

LSNReviews

From: James Winterle [jwinterle@cnwra.swri.edu]
Sent: Tuesday, December 11, 2007 4:28 PM
To: Sitakanta Mohanty
Subject: FW: presentation on multiple barriers ---- FYI
Attachments: MultipleBarriers_12Dec2007.ppt

FYI.

From: Femi [mailto:oosidele@cnwra.swri.edu]
Sent: Tuesday, December 11, 2007 1:14 PM
To: James Winterle
Subject: presentation on multiple barriers ---- FYI

Jim,

The attached slides have been reviewed and okayed by Bret. Keith has seen an earlier draft too. Most likely I will be giving the presentation during the team meeting tomorrow, unless Jim Rubenstone can find an alternative conflict-free time before the first TSPA-SEIS session (next Tuesday). The purpose of the presentation is to give the ISI teams some background and perspective on multiple barriers prior to the TSPA-SEIS sessions.

..... *Femi*

Properties Page

Return-path: <jwinterle@cnwra.swri.edu>
Received: from amon ([129.162.200.165])
by rogain.cnwra.swri.edu (Sun ONE Messaging Server 6.0 (built Oct 29 2003))
with ESMTP id <0JSW003MEMB4TY00@rogain.cnwra.swri.edu> for
smohanty@cnwra.swri.edu; Tue, 11 Dec 2007 15:28:17 -0600 (CST)
Date: Tue, 11 Dec 2007 15:28:17 -0600
From: James Winterle <jwinterle@cnwra.swri.edu>
Subject: FW: presentation on multiple barriers ---- FYI
To: Sitakanta Mohanty <smohanty@cnwra.swri.edu>
Message-id: <04da01c83c3c\$bea41db0\$a5c8a281@cnwra.swri.edu>
Organization: GED
MIME-version: 1.0
X-MIMEOLE: Produced By Microsoft MimeOLE V6.00.2900.3198
X-Mailer: Microsoft Office Outlook 11
Content-type: multipart/mixed;
boundary="-----_NextPart_000_04DB_01C83C0A.7409ADB0"
Thread-index: Acg8KfgwP8V8h2KHQZKYoLRhdd8qegAEr5KQ
Original-recipient: rfc822;smohanty@cnwra.swri.edu

Review of System Description and Demonstration of Multiple Barriers

B. Leslie and O. Osidele

December 12, 2007

October 7, 2004

Objectives

- ☐ To implement pre-LA submittal review strategies
 - Develop a common understanding of the regulatory requirements for multiple barriers
 - Resolve any differences of opinion through discussions
 - Obtain an initial understanding of the barriers DOE might rely on for waste isolation
 - Assign responsibilities for supporting forthcoming reviews and discussions of TSPA-SEIS

Definition of a barrier

☞ [10 CFR 63.2]

Any material, structure, or feature that:

- prevents or substantially reduces the rate of movement of water or radionuclides from the Yucca Mountain repository to the accessible environment, or
- prevents the release or substantially reduces the release rate of radionuclides from the waste
- [examples] a geologic feature, an engineered structure, a canister, a waste form, a material placed over and around the waste

Regulatory requirements for multiple barriers

☐ [10 CFR 63.113(a)]

The geologic repository must include multiple barriers, consisting of both natural barriers and an engineered barrier system

☐ [10 CFR 63.115]

Demonstration of compliance with §63.113(a) must:

- Identify barriers important to waste isolation
- Describe the capability of the barriers to isolate waste taking into account uncertainties in characterizing and modeling the behavior of the barriers
- Provide the technical basis for the description of the capability of the barriers based on and consistent with the technical basis for the performance assessments used to demonstrate compliance with §63.113(b) and (c)

Acceptance criteria for multiple barriers

☐ [YMRP § 2.2.1.1.3]

- Identification of Barriers Is Adequate
- Description of Barrier Capability to Isolate Waste Is Acceptable
- Technical Basis for Barrier Capability Is Adequately Presented

Multiple barriers

☐ Information about multiple barriers:

- Summarizes DOE's safety case
- Helps focus NRC's review of DOE's PA

☐ How does NRC's understanding of barriers relate to focusing the review ?

