be placed the entire length of the ramp or shaft and would assist in providing a continuous water-retarding barrier. In addition, concrete caps (Section 4.2.1) would close the repository entrances, combined with strategically placed plugs

down the ramps and shafts would discourage human intrusion. Plug locations, to maximize performance in retarding waterflow, will be determined, especially in relation to major faults and highly fractured areas. Where possible, plugs should be located in sections of good and higher quality rock for ease of construction. As identified in *Closure Seal Locations and Geologic Environment Study* (CRWMS M&O 2000d, Section 6.2.3.3, p. 28).

A location to be considered for placement of a mid-shaft plug would be above the PTn within the TCw (Figure 1) allowing dispersal of any potential build up of surface water. Significant infiltration occurs only every few years dependent on storm amplitudes, durations, or frequencies. In very wet years, infiltration impulses on the order of hundreds of millimeters per year may infiltrate into Yucca Mountain during a relatively short period. Once water enters the high permeability and well connected TCw fracture system, the velocity through the TCw may be on the order of tens or even 100 m/yr at certain locations with little attenuation relative to travel times in the matrix (Bodvarsson et al, Section 3.2, p. 10). However, once the unsaturated flow leaves the TCw and enters the PTn, the PTn greatly attenuates infiltration pulses. Should matrix flow dominate, the time for a typical water pulse to move through a 100-m thick Paintbrush unit, using average PTn permeabilities is in the order of several thousand years. (Bodvarsson et al, Section 3.3, p. 11).

The large amount of backfill, including the caps and plugs that would be required to be removed would also be an effective deterrent against human intrusion.

Figure 1. Conceptual Arrangement of Shaft Plug

6.1.2 Constructability

In general the equipment utilized will be commonly available, standard industry type. Construction/Installation will follow recognized industry construction practice. The equipment depending on the selected methodology can include mobile conveyor units, load haul dumps and/or pneumatic stowers for placing the backfill in-situ and pumping cast in place concrete plugs. All equipment will be self-powered and may include the use of temporary power

generators so that general surface demobilization can be a concurrent activity. (Section 5.1). One exception to this will be the existing main shaft ventilation fans and infrastructure. They will be used until that particular shaft is demobilized.

Various construction activities required for closure and decommissioning need to be accomplished.

Major activities include:

- Reconfiguration of isolation doors and airlocks
- Removal of utility services (pipes for compressed air, water etc.)
- Removal of power cables and equipment
- Filling all applicable openings, as required by regulations, potentially with crushed and sized tuff from the mined stockpile
- Installing plug seals and caps as applicable (Section 4.2.1)

In general, the fill material will be placed in the perimeter mains and access ramps and shafts. Closure will be conducted in such a manner so as to promote a strategic withdrawal from the repository. It will maximize the ability to utilize the ventilation shafts for air supply and potential access.

Figure 2 depicts a typical method that could be employed for backfilling and ventilation.

Figure 2. Conceptual Arrangement of Closure Backfilling

Upon completion of backfilling a section of main drift utilized by the intake or exhaust shaft, the shaft is decommissioned, and readied for demobilization

As the section of the repository shaft access is closed demobilization of the shaft begins. This consists of removing the main fans and plenum, including any services in the shaft and backfilling of the shaft commences. It is envisaged that a slick line on the retreat to the surface will place the backfill. Engineered fill (potentially crushed, screened and washed tuff) is delivered via the slick line to a distribution center on the galloway for placing in the shaft.

Temporary ventilation can be supplied to the work area by flexible duct and portable fans (Figure 3).

Should a mid-shaft plug be deemed necessary, the Galloway would require little modification to receive concrete delivered by the slick line.

A misting process, if necessary, will suppress any dust generated.

Final shaft closure to the subsurface is the construction of closure caps at the entries to shafts and ramps. (Section 4.2.1). Current design allows for concrete lining removal only at plug areas.

Seals and backfill systems for drift and shafts are considered to have negligible effects on repository performance. (CRWMS M&O 2000a, Section 6.2.9, p. 26 of 55). Water moving through the Unsaturated Zone is expected to pass through the pillar system employed at the repository horizon. Some water may enter the emplacement but this will be addressed by the Engineered Barrier System.

