DOE-NRC Technical Exchange/Management Meeting Agenda
KEY TECHNICAL ISSUES AND SUBISSUES RELATED TO CRITICALITY
9960 Covington Cross (M&O Complex in Summerlin), Room 915, Las Vegas, Nevada
October 23 and 24, 2000

Objective: Provide the basis to resolve open Key Technical Issues (KTIs) related to Criticality. Also, provide the basis to resolve criticality Safety Evaluation Report (SER) open items.

Times are approximate because the agenda items are expected to provide a framework for wider ranging discussions. Time allotted for each presentation includes time for the DOE presentation and time for accompanying discussion.

Monday, October 23, 2000

8:00-8:15 AM	Introduction/Objectives/Logistics Purpose of the interaction
8:15-9:00 AM	Criticality – Summary of Status from a DOE Perspective (Russell)
9:00-9:45 AM	Disposal Criticality Topical Report Update (Thomas)
9:45-10:10 AM	BREAK
	Container Life and Source Term Subissue 5: The effects of in-package criticality on waste package and engineered barrier subsystem performance.
10:10-10:30 AM	Acceptance Criterion 1 – Technical Bases for Design Criteria. (DOE (Dave Salmon)/NRC)
10:30-11:00 AM	Acceptance Criterion 2 - Features, events, and processes that may increase reactivity. (DOE (Peter Gottlieb) /NRC)
11:00-11:30	Acceptance Criterion 3 - Configuration classes and configurations that have potential for nuclear criticality. (DOE (Peter Gottlieb)/NRC)
11:30-12:30 PM	LUNCH
12:30-12:50 PM	Acceptance Criterion 4 - Technically defensible, transparent, and traceable method in assigning probability values. (DOE (Peter Gottlieb)/NRC).
12:50-2:50 PM	Acceptance Criterion 5 - Computer models, input parameters, and quantitative values for calculating the effective neutron multiplication factor (keff), including appropriate biases and uncertainties in the mode (DOE (Dave Salmon and Dan Thomas)/NRC).
2:50-3:15 PM	BREAK
3:15-4:45 PM	Caucus on CLST Subissue 5 - Acceptance Criteria 1 through 5
4:45-5:45 PM	DOE/NRC Discussion of Resolution Status of CLST Subissue 5- Acceptance Criteria 1 through 5

5:45-6:00 PM	Closing Comments
6:00 PM	Adjourn first day

Tuesday, October 24, 2000

8:00-9:15 AM	Acceptance Criterion 6 - Computer models, input parameters, and quantitative values for calculating the radionuclide inventory, heat, kinetic energy, and other parameters that would change as a result of keff exceeding the subcritical limit. (DOE (Peter Gottlieb)/NRC).
9:15-9:45 AM	Acceptance Criterion 7 - Risk contribution from the in-package criticality to the total repository system performance appropriately. (DOE/NRC)
9:45-10:00 AM	BREAK
10:00-11:00 AM	Caucus on CLST Subissue 5 – Acceptance Criteria 6 and 7
11:00-11:30 AM	DOE-NRC discussion of resolution status of CLST Subissue 5, Acceptance Criteria 6 and 7
11:30-12:00 PM	**Radionuclide Transport (RT) Subissue 4** and **Evolution of the Near-Field Environment (ENFE) Subissue 5:** Resolution Status and Path Forward Summary Discussion
12:00-1:00 PM	LUNCH
1:00-2:00 PM	Caucus on RT Subissue 4 and ENFE Subissue 5
2:00-2:30 PM	DOE-NRC discussion of resolution status of RT Subissue 4 and ENFE Subissue 5
2:30-3:30 PM	DOE caucus to discuss proposed agreement
3:30-4:00 PM	Discussion of Agreements
4:00-4:15 PM	Closing Comments
4:15 PM	Adjourn Technical Exchange

SUBISSUES RELATED TO CRITICALITY
TECHNICAL EXCHANGE AND MANAGEMENT MEETING
OCTOBER 23-24, 2000
LAS VEGAS, NEVADA

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SUBISSUES RELATED TO CRITICALITY
TECHNICAL EXCHANGE AND MANAGEMENT MEETING
OCTOBER 23-24, 2000
LAS VEGAS, NEVADA

NAME	ORGANIZATION	PHONE NUMBER
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ATTACHMENT 4

LIST OF VALIDATION REPORTS

AND PRESENTER'S SLIDES

Validation Reports

Available 6-12 months prior to LA docketing

AREA - TYPE - TITLES

Geochemistry
- Degradation
  - Geochemistry Model Validation Report: Material Degradation and Release
- Accumulation
  - Geochemistry Model Validation Report: Material Accumulation

Configuration Generator
- Internal CSNF (including MOX)
  - Configuration Generator Model Validation Report: CSNF Waste Package
- Internal DOE SNF (9 categories) w/ HLW
  - Configuration Generator Model Validation Report: DOE-SNF Codisposal Waste Package
- Internal Immobilized Pu w/ HLW
  - Configuration Generator Model Validation Report: Immobilized Pu Codisposal Waste Package
- External Near-Field (In-Drift)
  - Configuration Generator Model Validation Report: Near-Field/In-Drift Criticality
- External Far-Field
  - Configuration Generator Model Validation Report: Far-Field Criticality

Isotopic
- BWR
  - Isotopic Model Validation Report: BWR
- PWR
  - Isotopic Model Validation Report: PWR

Criticality
- BWR
  - Criticality Model Validation Report: BWR
- PWR
  - Criticality Model Validation Report: PWR
- External
  - Criticality Model Validation Report: External
- DOE SNF (9 categories) w/ HLW
  - Criticality Model Validation Report: DOE SNF Codisposal
- Immobilized Pu w/ HLW
  - Criticality Model Validation Report: Immobilized Pu Codisposal

Consequence
- Steady-State
  - Steady-State Criticality Consequence Model Validation Report: Internal and External
- Internal Transient
  - Transient Criticality Consequence Model Validation Report: Internal
- External Transient
  - Transient Criticality Consequence Model Validation Report: External

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Criticality - Summary of Status from a DOE Perspective

Presented to:
DOE/NRC Technical Exchange on Key Technical Issues and Subissues Related to Criticality

Presented by:
Paige Russell
Yucca Mountain Site Characterization Office
U.S. Department of Energy

October 23-24, 2000
Las Vegas, NV

YUCCA MOUNTAIN PROJECT

Outline

- **Current Subissue Status**
- **Process for Addressing Criticality**
  - Methodology
  - Validation
  - Application
- **History of Criticality Activities**
- **Status of Criticality Activities**
- **Purpose of the Technical Exchange**

Current Subissue Status

Subissue	Status*	
	NRC	DOE Proposed
Container Life and Source Term (CLST) Subissue 5	**Open**	**Closed - Pending**
Radionuclide Transport (RT) Subissue 4	**Closed - Pending**	**Closed - Pending**
Evolution of the Near Field Environment (ENFE) Subissue 5	**Closed - Pending**	**Closed - Pending**

***NRC status based on CLST IRSR, Rev. 02; RT IRSR Rev. 2, & ENFE IRSR, Rev. 3. Delta Analysis provides additional details about how CLST IRSR acceptance criteria and NRC open items have been addressed and provides references to relevant information**

Current Subissue Status
CLST, Subissue 5

Acceptance Criteria CLST IRSR Rev. 2	NRC Status	DOE - Proposed Status
1. Technical Basis for Design Criteria	Open	Closed- Pending
2. Features, Events, and Processes	Open	Closed - Pending
3. Configurations	Open	Closed - Pending
4. Technically Defensible, Transparent, and Traceable Method in Assigning Probability Values	Open	Closed - Pending
5. Computer Models Input Parameters, and Quantitative Values for Calculation k_{eff}	Open	Closed - Pending
6. Computer Models Input Parameters, and Quantitative Values for Calculating Consequences	Open	Closed - Pending
7. Risk Contributing from In-Package Criticality to Performance	Open	Closed - Pending