Risk-informed logic

Focus

		Barriers?	
Risk Insights	NRC \ DOE	Y	N
	H	H	M
	M	H	L
	L	H	L

Approach

- ❏ Multiple Barriers team searches DOE documents (TSPA-LA direct feeds and supporting documents) and extracts information on barriers and their capabilities
- ❏ Multiple Barriers team assigns known barriers to ISIs and obtains feedback on assignments
- ❏ Discuss barrier information within each ISI team during TSPA-SEIS sessions
- ❏ Multiple Barriers team applies the risk-informed logic table at the ISI level (see Slide #13)

TSPA-LA direct feeds

[Derived from TSPA-LA Methods & Approach document]

ISI	Submodel	Document Number	Title	Latest Public Revision	Date	YMP.GOV Revision Status						Latest LSO Revision	Status
						0	1	2	3	4	5		
UZ1	UZ Flow: Climate	ANL-NBS-GS-000008	Future Climate Analysis	Rev 01	Sep-04	1	1					Rev 01	status
UZ1	UZ Flow: Infiltration	ANL-NBS-HS-000027	Analysis of Infiltration Uncertainty	Rev 01	Oct-03	1	1					Rev 01	status
UZ2	UZ Flow: Mountain-Scale Flow Model	MDL-NBS-HS-000006	UZ Flow Models and Submodels	Rev 02	Oct-04	1	1	1				Rev 02	status
UZ2	UZ Flow: Drift Seepage	MDL-NBS-HS-000019	Abstraction of Drift Seepage	Rev 01	Nov-04	2	1					Rev 01	status
UZ2	UZ Flow: Drift Seepage	MDL-NBS-HS-000002	Seepage Model for PA Including Drift Collapse	Rev 03	Sep-04	1		1	1			Rev 03	status
ENG3	EBS Environment: EBS Chemical Environment	ANL-EBS-MD-000049	Multiscale Thermohydrologic Model	Rev 03	Jul-05	1	1	1	1			Rev 03	status
UZ2	EBS Environment: EBS Thermal-Hydrologic Environment	ANL-EBS-MD-000033	Engineered Barrier System: Physical and Chemical Environment	Rev 05	Aug-05	1		1			1	Rev 05	status
ENG1	WPDS Degradation: Waste Package and Drip Shield Degradation	ANL-EBS-PA-000001	WAPDEG Analysis of Waste Package and Drip Shield Degradation	Rev 02	Sep-04	1	1	1				Rev 02	status
ENG1	WPDS Degradation: Waste Package and Drip Shield Degradation	ANL-EBS-MD-000003	General Corrosion and Localized Corrosion of Waste Package Outer Barrier	Rev 02	Oct-04	1	1	1				Rev 02	status
ENG4	WF Degradation and Mobilization: Radionuclide Inventory	ANL-WIS-MD-000020	Initial Radionuclide Inventories	Rev 01	Sep-04		1					Rev 01	status
ENG4	WF Degradation and Mobilization: In-Package Chemistry	ANL-EBS-MD-000037	In-Package Chemistry Abstraction	Rev 04	Jul-05	1		1				Rev 04	status
ENG4	WF Degradation and Mobilization: Cladding Degradation	ANL-WIS-MD-000021	Cladding Degradation Summary for LA	Rev 03	Feb-05		1					Rev 03	status
ENG4	WF Degradation and Mobilization: Waste Form Degradation	ANL-EBS-MD-000015	CSNF Waste Form Degradation: Summary Abstraction	Rev 02	Aug-04	1		1				Rev 02	status
ENG4	WF Degradation and Mobilization: Waste Form Degradation	ANL-EBS-MD-000016	Defense HLW Glass Degradation Model	Rev 02	Aug-04	2		1				Rev 02	status
ENG4	WF Degradation and Mobilization: Waste Form Degradation	ANL-WIS-MD-000004	DSNF and Other Waste Form Degradation Abstraction	Rev 04	Nov-04		1			1		Rev 04	status
ENG4	WF Degradation and Mobilization: Dissolved Radionuclide Concentration Limits	ANL-WIS-MD-000010	Dissolved Concentration Limits of Radioactive Elements	Rev 05	Jul-05		1					Rev 05	status
ENG4	WF Degradation and Mobilization: Waste Form and EBS Colloids	MDL-EBS-PA-000004	Waste Form and In-Drift Colloids-Associated Radionuclide Concentrations	Rev 02	Aug-05	2		1				Rev 02	status
ENG4	EBS Flow and Transport: EBS Flow and Transport	ANL-WIS-PA-000001	EBS Radionuclide Transport Abstraction	Rev 02	Jul-06	3	1	1				Rev 02	Latest public version of Rev 02 ACN 01 is in ADAMS
ENG4	EBS Flow and Transport: EBS Invert Advection and Diffusion Analysis	ANL-EBS-MD-000063	Advection versus Diffusion in the Invert	Rev 00	Aug-03	1						n/avail	status