Seals located in the repository access drifts and ventilation shafts are expected to have very little effect on the movement of gas or water in the repository environment. (CRWMS M&O 2000a, Section 6.2.7, p. 26 of 55).

Figure 3. Conceptual Arrangement - Backfilling Shaft

Should there be no requirement or necessity for human entry at shaft closure, then the shaft could be filled remotely utilizing current technology.

6.1.3 Materials

Potential backfill materials that can be considered are crushed tuff, bentonite, and a combination of sand and bentonite. Materials that may be used for plugs, and grout covers, include concrete,

and cementitious grout. Actual materials used will be selected so as not to compromise repository performance. (4.2.2)

Plug and seal materials under evaluation include earthen materials, grout mixtures and concrete mixtures and shall be designed to meet the system performance requirements through the use of materials with different strengths, durability, and failure mechanisms (Section 4.2.3).

Excavated muck (tuff) produced by the tunnel boring machines would be crushed, screened for sizing and washed prior to its use as backfill. An advantage of using crushed tuff is that it has the same chemical composition and properties, (Section 4.2.2) in general, as the surrounding rock mass.

A combination of sand and bentonite may be used also as a backfill. The addition of a small percentage of bentonite to a cohesionless material such as sand contributes to a significant reduction in the hydraulic conductivity of the backfill (Fernandez et al. 1987, p. D-6).

Geological mapping and geological observations of the rock characteristics gathered during the life of the repository will assist the final design configuration and placement location of seals and plugs. Site variables to be determined are the general and specific rock conditions encountered after the location of the seal plug is established. For example, the dimensions of the seal, the excavation profile, the potential need for any primary grouting, etc.

6.1.4 Human Intrusion

Unintentional human intrusion as postulated and defined as a drilling event. (Dyer J. R. 1999, Section 113d, p. 18).

"Human intrusion occurs 100 years after permanent closure and takes the form of a drilling event that results in a single, nearly vertical borehole that penetrates a waste package, extends to the saturated zone, and is not adequately sealed. It shall be assumed that the effect of the drilling is no more severe than the creation of an enhanced groundwater flow path from the crest of Yucca Mountain through a waste package to the water table." (Section 4.2.6).

This definition of human intrusion has been evaluated by Performance Assessment. They have determined from preliminary calculations that peak dose rates results are similar in magnitude to the TSPA-VA base case and is below the proposed regulatory limit of 25 mrem/yr. (CRWMS M&O 1999d, p. 3).

The backfilling, including the caps and plugs, that would have to be breached are an effective deterrent against human intrusion. Entanglement barriers, such as steel pipe and / or reinforced concrete block, would further reinforce this.

Access would become more difficult than gaining access through the host rock.

7. CONCLUSIONS

Seals and backfill systems for drift and shafts are not considered significant from a waste isolation perspective.

Water moving through the Unsaturated Zone is expected to pass through the pillar system employed at the repository horizon. Some water may enter the emplacement but this will be addressed by the Engineered Barrier System.

Given the lesser significance of seals and backfill in ramps, drifts and shafts, conventional methods used by mining and underground industry to seal these structures from human intrusion, and mitigate the possibility of surface water infiltration, are considered appropriate and effective.

Features, Events, and Processes in UZ Flow and Transport have identified the location and depths of boreholes used to site characterize. Boreholes are also considered as being relatively insignificant.

Conventional methods, including grouting and fill will be employed in sealing. At presently under evaluation potential backfill materials being considered are crushed tuff, bentonite, and a combination of sand and bentonite. Other materials that may be used for seals, plugs, and grout covers, include concrete, and cementitious grout. As repository design progresses materials selected may change.

This document may be affected by technical product input information that requires confirmation. Any changes to the document that may occur as a result of completing the confirmation activities will be reflected in subsequent revisions. The status of the input information quality may be confirmed by review of the Document Input Reference System database. TBD 185 and TBV 1036 referenced in Section 4.2.2 and 4.2.5 respectively are considered to have no impact to this document.