Process for Addressing Criticality Methodology

- **DOE has two documents that will give the methodology for evaluating criticality**
  - *Disposal Criticality Analysis Methodology Topical Report* contains the methodology for performing postclosure disposal criticality analyses
    - Method (process and order different models are used)
    - Modeling Approach
    - Validation Approach
  - *Preclosure Criticality Analysis Process Report* will contain the equivalent information, but for preclosure criticality analyses

Process for Addressing Criticality Validation

- **DOE plans to validate models in a series of validation reports**
- **Validation reports will contain model validation information. This information includes:**
  - Identify the specific models
  - Provide justification for the range over which the models are to be used
- **Types of validation reports will include**
  - Geochemistry, Configuration Generator, Isotopics, Criticality, and Consequence
- **DOE expects these reports to justify the tools DOE plans to use**

Process for Addressing Criticality Application

- **The application of DOE's criticality evaluations will be documented in Calculations and Design Analyses**
  - Calculations will contain the detailed data, checks of the ranges of applicability, and results of the application of the models
  - Design Analyses will summarize the calculation results for specific designs, define the ranges of parameters used, and make the comparison against the design criteria and requirements
- **The results of the application will be completed for the License Application**

History of Criticality Activities

- DOE/NRC discussions on disposal criticality activities have been conducted since 1993
- Annotated Outline approved by NRC in 1995 agreed with DOE that the Topical Report process was appropriate for postclosure criticality
- First DOE/NRC Technical Exchange on Disposal Criticality was held in October 1995
- In January 1999, DOE delivered to NRC the *Disposal Criticality Analysis Methodology Topical Report, Rev. 0*
- In June 2000, NRC issued the *Safety Evaluation Report for Disposal Criticality Analysis Methodology Topical Report, Rev. 0*

DOE Status on Criticality Issues

- DOE has developed a revision to the Topical Report to address Open Items from the Safety Evaluation Report and is preparing to deliver it to NRC in December 2000
- DOE is currently working on the validation reports
- DOE is also performing preliminary application evaluations on specific waste forms, for which information is available, to test the methodology

DOE Status on Criticality Issues
(Continued)

- Final evaluations are to be completed by License Application for waste forms for which DOE has sufficient information
- Waste forms (minor amounts) for which there is not yet sufficient information will be included in supplemental licensing documents when sufficient information is available

Purpose of the Technical Exchange

- Summarize technical basis for resolution of NRC comments, concerns, and Safety Evaluation Report Open Items to support closure of Key Technical Issue subissues related to criticality
- Document agreements on items needed to support eventual closure of the criticality-related issues and subissues

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Disposal Criticality Topical Report Update

Presented to:
DOE/NRC Technical Exchange on Key Technical Issues and Subissues Related to Criticality

Presented by:
Daniel A. Thomas
Civilian Radioactive Waste Management System Management and Operating Contractor

October 23-24, 2000
Las Vegas, NV

YUCCA MOUNTAIN PROJECT

Outline

- Presentation Objectives
- Background
- General Description
- Changes From Rev. 0
- Overview of Methodology Figure
- Topical Report, Validation Reports, and Key Technical Issues
- Safety Evaluation Report Open Item 1
- Conclusions
- Backup: Safety Evaluation Report Open Item Cross-Reference

Presentation Objectives

- **The objectives of this presentation include:**
  - Give a general description of the *Disposal Criticality Analysis Methodology Topical Report*, Rev. 01
  - Briefly summarize the changes in the Topical Report, Rev. 01
  - Provide a cross-reference among the Safety Evaluation Report Open Items; the Topical Report, Rev. 01 locations where the Open Items are discussed; and the presentations for this technical exchange in which the Open Items are discussed

Background

- Topical Report, Rev. 0 delivered to NRC January 1999
- NRC issued the Safety Evaluation Report in June 2000
- Topical Report, Rev. 01 has been developed to address Open Items

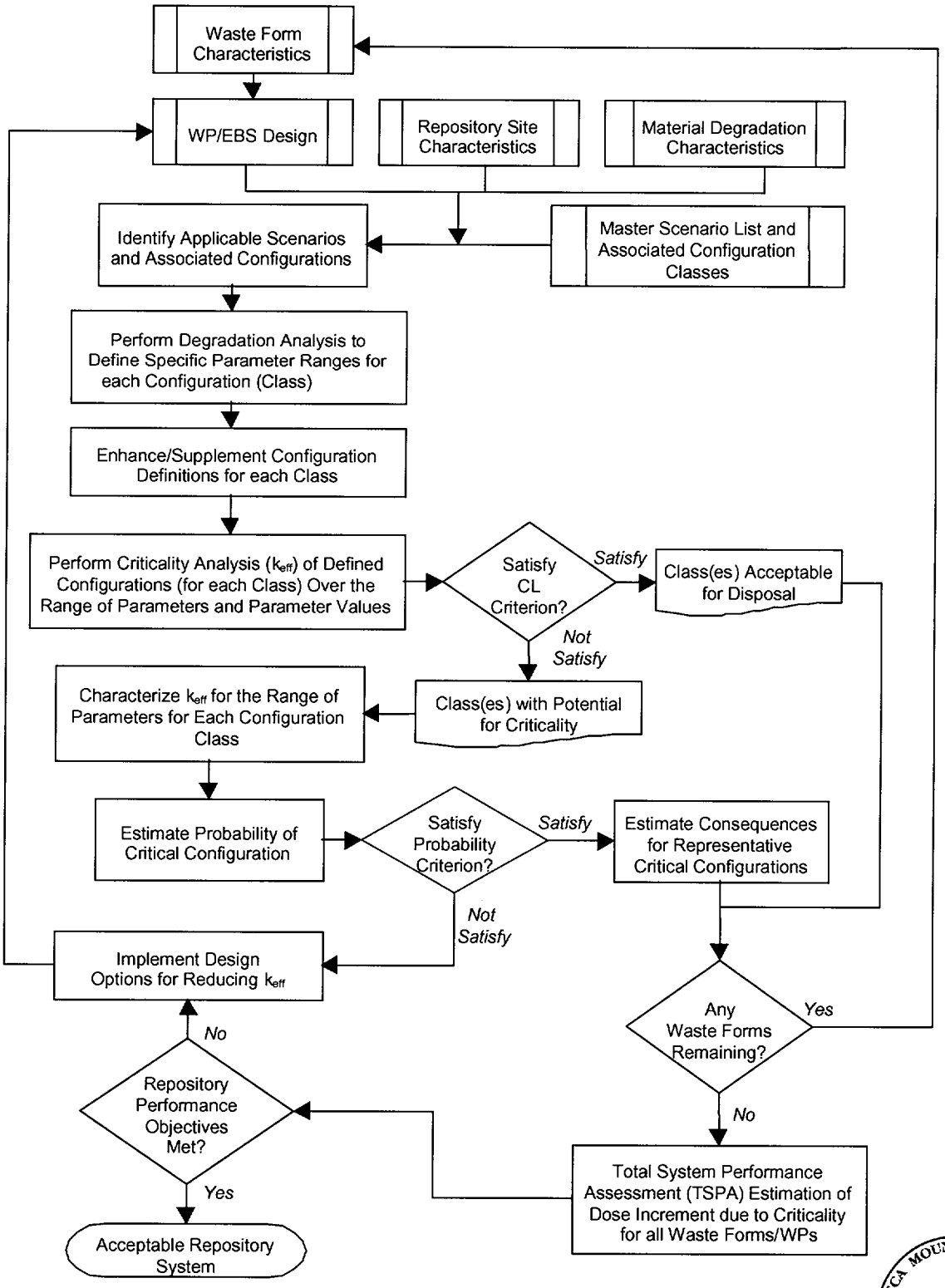
General Description

- ***Disposal Criticality Analysis Methodology Topical Report*** **contains a risk-informed, performance-based methodology for performing postclosure disposal criticality analyses to demonstrate how the potential for postclosure criticality will be limited and how public health and safety will be protected**
- **In addition to providing the methodology, the Topical Report also discusses the types of analyses needed to evaluate criticality (modeling approach) and discusses the necessary validation activities for the various models (to be provided in validation reports)**