TSPA-LA direct feeds

[Derived from TSPA-LA Methods & Approach document]

ISI	Submodel	Document Number	Title	Latest Public Revision	Date	YMP.GOV Revision Status						Latest LSO Revision	Status
						0	1	2	3	4	5		
ENG4/UZ3	EBS Flow and Transport: UZ/Invert Interface Transport Model	MDL-NBS-HS-000008	Radionuclide Transport Models Under Ambient Conditions	Rev 02	Oct-04	1	1	1				Rev 02	status
ENG4/UZ3	EBS Flow and Transport: UZ/Invert Interface Transport Model	MDL-NBS-HS-000016	Drift-Scale Radionuclide Transport	Rev 01	Sep-04	1	1					Rev 01	status
ENG4/UZ3	EBS Flow and Transport: UZ/Invert Interface Transport Model	MDL-NBS-HS-000006	UZ Flow Models and Submodels	Rev 02	Oct-04	1	1	1				Rev 02	status
ENG4/UZ3	EBS Flow and Transport: UZ/Invert Interface Transport Model	MDL-NBS-HS-000003	Calibrated Properties Model	Rev 02	Oct-04	1	1	1				Rev 02	status
UZ3	UZ Transport: UZ Particle Tracking	MDL-NBS-HS-000020	Particle-Tracking Model and Abstraction of Transport Processes	Rev 01	Oct-04	1	1					Rev 02	status
UZ3	UZ Transport: UZ Particle Tracking	MDL-NBS-HS-000006	UZ Flow Models and Submodels	Rev 02	Oct-04	1	1	1				Rev 02	status
UZ3	UZ Transport: UZ Particle Tracking	MDL-NBS-HS-000003	Calibrated Properties Model	Rev 02	Oct-04	1	1	1				Rev 02	status
UZ3	UZ Transport: UZ Particle Tracking	MDL-NBS-HS-000008	Radionuclide Transport Models Under Ambient Conditions	Rev 02	Oct-04	1	1	1				Rev 02	status
ENG4/UZ3	UZ Transport: Drift-Scale Radionuclide Transport	MDL-NBS-HS-000016	Drift-Scale Radionuclide Transport	Rev 01	Sep-04	1	1					Rev 01	status
SZ1/2	SZ Flow and Transport: SZ Convolution	MDL-NBS-HS-000021	Saturated Zone Flow and Transport Model Abstraction	Rev 02	Oct-04	1		1				Rev 03	status
SZ1/2	SZ Flow and Transport: 1D SZ Transport	MDL-NBS-HS-000021	Saturated Zone Flow and Transport Model Abstraction	Rev 02	Oct-04	1		1				Rev 03	status
SZ1/2	SZ Flow and Transport: SZ Flow and Transport	MDL-NBS-HS-000021	Saturated Zone Flow and Transport Model Abstraction	Rev 02	Oct-04	1		1				Rev 03	status
DOSE1	Biosphere: Biosphere	ANL-MGR-MD-000009	Nominal Performance Biosphere Dose Conversion Factor Analysis	Rev 04	Apr-05		1	1	1			Rev 04	status
DOSE1	Biosphere: Biosphere	ANL-MGR-MD-000003	Disruptive Event Biosphere Dose Conversion Factor Analysis	Rev 04	May-05	1	1	1	1			Rev 04	status
ENG4	Disruptive Events: Seismic Activity	MDL-WIS-PA-000003	Seismic Consequence Abstraction	Rev 01	Oct-04	1	1					Rev 02	status
DIR1	Disruptive Events: Igneous Intrusion	ANL-MGR-GS-000001	Characterize Framework for Igneous Activity at Yucca Mountain, Nevada	Rev 02	Oct-04	2	1	1				Rev 02	status
DIR1	Disruptive Events: Igneous Intrusion	MDL-EBS-GS-000002	Igneous Intrusion Impacts On Waste Packages And Waste Forms	Rev 01	Apr-04	1						n/avail	status
DIR1	Disruptive Events: Igneous Intrusion	ANL-MGR-GS-000003	Number of Waste Packages Hit by Igneous Intrusion	Rev 01	Oct-04		1					Rev 02	status
DIR2 /DOSE2	Disruptive Events: Volcanic Eruption	MDL-MGR-GS-000002	Atmospheric Dispersal and Deposition of Tephra from a Potential Volcanic Eruption	Rev 02	Aug-05							Rev 02	status
DIR1	Disruptive Events: Volcanic Eruption	ANL-MGR-GS-000001	Characterize Framework for Igneous Activity at Yucca Mountain, Nevada	Rev 02	Oct-04	2	1	1				Rev 02	status
DIR1	Disruptive Events: Volcanic Eruption	ANL-MGR-GS-000003	Number of Waste Packages Hit by Igneous Intrusion	Rev 01	Oct-04		1					Rev 02	status