8. INPUTS AND REFERENCES

This section of the analysis will list all sources of inputs.

8.1 DOCUMENTS CITED

Bodvarsson, G.S.; Boyle, W.; Patterson, R.; and Williams, D. 1999. "Overview of Scientific Investigations at Yucca Mountain—The Potential Repository for High-Level Nuclear Waste." *Journal Of Contaminant Hydrology*, 38, (1-3), 3-24. New York, New York: Elsevier. TIC: 244160.

CRWMS M&O (Civilian Radioactive Waste Management System Management and Operating Contractor) 1999a. *Subsurface Closure & Seal System Description Document*. BCA000000-01717-1705-00012 REV 01. Two volumes. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990713.0240.

CRWMS M&O 1999b. Not Used

CRWMS M&O 1999c. *Classification of the MGR Subsurface Closure and Seal System*. ANL-SCS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0145.

CRWMS M&O 1999d. *Preliminary Calculation of Dose Rate, Managed by Upper and Lower Bounds, Due to a Post Closure Drilling Event (Human Intrusion)*. Input Transmittal SSR-PA-99237.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990719.0183.

CRWMS M&O 2000a. *Features, Events, and Processes in UZ Flow and Transport*. ANL-NBS-MD-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000502.0240.

CRWMS M&O 2000b. *Repository Closure and Sealing Approach (WP# 12012124M8)*. Activity Evaluation, February 8, 2000. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000207.0661.

CRWMS M&O 2000c. *Repository Closure and Sealing Approach*. TDP-SCS-MG-000003 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000216.0099.

CRWMS M&O 2000d. *Closure Seal Locations and Geologic Environment Study*. TDR-SCS-MG-000002 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000122.0037.

CRWMS M&O 2000e. *Closure Seal Materials and Configuration*. TDR-SCS-MG-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000124.0136.

DOE (U.S. Department of Energy) 2000. *Quality Assurance Requirements and Description*. DOE/RW-0333P, Rev. 10. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20000427.0422.

Dyer, J. R. 1999. "Interim Guidance Pending Issuance of New U.S. Nuclear Regulatory Commission (NRC) Regulations for Yucca Mountain, Nevada." Letter from J. R. Dyer (DOE/YMSCO) to D. R. Wilkins (CRWMS M&O), June 18, 1999, OL&RC: AVG: 1435, with enclosure. ACC: MOL.19990623.0026, MOL.19990623.0027.

Fernandez, J.A.; Kelsall, P.C.; Case, J.B.; and Meyer, D. 1987. *Technical Basis for Performance Goals, Design Requirements and Material Recommendations for the NNWSI Repository Sealing Program*. SAND84-1895. Albuquerque, New Mexico: Sandia National Laboratories. ACC: MOL.19980605.0182.

Stroupe, E.P. 2000. "Approach to Implementing the Site Recommendation Design Baseline." Interoffice correspondence from E.P. Stroupe (CRWMS M&O) to D.R. Wilkins, January 26, 2000, LV.RSO.EPS.1/00-004, with attachment. ACC: MOL.20000214.0480.

8.2 CODES, STANDARDS, REGULATIONS, AND PROCEDURES

AP-2.13Q, Rev. 0. ICN 4 *Technical Product Development Plan*. Washington, D.C.; U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20000620.0067.0305

AP-3.10Q, Rev. 2, ICN 2, *Analyses and Models*. Washington, D.C.: DOE Office of Civilian Radioactive Waste Management,
ACC: MOL.20000619.0576

AP-3.15Q, Rev. 1, ICN 1. *Managing Technical Product Inputs*. Washington, D.C.: U.S. Department of Energy, OCRWM. ACC: MOL. 19990831.0079.

QAP-2-0, Rev. 5, ICN 1. *Conduct of Activities*. Las Vegas, Nevada: CRWMS M&O.
ACC: MOL.19991109.0221.

QAP-2-3, Rev. 10. *Classification of Permanent Items*. Las Vegas, Nevada: CRWMS M&O.
ACC: MOL.19990316.0006.