Changes From Rev. 0

- Reorganization consistent with the Safety Evaluation Report
- Removal of Appendices C and D (examples)
- Incorporation of discussion to address the Requests for Additional Information and Safety Evaluation Report Open Items
- Revision of Figure 3-1 Overview of Methodology (formerly Figure 1-1 in Topical Report, Rev. 0)

Overview of Methodology



Topical Report and Criticality Key Technical Issues

- The Topical Report/Safety Evaluation Report process includes a number of technical exchanges between DOE and NRC in which discussions of various criticality related technical issues and NRC concerns have occurred and will occur
- DOE understands that the Safety Evaluation Report comprehensively identifies remaining NRC open items regarding criticality that need to be resolved prior to licensing
- DOE believes the Topical Report/Safety Evaluation Report process is sufficient to support the closed-pending status for the criticality-related Key Technical Issues

Validation Reports and Criticality Key Technical Issues

- **The validation reports generated per the methodology in the Topical Report will provide justification, prior to License Application, that the models used for evaluating criticality are sufficient**

Safety Evaluation Report (Open Item 1)

- Of the 28 Safety Evaluation Report Open Items, all except Open Item 1 are addressed in criticality-related Key Technical Issue presentations
- Open Item 1 addresses confirming waste form properties during operations and does not relate to design, site, or test data sufficiency important for determining site suitability as do the other Key Technical Issues
- DOE plans to address this Open Item as part of the Topical Report/Safety Evaluation Report process rather than in association with Key Technical Issues and subissues
- Status of this Open Item is provided in the following slides

Safety Evaluation Report (Open Item 1)
(Continued)

- **Topical Report, Rev. 01 addresses Open Item 1 burnup verification issue in two places**
  - Topical Report, Rev. 01, Section 2.3.2, 11th paragraph, page 2-9
  - Topical Report, Rev. 01, Section 2.3.3, 2nd paragraph, page 2-9
- **Discussion in the Topical Report, Rev. 01 does not provide the approach DOE plans to use to verify fuel assembly burnup**
- **DOE is developing its approach for burnup verification and will formally document the approach in the *Preclosure Criticality Analysis Process Report***

Conclusions

- Safety Evaluation Report Open Items will be resolved through the Topical Report/Safety Evaluation Report process
- Open Items are discussed in Topical Report, Rev. 01 and DOE believes the majority can be resolved based on this information
- DOE believes the Topical Report/Safety Evaluation Report process is sufficient to bring criticality-related Key Technical Issues and subissues to closed-pending

Backup:
Safety Evaluation Report Open Item Cross-Reference

Safety Evaluation Report (Open Item 1)

- **"The [NRC] staff believes that burnups of spent fuel assemblies must be verified through measurements before their loading into the WP [waste package] for the purpose of burnup credit verification."**
  - Topical Report, Rev. 01, Section 2.3.2, 11th paragraph, page 2-9
  - Topical Report, Rev. 01, Section 2.3.3, 2nd paragraph, page 2-9
  - Discussed in presentation
    - Disposal Criticality Topical Report Update

Safety Evaluation Report (Open Item 2)

- **"The consequence criteria for transient and external criticalities are not addressed in the TR [Topical Report]. The DOE must specify if it intends to perform full consequence analyses for transient and external criticality events and include them in TSPA [Total System Performance Assessment] or use some type of criteria for the purpose of criticality control design selection."**
  - Topical Report, Rev. 01, Figure 3-1 and Sections 3.1, 9th paragraph, page 3-4
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 1: Design Criteria

Safety Evaluation Report (Open Item 3)

- **"The DOE needs to provide a modeling approach for igneous-activity-induced criticality."**
  - Topical Report, Rev. 01, Section 3.3.4, page 3-18
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 2: Features, Events, and Processes

Safety Evaluation Report (Open Item 4)

- **"The DOE must include the effects of radionuclide migration from an intact fuel assembly though pin-holes and cracks in the cladding."**
  - Topical Report, Rev. 01, Section 3.5.1.1, 4th paragraph, page 3-31
  - Topical Report, Rev. 01, Section 3.5.2.1.1, 3rd & 4th paragraphs, page 3-35
  - Topical Report, Rev. 01, Section 3.5.2.1.4, 2nd & 3rd paragraph, page 3-38
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 5)

- **"The DOE must include a criticality margin when comparing k_{eff} values from regression analyses to CL [Critical Limit] values."**
  - Topical Report, Rev. 01, Section 2.3.2, 9th paragraph, pages 2-8 & 2-9
  - Topical Report, Rev. 01, Figure 3-5 in Section 3.5.1.3
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 6)

- **"The DOE must present an approach for developing the criticality margin."**
  - Topical Report, Rev. 01, Section 3.5.3.2.3, 1st paragraph, page 3-48
  - Topical Report, Rev. 01, Section 3.5.1.2, 3rd paragraph, page 3-32
  - Topical Report, Rev. 01, Section 3.5.2.1.3, 4th paragraph, page 3-38
  - Topical Report, Rev. 01, Section 3.5.3.2, 4th & 5th paragraphs, page 3-45
  - Topical Report, Rev. 01, Section 3.5.3.2.5, 5th paragraph, page 3-50
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 7)

- **"The DOE must demonstrate the adequacy of using one-dimensional calculations to capture three-dimensional neutron spectrum effect in their point-depletion calculation or use two/three dimensional calculations for determining the neutron spectra during the depletion cycles to be used in the depletion analyses."**
  - Topical Report, Rev. 01, Section 3.5.2.1.2, 4th & 5th paragraphs, page 3-36
  - Topical Report, Rev. 01, Section 3.5.3.1.1, 5th – 7th paragraphs, page 3-42
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 8)

- **"The DOE needs to use the cross-section data corresponding to the temperature for the WP [waste package] or critical benchmarks."**
  - Topical Report, Rev. 01, Section 3.5.2.2, 3rd paragraph, page 3-39
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 9)

- **"The DOE must include the cross-dependency of configuration parameters for k_{eff} regression equations."**
  - Topical Report, Rev. 01, Section 3.5.3.2.7, 5th paragraph, page 3-55
  - Topical Report, Rev. 01, Section 3.5.3.3, 2nd paragraph, page 3-58
  - Topical Report, Rev. 01, Section 3.6.1, 7th paragraph, page 3-61
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 10)

- **"The DOE must provide the technical basis for the correction factors developed for boron remaining in the solution."**
  - Topical Report, Rev. 01, Section 3.4.1.1, 1st list, item 6, page 3-21
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 11)

- **"The DOE is required to develop an acceptable methodology for establishing bias and uncertainties for the isotopic depletion model."**
  - Topical Report, Rev. 01, Section 3.5.3.1.1, 2nd & 3rd paragraphs, page 3-42
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 12)

- **"The DOE needs to establish the bias and associated uncertainty regarding the analysis or model, keeping track of isotopic inventory loss, through cracks or pinholes, within intact spent fuel assemblies."**
  - Topical Report, Rev. 01, Section 3.5.3.1, 2nd & 4th paragraphs, page 3-41
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 13)

- **"The DOE should address the types of criticality uncertainties and biases, which are based on ANSI/ANS-8.17, presented by the [NRC] staff in this SER [Safety Evaluation Report]."**
  - Topical Report, Rev. 01, Sections 3.5.3.2.5 to 3.5.3.2.10
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 14)

- **"The DOE must include a multi-parameter approach in its bias-trending analysis."**
  - Topical Report, Rev. 01, Section 3.5.3.2.7, 6th paragraph, page 3-55
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 15)

- **"The DOE is required to include the isotopic bias and uncertainties as part of Δk_c, if not included as isotopic correction factors."**
  - Topical Report, Rev. 01, Section 3.5.3.2.10, Equation 3-7, page 3-58
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 16)