DOE barriers

Barrier	Barrier Component	Barrier Performance Function
Upper Natural Barrier	Surface soils and topography	Reduce the amount of water entering the UZ
	UZ rock units above repository	Reduce the amount of water entering emplacement drifts
EBS	Drip shield	Prevent water contacting the waste package and waste form
	Waste package	Prevent water from contacting the waste form
		Limit advective and diffusive transport of radionuclides from failed waste packages
	Cladding	Delay and/or limit liquid water contacting SNF after waste packages have degraded
	Waste form	Limit radionuclide release rates
	Invert	Limit advective and diffusive transport of radionuclides out of the EBS
Lower Natural Barrier	UZ rock units below repository	Delay radionuclide movement
		Decrease radionuclide concentrations in the groundwater aquifer
	SZ rock units	Delay radionuclide movement to the receptor location
		Reduce radionuclide concentrations

Focus and Assignments

			DOE barriers	Surface soils and topography	Unsaturated rock layers above the repository	Drip shield around the waste packages	Waste package	Cladding	Waste form	Invert	Unsaturated rock layers below the repository	Saturated rocks from the repository to the RMEI location
			Y	Y	Y	Y	Y	Y (?)	Y	Y	Y	Y
ISI	Risk Insights	Ranking										
ENG1	Persistence of a Passive Film	H										
	Waste Package Failure	M										
	Drip Shield Integrity	M										
	Stress Corrosion Cracking	M										
	Juvenile Failures of the Waste Package	L										
ENG2	Effects of Accumulated Rockfall on Engineered Barriers	M										
	Dynamic Effects of Rockfall on Engineered Barriers	L										
	Effects of Seismic Loading on Engineered Barriers	M										
	Effects of Faulting on Engineered Barriers	L										
ENG3	Chemistry of Seepage Water	H										
ENG4	Waste Form Degradation Rate	M										
	Cladding Degradation	M										
	Solubility limits	M										
	Mode of Release from Waste Package	L										
	Effect of Colloids on Waste Package Releases	M										
	Invert Flow and Transport	L										
	Criticality	L										
UZ1	Present-day Net Infiltration Rate	M										
	Long-term Climatic Change	M										
UZ2	Seepage	H										
	Hydrologic Properties of the Unsaturated	M										
	Transient Percolation	L										
UZ3	Retardation in the Calico Hills Non-Welded Vitric Unit	M										
	Matrix Diffusion in the Unsaturated Zone	M										
	Effect of Colloids on Transport in the Unsaturated Zone	M										
SZ1	Saturated Alluvium Transport Distance	M										
SZ2	Retardation in the Saturated Alluvium	H										
	Matrix Diffusion in the Saturated Zone	M										
	Effect of colloids on Transport in the Saturated Zone	M										
DIRECT1	Probability of Igneous Activity	H										
	Number of Waste Packages Affected by Eruption	H										
	Number of Waste Packages Damaged by Intrusion	M										
DIRECT2	Volume of Ash Produced by an Eruption	M										
	Remobilization of Ash Deposits	M										
	Inhalation of Resuspended Volcanic Ash	H										
	Wind Vectors During an Eruption	M										
DOSE1	Well-pumping Model	L										
DOSE2	Redistribution of Radionuclides in Soil	L										
DOSE3	Characterization of the Biosphere	L										

Next steps

- ☐ Complete focus and assignments; get feedback on assignments
- ☐ Provide barrier information to ISI teams prior to TSPA-SEIS sessions
- ☐ Discuss barrier information within each ISI team during TSPA-SEIS sessions
- ☐ Capture common understandings and resolve any difference of opinion on barrier capabilities implemented in DOE's TSPA