- **"The DOE must present a validation methodology or work scope for external criticality models."**
  - Topical Report, Rev. 01, Section 3.5.3.2, 1st paragraph, page 3-44
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 17)

- **"The DOE should subject the method used for extending the trend to the procedures defined in ANSI/ANS-8.1-1998, C4(a) and C4(b)."**
  - Topical Report, Rev. 01, Section 3.5.3.2.3, 3rd paragraph, page 3-49
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 18)

- **"The DOE must verify and validate the regression equation or look-up table for all ranges of configuration and WF [waste form] parameters affecting k_{eff}."**
  - Topical Report, Rev. 01, Section 3.5.3.3, page 3-58
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 19)

- **"The DOE is required to include all uncertainties and variabilities introduced by the regression equation or the look-up table."**
  - Topical Report, Rev. 01, Section 3.5.3.3, page 3-58
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Safety Evaluation Report (Open Item 20)

- **"In developing the methodology for steady-state criticality consequences, the DOE must consider other types of moderators, especially with respect to external criticality."**
  - Topical Report, Rev. 01, Section 3.7.2, 2nd paragraph, page 3-76
  - Discussed in presentations
    - Container Life and Source Term Subissue 5, Acceptance Criterion 6: Computer Models for Criticality Consequences

Safety Evaluation Report (Open Item 21)

- **"The DOE must also consider the loss of soluble neutron-absorbing isotopes through pinholes and cracks in the spent fuel cladding, and its effect on steady-state criticality consequence."**
  - Topical Report, Rev. 01, Section 3.7.3.1, 5th paragraph, page 3-85
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 6: Computer Models for Criticality Consequences

Safety Evaluation Report (Open Item 22)

- **"The DOE must also include other types of steady-state criticality consequences, especially with respect to internal criticality, in its consequence analysis approach."**
  - Topical Report, Rev. 01, Section 3.7.1, 1st paragraph, page 3-73
  - Topical Report, Rev. 01, Section 3.7.1.1, 4th paragraph, page 3-74
  - Topical Report, Rev. 01, Section 3.7.1.2, 3rd paragraph, page 3-75
  - Topical Report, Rev. 01, Section 3.7.2, 2nd & 3rd paragraphs, page 3-76
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 6: Computer Models for Criticality Consequences

Safety Evaluation Report (Open Item 23)

- **"The DOE needs to develop, and present for acceptance, the modeling approach for an external steady-state criticality consequence."**
  - Topical Report, Rev. 01, Section 3.7.2.3, page 3-81
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 6: Computer Models for Criticality Consequences

Safety Evaluation Report (Open Item 24)

- **"The DOE must develop and present a request for approval of a methodology for transient criticality consequence."**
  - Topical Report, Rev. 01, Section 3.7.3, page 3-84
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 6: Computer Models for Criticality Consequences

Safety Evaluation Report (Open Item 25)

- **"The DOE needs to develop and present, for NRC acceptance, the modeling approach for transient criticality consequence."**
  - Topical Report, Rev. 01, Section 3.7.3.2, 3rd paragraph, page 3-86
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 6: Computer Models for Criticality Consequences

Safety Evaluation Report (Open Item 26)

- **"The DOE needs to develop a validation approach for the power model for steady-state criticality consequences."**
  - Topical Report, Rev. 01, Section 3.7.2.1, 1st paragraph, page 3-77
  - Topical Report, Rev. 01, Section 3.7.2.3, 2nd paragraph, page 3-81
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 6: Computer Models for Criticality Consequences

Safety Evaluation Report (Open Item 27)

- **"The DOE is require to develop a validation approach for a transient criticality consequence model."**
  - Topical Report, Rev. 01, Section 3.7.3.2, page 3-86
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 6: Computer Models for Criticality Consequences

Safety Evaluation Report (Open Item 28)

- **"The DOE should describe the interface between Figure 1-1 of the RAI [Request for Additional Information] responses and the TSPA [Total System Performance Assessment] criticality risk analysis."**
  - Topical Report, Rev. 01, Section 3.8.1, page 3-91
  - Topical Report, Rev. 01, Section 3.8.2, page 3-93
  - Discussed in presentation
    - Container Life and Source Term Subissue 5, Acceptance Criterion 7: Risk

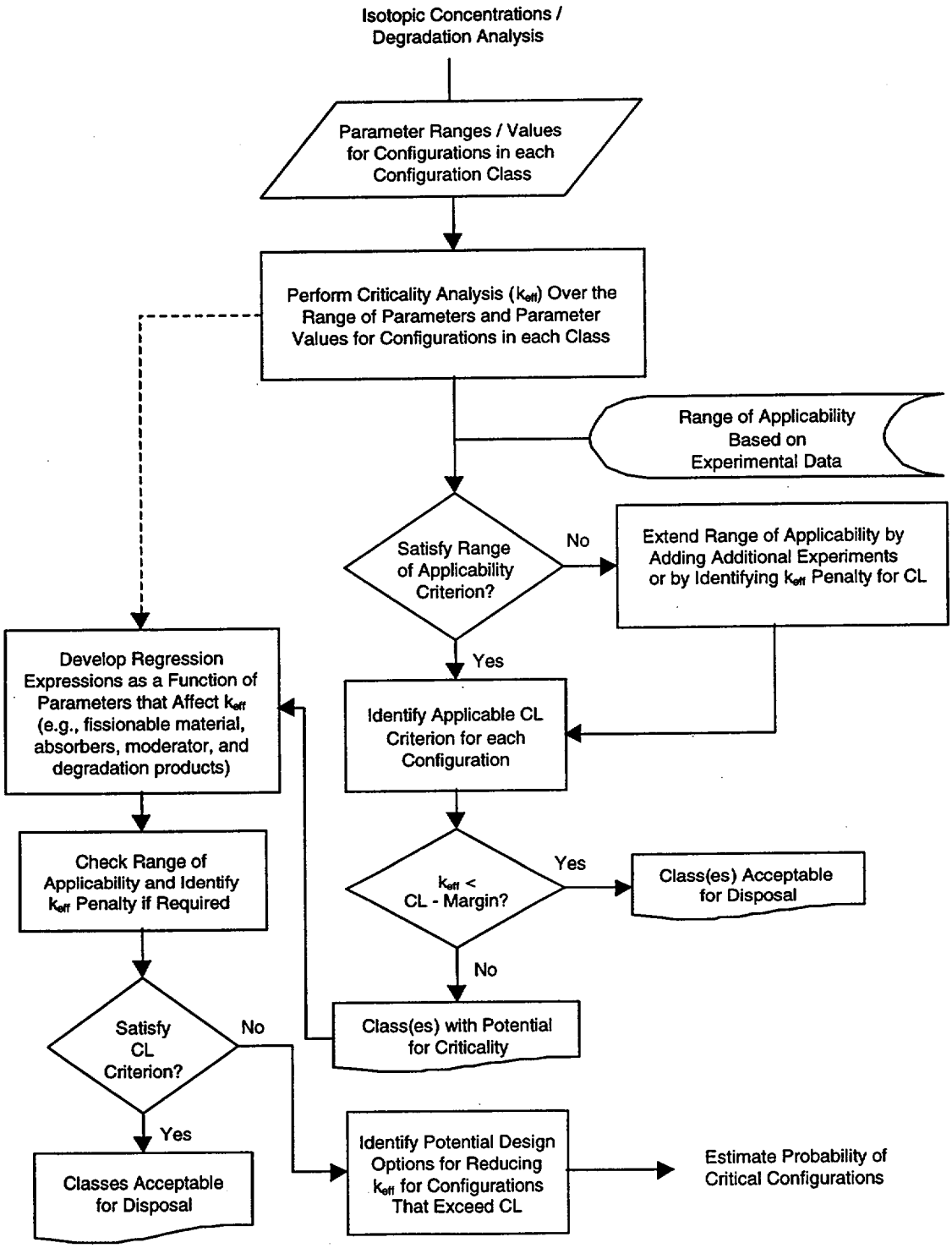


Figure 3-5. Criticality Analysis Methodology

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Container Life and Source Term Subissue 5, Acceptance Criterion 1: Design Criteria

Presented to:
DOE/NRC Technical Exchange on Key Technical Issues and Subissues Related to Criticality

Presented by:
David A. Salmon
Civilian Radioactive Waste Management System Management and Operating Contractor

October 23-24, 2000
Las Vegas, NV

YUCCA MOUNTAIN PROJECT

Outline

- **Presentation Objectives**
- **Current Subissue Status**
- **For items identified in the Container Life and Source Term Issue Resolution Status Report, Rev. 02 and in the Safety Evaluation Report, this presentation will:**
  - Summarize technical basis for item resolution
  - Identify basis documents (References)
  - Summarize technical adequacy of basis
- **Conclusions**

Note: Additional summary information is provided in the delta analysis

Presentation Objectives

- Describe the basis for resolving Acceptance Criterion 1, criticality Subissue 5 of the Container Life and Source Term Key Technical Issue
- Acceptance Criterion 1: Department of Energy (DOE) used sound technical bases for selecting the design criteria for components to mitigate potential effects of in-package criticality on repository performance. These design criteria may include development of subcritical limit, probability and consequence of criticality, and other design criteria considered necessary

Current Subissue Status

- **Container Life and Source Term Issue Resolution Status Report, Rev. 02 indicates technical acceptance criteria applicable to this subissue are OPEN**

Acceptance Criterion 1

- **Action or information needs identified**
  - Transient and external criticality consequence criteria not addressed in the *Disposal Criticality Analysis Methodology Topical Report,* Rev. 0 (Safety Evaluation Report, Open Item 2)
  - Only probability defined in the proposed 10 CFR 63.114(d) can be used for screening criticality events (Safety Evaluation Report, Section 3.2.2)

Acceptance Criterion 1
(Continued)

- **Basis for closure**
  - U.S. Nuclear Regulatory Commission (NRC) (Safety Evaluation Report, Section 3.2) accepted four proposed design criteria:
    - criticality limit
    - criticality probability
    - criticality consequence (with exception)
    - repository performance
  - Topical Report, Rev. 01 adequately addresses the exception by the removal of the of consequence criteria
- **No additional work required. This acceptance criterion is closed-pending the NRC staff review of the Topical Report, Rev. 01**

Criticality Consequence Criteria (Open Item 2)

- **Basis for resolution**
  - Consequence criterion has been removed from the Topical Report, Rev. 01
  - All probability/consequence pairs will be evaluated for inclusion in at least one Total System Performance Assessment sensitivity analysis
- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q REV 01, Section 3.1, Overall Methodology
- **Topical Report, Rev. 01 adequately addresses the criticality consequences by having all probability consequence pairs evaluated for inclusion in Total System Performance Assessment**

Probability Criteria for Screening

- **Basis for resolution**
  - Only probability defined in the proposed 10 CFR 63.114(d) will be used for screening criticality events
- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q REV 01, Subsection 3.2.2, Probability Criterion
- **Topical Report, Rev. 01 identifies that only the probability of 10 CFR 63.114(d) will be used for screening criticality events from the Total System Performance Assessment**

Conclusions

- **DOE believes the status of Acceptance Criterion 1 for the Container Life and Source Term Subissue 5, is closed-pending the NRC staff review of the Topical Report, Rev. 01**

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Container Life and Source Term Subissue 5, Acceptance Criterion 2: Features, Events, and Processes

Presented to:
DOE/NRC Technical Exchange on Key Technical Issues and Subissues Related to Criticality

Presented by:
Peter Gottlieb
Civilian Radioactive Waste Management System Management and Operating Contractor

October 23-24, 2000
Las Vegas, NV

YUCCA MOUNTAIN PROJECT

Outline

- **Presentation Objectives**
- **Current Subissue Status**
- **For items identified in the Container Life and Source Term Issue Resolution Status Report, Rev. 02 and in the Safety Evaluation Report, this presentation will:**
  - Summarize technical basis for item resolution
  - Identify basis documents (References)
  - Summarize technical adequacy of basis
- **Conclusions**

Note: Additional summary information is provided in the delta analysis

Presentation Objectives

- Describe the basis for resolving Acceptance Criterion 2, criticality Subissue 5 of the Container Life and Source Term Key Technical Issue
- Acceptance Criterion 2: Department of Energy (DOE) identified the Features, Events, and Processes that may increase the reactivity of the system inside the Waste Package

Current Subissue Status

- **Container Life and Source Term Issue Resolution Status Report, Rev. 02 indicates technical acceptance criteria applicable to this subissue are OPEN**

Acceptance Criterion 2

- **Action or information needs identified**
  - DOE needs to provide modeling approach for igneous-activity induced criticality, Safety Evaluation Report, Open Item 3
  - Inclusion of seismicity, faulting, and igneous activity in the in-package criticality scenario development is not apparent, Container Life and Source Term Issue Resolution Status Report, Section 5.5.2, paragraph 1
  - Faulting is a feature that needs to be considered in combination with seismic events, Container Life and Source Term Issue Resolution Status Report, Section 5.5.2, paragraph 3

Acceptance Criterion 2
(Continued)

- **Basis for closure**
  - NRC accepted adequacy of DOE's approach, Safety Evaluation Report, Section 3.3.1
  - Topical Report, Rev. 01 comprehensively addresses the Features, Events, and Processes (Total System Performance Assessment and Integration, Issue Resolution Status Report, Rev. 3, Subsection 4.1.1.1.1) pertinent to criticality
- **Actions and information requested regarding this criterion are provided in the Topical Report, Rev. 01 and NRC has accepted DOE's approach. Therefore, this acceptance criterion should be closed with no further work required**

Modeling Approach for Igneous-activity Induced Criticality

- **Basis for resolution**
  - The description of methodology and modeling for igneous events is provided in Topical Report, Rev. 01 and the Disruptive Events Process Model Report. Application of this methodology is based on the volcanic intrusion waste package damage estimated in the Disruptive Events Process Model Report. An application of this methodology is now available (third reference below)
- **References**
  - *Disposal Criticality Analysis Methodology Topical Report,* YMP/TR-004Q REV 01, Subsection 3.3.4, Effect of Volcanic Events
  - *Disruptive Events Process Model Report.* TDR-NBS-MD-000002 REV 00
  - *Probability of Criticality Before 10,000 years.* CAL-EBS-NU-000014 REV 00
- **The methodology and model for the effect of igneous intrusion on criticality are described in Topical Report, Rev. 01 and have been applied in a calculation. Therefore, this open item should be closed with no further work**

Seismicity, Faulting, and Igneous-activity

- **Basis for resolution**
  - DOE believes that the description of methodology and modeling for seismicity and igneous events is now provided in Topical Report, Rev. 01 and the Disruptive Events Process Model Report. The description for seismicity has already been accepted in the Safety Evaluation Report. The Features, Events and Processes for faulting (1.2.02.03.00, Fault Movement Shears Waste Container) has been screened out for low probability
- **References**
  - *Disposal Criticality Analysis Methodology Topical Report,* YMP/TR-004Q REV 01, Sections 3.3.3, Effect of Seismic Events and 3.3.4, Effect of Volcanic Events
  - *Disruptive Events Process Model Report.* TDR-NBS-MD-000002 REV 00
  - *Safety Evaluation Report for Disposal Criticality Analysis Methodology Topical Report, Revision 0.* Letter from C.W. Reamer (NRC) to S. Brocoum (DOE/OCRWM), June 26, 2000, with enclosure. ACC: MOL.20000919.0157, Section 3.3.1

Seismicity, Faulting, and Igneous-activity (Continued)

- The methodology and modeling for seismicity and igneous events has now been incorporated in the Topical Report, Rev. 01 and the Features, Events, and Processes for damage to the Waste Package from faulting has been screened out for low probability. Therefore, this issue should be considered resolved

Faulting

- **Basis for resolution**
  - The Features, Events, and Processes for faulting (1.2.02.03.00, Fault Movement Shears Waste Container) has been screened out on low probability. Therefore, DOE believes that is sufficient demonstration it can have no effect on criticality beyond that already considered as part of seismic vibration. The effect of faulting on the drip rate and/or transport from the Waste Package has also been screened out of Total System Performance Assessment. For these reasons, faulting has not been included in the Topical Report, Rev. 01 configuration classes
- **References**
  - *Fault Displacement Effects on Transport in the Unsaturated Zone* ANL-NBS-HS000020
  - *Disruptive Events FEPs AMR*, ANL-WIS-MD-000005
  - *FEPs database*, 1.2.02.03.00
- **Since Waste Package damage by faulting has been screened out by consideration of Features, Events and Processes, this issue should be considered resolved**

Conclusions

- **DOE believes the status of Acceptance Criterion 2 is closed-pending confirmation by NRC staff review of the Topical Report, Rev. 01**

Primary Criticality FEPs (YMP FEP Database) Correspondence to Topical Report Configuration Classes and Scenarios

No	YMP FEP Database Number/FEP Class	Original FEP Name (in the current version of YMP FEP database)	Topical Report Configuration Class and Standard Scenario
1	**2.1.14.01.00/ Primary entry**	Criticality in waste and EBS	**All IP and NF scenarios and resultant configuration classes** Suggested to be changed to a secondary entry. Covers primary entries 2.1.14.02.00 to 2.1.14.13.00
2	**2.1.14.02.00/ Primary entry**	Criticality in-situ, nominal configuration, top breach	**Flooded nominal intact configuration**
3	**2.1.14.03.00/ Primary entry**	Criticality in-situ, WP internal structures degrade faster than waste form, top breach	**Internal Configuration Class 1 (IP-3a, 3b, 3c, 3d)**
4	**2.1.14.04.00/ Primary entry**	Criticality in-situ, WP internal structures degrade at same rate as waste form, top breach	**Internal Configuration Class 2 (IP-2a)**
5	**2.1.14.05.00/ Primary entry**	Criticality in-situ, WP internal structures degrade slower than waste form, top breach	**Internal Configuration Class 3 (IP-1b)**
6	**2.1.14.06.00/ Primary entry**	Criticality in-situ, waste form degrades in place and swells, top breach	**Internal Configuration Class 6 (IP-1a)**
7	**2.1.14.07.00/ Primary entry**	Criticality in-situ, bottom breach allows flow through WP, fissile material collects at bottom of WP	**Internal Configuration Class 4 (IP-4b, IP-5a and IP-6a)**
8	**2.1.14.08.00/ Primary entry**	Criticality in-situ, bottom breach allows flow through WP, waste form degrades in place	**Internal Configuration Class 5 (IP-4a)**
9	**2.1.14.09.00/ Primary entry**	Near-field criticality, fissile material deposited in near field pond	**External Configuration Class 4 (NF-4a, NF-5a)**
10	**2.1.14.10.00/ Primary entry**	Near-field criticality, fissile solution flows into drift low point	**External Configuration Class 6 (NF-1c)**
11	**2.1.14.11.00/ Primary entry**	Near-field criticality, fissile solution is adsorbed or reduced in invert	**External Configuration Class 3 (NF-1a, NF-1b)**
12	**2.1.14.12.00/ Primary entry**	Near-field criticality, filtered slurry or colloidal stream collects on invert surface	**External Configuration Class 8 (NF-2a, NF-3a)**
13	**2.1.14.13.00/ Primary entry**	Near-field criticality associated with colloidal	**External Configuration Class 5 (NF-3b, NF-3c))**

No	YMP FEP Database Number/FEP Class	Original FEP Name (in the current version of YMP FEP database)	Topical Report Configuration Class and Standard Scenario
		deposits	
14	2.1.14.14.00/ Primary entry	Out-of-package criticality, fuel/magma mixture	Added in response to RAI 3-1; incorporated in proposed Section 3.3.4 of Topical Report
15	2.2.14.01.00/ Primary entry	Critical assembly forms away from repository	All far field (FF) Suggested to be changed to a secondary entry. Covers primary entries 2.2.14.02.00 to 2.2.14.08.00
16	2.2.14.02.00/ Primary entry	Far-field criticality, precipitation in organic reducing zone in or near water table	External Configuration Class 1 (FF-3c, FF-3d, FF-3e)
17	2.2.14.03.00/ Primary entry	Far-field criticality, sorption on clay/zeolite in TSbv	External Configuration Class 2 (FF-1b)
18	2.2.14.04.00/ Primary entry	Far-field criticality, precipitation caused by hydrothermal upwell or redox front in the SZ	External Configuration Class 7 (FF-3a and FF-3b)
19	2.2.14.05.00/ Primary entry	Far-field criticality, precipitation in perched water above TSbv	External Configuration Class 9 (FF-1c)
20	2.2.14.06.00/ Primary entry	Far-field criticality, precipitation in fractures of TSw rock	External Configuration Class 10 (FF-1a)
21	2.2.14.07.00/ Primary entry	Far-field criticality, dryout produces fissile salt in a perched water basin	External configuration Class 9 (FF-1c)
22	2.2.14.08.00/ Primary entry	Far-field criticality associated with colloidal deposits	External Configuration Class 5 (FF-2a, FF-2b, FF-2c)

Secondary Criticality FEPs Mapping into the Primary FEPs and Topical Report Configuration/Scenario Terminology

YMP FEP Database Number/ FEP Class	Original FEP Name (in the current version of YMP FEP database)	Mapping to Primary FEPs	Topical Report Configuration Class and Standard Scenario
2.1.14.00.00 (heading)/ secondary entry	Nuclear Criticality (in wastes and EBS)	Covers primary entries 2.1.14.02.00 to 2.1.14.13.00	All IP and NF scenarios
2.1.14.01.01/ secondary entry	Criticality (in waste and EBS)	N/A-redundant entry (identical with the heading)	N/A-redundant entry
2.1.14.01.02/ secondary entry	Criticality (in waste and EBS)	N/A-redundant entry	N/A-redundant entry
2.1.14.01.03/ secondary entry	Nuclear Criticality (in waste and EBS)	N/A-redundant entry	N/A-redundant entry
2.1.14.01.04/ secondary entry	Nuclear Criticality (in waste and EBS)	N/A-redundant entry	N/A-redundant entry
2.1.14.01.05/ secondary entry	Nuclear Criticality (in waste and EBS)	N/A-redundant entry	N/A-redundant entry
2.1.14.01.06/ secondary entry	Nuclear Criticality: heat (in waste and EBS)	N/A-redundant entry	N/A-redundant entry
2.1.14.01.07/ secondary entry	Nuclear explosions (in waste and EBS)	Considered as part of each primary criticality FEP	N/A
2.1.14.01.08/ secondary entry	DOE SNF criticality in-situ	Included in primary entries 2.1.14.02.00 to 2.1.14.08.00	All IP scenarios for codisposal WP
2.1.14.01.09/ secondary entry	DOE SNF criticality in-situ (radionuclide inventory impact)	Included in primary entries 2.1.14.02.00 to 2.1.14.08.00 Impacts irrelevant to FEPs classification*	All IP scenarios for codisposal WP
2.1.14.01.10/ secondary entry	DOE SNF criticality near-field (radionuclide inventory impact)	Included in primary entries 2.1.14.09.00 to 2.1.14.13.00 Impacts irrelevant to FEPs classification*	All NF scenarios for codisposal WP
2.1.14.01.11/ secondary entry	DOE SNF criticality in-situ (waste heat impact)	Included in primary entries 2.1.14.02.00 to 2.1.14.08.00 Impacts irrelevant to FEPs classification*	All IP scenarios for codisposal WP

* Impacts are part of consequences, which are evaluated for each potentially critical configuration

YMP FEP Database Number/ FEP Class	Original FEP Name (in the current version of YMP FEP database)	Mapping to Primary FEPs	Topical Report Configuration Class and Standard Scenario
2.1.14.01.12/ secondary entry	DOE SNF criticality in-situ (waste package degradation impact)	Included in primary entries 2.1.14.03.00 to 2.1.14.08.00 Impacts irrelevant to FEPs classification*	All IP scenarios for codisposal WP
2.1.14.01.13/ secondary entry	DOE SNF criticality in-situ (waste form degradation impact)	Included in primary entries 2.1.14.03.00 to 2.1.14.08.00 Impacts irrelevant to FEPs classification*	All IP scenarios for codisposal WP
2.1.14.01.14/ secondary entry	DOE SNF criticality in-situ (cladding degradation impact)	Included in primary entries 2.1.14.03.00 to 2.1.14.08.00 Impacts irrelevant to FEPs classification*	All IP scenarios for codisposal WP
2.1.14.02.01/ secondary entry	Criticality - MPC flooded	Included in primary entry 2.1.14.02.00	Flooded nominal intact configuration
2.1.14.02.02/ secondary entry	Criticality – nominal configuration, partially flooded, otherwise intact	N/A-redundant (similar to 2.1.14.02.01)	N/A-redundant
2.1.14.03.01/ secondary entry	Waste package internal structures degrade faster than waste form	N/A-redundant entry (identical with primary entry 2.1.14.03.00)	N/A-redundant
2.1.14.03.02/ secondary entry	Waste package internal structures collapse	Included in primary entries 2.1.14.03.00 to 2.1.14.08.00	Internal Configuration classes 1 to 6 (IP-1 to 6)
2.1.14.03.03/ secondary entry	Criticality – container partially gone, optimal rod configuration, flooded	Included in primary entries 2.1.14.03.00, 2.1.14.04.00 and 2.1.14.07.00	Internal configuration classes 1, 2 and 4 (IP-3a, 3b, 3c, 3d, IP-2a and IP-6a
2.1.14.04.01/ secondary entry	Waste package internal structures and the waste form degrade at the same rate	N/A-redundant entry (identical with primary entry 2.1.14.04.00	N/A-redundant
2.1.14.04.02/ secondary entry	Criticality – clad and disintegrated pellets, optimally mixed, flooded	Included in the primary entries 2.1.14.03.00, 2.1.14.04.00 and 2.1.14.06.00	Internal configuration classes 1, 2 and 6.(IP-3, IP-2a and IP-1a)
2.1.14.05.01/ secondary entry	Waste package internal structures degrade slower than waste form	N/A-redundant entry (identical with primary entry 2.1.14.05.00	N/A-redundant
2.1.14.08.01/ secondary	Neutron absorber system selectively	Included in primary entries 2.1.14.03.00, 2.1.14.04.00, 2.1.14.05.00, 2.1.14.07.00,	Internal configuration classes 1 to 5 (IP-1b, IP-2, IP-3, IP-4 and IP-5)

* Impacts are part of consequences, which are evaluated for each potentially critical configuration

YMP FEP Database Number/ FEP Class	Original FEP Name (in the current version of YMP FEP database)	Mapping to Primary FEPs	Topical Report Configuration Class and Standard Scenario
entry	degrades	2.1.14.08.00	
2.1.14.08.02/ secondary entry	Neutron sorbers selectively flushed from containers	Included in primary entries 2.1.14.03.00, 2.1.14.04.00, 2.1.14.05.00, 2.1.14.07.00, 2.1.14.08.00	Internal configuration classes 1 to 5 (IP-1b, IP-2, IP-3, IP-4 and IP-5)
2.1.14.08.03/ secondary entry	Selective leaching of neutron sorbers	N/A-redundant entry (similar to 2.1.14.08.02)	N/A-redundant
2.1.14.09.01/ secondary entry	Criticality – container gone, intact rods, flooded	Included in primary entry 2.1.14.09.00	External configuration class 4 (NF-5a)
2.1.14.09.02/ secondary entry	Criticality – container gone, intact rods, dry	Included in primary entry 2.1.14.09.00	External configuration class 4 (NF-5a)
2.1.14.09.03/ secondary entry	Criticality – container gone, pile of fuel pellets, dry	Included in primary entry 2.1.14.09.00	External configuration class 4 (NF-5a)
2.1.14.09.04/ secondary entry	Criticality – container gone, pile of fuel pellets, flooded	Included in primary entry 2.1.14.09.00	External configuration class 4 (NF-4a)
2.1.14.09.05/ secondary entry	Criticality – container and cladding gone, fuel powder, flooded	Included in primary entry 2.1.14.09.00	External configuration class 4 (NF-4a)
2.1.14.09.06/ secondary entry	Criticality – container gone, pile of fuel pellets, dry	N/A-redundant entry (identical with 2.1.14.09.03)	N/A-redundant
2.1.14.09.07/ secondary entry	Formation of a critical assembly in a pool (in waste and EBS)	Included in primary entry 2.1.14.09.00	External configuration class 4 (NF-4a)
2.1.14.09.08/ secondary entry	Pu accumulates in basin pool (in waste and EBS)	Included in primary entries 2.1.14.09.00 and 2.1.14.10.00	External configuration classes 4 and 6 (NF-4a and NF-1c)
2.1.14.09.09/ secondary entry	Accumulated 239Pu decays to 235U in basin pool (in waste and EBS)	Included in primary entries 2.1.14.09.00, 2.1.14.10.00 and 2.1.14.12.00	External configuration classes 4, 6 and 8 (NF-4a, NF-1c, NF-3a) Pu decay should be addressed in all configurations containing fissile Pu.
2.1.14.10.01/ secondary entry	Accumulation of clays and sediments in basin (in EBS)	Included in primary entries 2.1.14.09.00 and 2.1.14.10.00	External configuration classes 4 and 6 (NF-4a and NF-1c)
2.1.14.10.02/ secondary entry	Differential solubility of neutron poisons	Included in all primary entries that cover degraded configurations	All degraded configurations
2.1.14.10.03/ secondary entry	Selective leaching of fissile materials	Included in all primary entries that cover degraded configurations	All degraded configurations
2.1.14.11.01/	Differential solubility of	Included in all primary entries	All degraded configurations

YMP FEP Database Number/ FEP Class	Original FEP Name (in the current version of YMP FEP database)	Mapping to Primary FEPs	Topical Report Configuration Class and Standard Scenario
secondary entry	fissile isotopes	that cover degraded configurations	
2.2.14.00.00 (heading)/ secondary entry	Nuclear criticality in geosphere	Covers primary entries 2.2.14.01.00 to 2.2.14.08.00	All far-field configurations
2.2.14.01.01/ secondary entry	Reconcentration (release/ migration factors)	Included in primary entries 2.2.14.01.00 to 2.2.14.08.00	All far-field configurations
2.2.14.01.02/ secondary entry	Reconcentration (release/migration factors)	N/A-redundant (identical with 2.2.14.01.01)	N/A-redundant
2.2.14.01.03/ secondary entry	DOE SNF criticality far-field (radionuclide inventory impact)	Included in primary entries 2.2.14.01.00 to 2.2.14.08.00 Impacts irrelevant to FEPs classification*	All far-field configurations
2.2.14.01.04/ secondary entry	DOE SNF criticality far-field (waste heat impact)	Included in primary entries 2.2.14.01.00 to 2.2.14.08.00 Impacts irrelevant to FEPs classification*	All far-field configurations
2.2.14.02.01/ secondary entry	Precipitation of U at reducing zone associated w/organics in alluvial aquifer	Included in primary entry 2.2.14.02.00	External configuration class 1 (FF-3d)
2.2.14.02.02/ secondary entry	Precipitation of U at reducing zone associated w/organics in Franklin Lake Playa	Included in primary entry 2.2.14.02.00	External configuration class 1 (FF-3e)
2.2.14.03.01/ secondary entry	Accumulation of solute in topographic lows of the altered TSbv	Included in primary entry 2.2.14.05.00	External configuration class 9 (FF-1c)
2.2.14.04.01/ secondary entry	Precipitation of U in the upwelling zone along some faults	Included in primary entry 2.2.14.04.00	External configuration class 7 (FF-3a)
2.2.14.04.02/ secondary entry	Precipitation of U below the redox front in the SZ	Included in primary entry 2.2.14.04.00	External configuration class 7 (FF-3b)

* Impacts are part of consequences, which are evaluated for each potentially critical configuration

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Container Life and Source Term Subissue 5 Acceptance Criterion 3: Configuration Classes that have Potential for Criticality

Presented to:
DOE/NRC Technical Exchange on Key Technical Issues and Subissues Related to Criticality

Presented by:
Peter Gottlieb
Civilian Radioactive Waste Management System Management and Operating Contractor

October 23-24, 2000
Las Vegas, NV

YUCCA MOUNTAIN PROJECT

Outline

- **Presentation Objectives**
- **Current Subissue Status**
- **For items identified in Container Life and Source Term Issue Resolution Status Report, Rev. 02 and in the Safety Evaluation Report, this presentation will:**
  - Summarize technical basis for item resolution
  - Identify basis documents (References)
  - Summarize technical adequacy of basis
- **Conclusions**

Note: Additional summary information is provided in the delta analysis

Presentation Objectives

- Describe the basis for resolving Acceptance Criterion 3, criticality Subissue 5 of the Container Life and Source Term Key Technical Issue
- Acceptance Criterion 3: Department of Energy (DOE) identified the configuration classes and configurations with potential for nuclear criticality. Models used to develop the configuration, approach, and accuracy in modeling verification and validation will be evaluated

Current Subissue Status

- **Container Life and Source Term Issue Resolution Status Report, Rev. 02 indicates technical Acceptance Criterion applicable to this subissue are OPEN**

Acceptance Criterion 3

- **Action or Information Needs Identified**
  - [Justify] Chemical composition and quantity of corrosion products present within the waste package [for which criticality control credit is taken]. Container Life and Source Term Issue Resolution Status Report, Section 5.5.3
  - Alternate forms of corrosion products, such as FeOOH need to be considered explicitly. Container Life and Source Term Issue Resolution Status Report, Section 5.5.3
  - DOE [must] evaluate the probability of occurrence of all configurations identified as *autocatalytic* in published articles as promised in the response to Request for Additional Information 1-4. Safety Evaluation Report, Section 3.4.1.1
  - DOE should clarify the correspondence between configuration classes of the Topical Report, Rev. 01 and the Features, Events, and Processes database

Acceptance Criterion 3

(Continued)

- **Basis for Closure**
  - Acceptance of the methodology for identifying the configurations in the Safety Evaluation Report, Section 3.4.1.2
  - DOE methodology identified the configuration classes and configurations with potential for nuclear criticality and defined procedures for evaluating the accuracy of the models used
- **This Acceptance Criterion should be closed-pending the following work**
  - Complete and provide validation reports, which will include evaluating model accuracy for the parameter ranges used in actual licensing applications of the methodology of the Topical Report, Rev. 01

Quantity of Corrosion Products within the Waste Package

- **Basis for resolution**
  - DOE believes the methodology comprehensively examines possible ranges for concentrations of fissionable materials, neutron absorbers in solution and in solids, and for insoluble corrosion products of other internal waste package components. Application of this methodology to the broadest possible range of parameters has been demonstrated by the following calculations:
    - Calculation of criticality for 21 Pressurized Water Reactor waste packages with loss of neutron absorbers and iron oxide increasing, with time, to 100%
    - Calculation of internal criticality for Pu ceramic waste form with Gd loss increasing, with time, to 100%
  - The Safety Evaluation Report, Section 3.4.1.2, has accepted the use of a steady-state geochemistry code to calculate the loss of fissionable elements and neutron absorbers and the composition of degradation products

Quantity of Corrosion Products within the Waste Package (Continued)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q REV 01,Section 3.4.1.1, Methodology for Internal Configurations, Item 6
  - *Updated Calculation of Probability of Criticality for EDA II Waste Package Design.* CAL-UDC-MD-000001REV 00
  - *Probability of Criticality for MOX SNF.* CAL-EBS-NU-000007 REV 00
  - *Waste Package Related Impacts of Plutonium Disposition Waste Forms in a Geologic Repository.* TDR-EBS-MD-000003 REV 01, for application to the Pu ceramic containing Waste Package
- **Topical Report, Rev. 01, describes the requested aspect of the methodology. The Safety Evaluation Report has accepted the use of geochemistry code for this purpose. The cited calculations are examples of such sensitivity considerations. No additional work is required to ensure chemical composition and quantity of corrosion products**

Alternate forms of Corrosion Products (e.g., FeOOH)

- **Basis for resolution**
  - DOE believes the methodology ensures consideration of all mineral variations formed from elements released by degradation of waste package components. In particular, the geochemistry calculations have considered at least one sensitivity case with FeOOH, instead of hematite
  - General geochemistry methodology described in the Topical Report, Rev. 01, Section 3.4
- **References**
  - *Safety Evaluation Report for Disposal Criticality Analysis Methodology Topical Report, Revision 0*. Letter from C.W. Reamer (NRC) to S. Brocoum (DOE/OCRWM), June 26, 2000, with enclosure. ACC: MOL.20000919.0157, Section 3.4.1.2
  - Brocoum, S. 1999. U.S. Department of Energy (DOE) Response to U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information on the DOE Topical Report on Disposal Criticality Analysis Methodology. Letter from S. Brocoum, (DOE) to C.W. Reamer (NRC), November 19, 1999, with enclosures. ACC: MOL.20000119.0208, response to 3-17

Alternate forms of Corrosion Products (e.g., FeOOH) (Continued)

- **References (Continued)**
  - *EQ6 Calculation for Chemical Degradation of Shippingport LWBR (Th/U Oxide) Spent Nuclear Fuel Waste Packages.* CAL-EDC-MD-000008 REV 00
  - *EQ6 Calculation for Chemical Degradation of Pu-Ceramic Waste Packages: Effects of Updated Materials Composition and Rates.* CAL-EDC-MD-000003 REV 00
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q REV 01, Section 3.4, Potentially Critical Configurations
- **Adequacy to ensure consideration of mineral variations without additional work has been demonstrated by the description of the requested aspect of the methodology in the Topical Report, Rev. 01 and the example geochemistry calculations**

Probability of Occurrence of Potentially *Autocatalytic* Configurations

- **Basis for resolution**
  - DOE believes the methodology ensures consideration of all credible configurations that are potentially *autocatalytic* and will ensure development of probability upper bounds for configurations proposed by credible authorities. The Safety Evaluation Report states that the NRC indicated acceptance of this aspect of the methodology
- **References**
  - Brocoum, S. 1999. U.S. Department of Energy (DOE) Response to U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information on the DOE Topical Report on Disposal Criticality Analysis Methodology. Letter from S. Brocoum, (DOE) to C.W. Reamer (NRC), November 19, 1999, with enclosures. ACC: MOL.20000119.0208, response to 1-4
  - *Safety Evaluation Report for Disposal Criticality Analysis Methodology Topical Report, Revision 0.* Letter from C.W. Reamer (NRC) to S. Brocoum (DOE/OCRWM), June 26, 2000, with enclosure. ACC: MOL.20000919.0157, Section 3.4.1.1

Probability of Occurrence of Potentially *Autocatalytic* Configurations (Continued)

- NRC has agreed this aspect of the methodology is adequately implemented by the language in the response to Request for Additional Information 1-4. Therefore, no further work is required

Configuration Classes and Features, Events, and Processes database

- **Basis for resolution**
  - DOE believes the Features, Events, and Processes correspondence table provided to the NRC staff in January 2000 was sufficient to demonstrate both the criticality Features, Events, and Processes and configuration classes of the Topical Report, Rev. 01 comprehensively covered the possibilities of criticality
  - To facilitate future comparisons by the NRC staff, the following tables are provided as part of the Technical Exchange
    - Table listing those criticality Features, Events, and Processes that are non-redundant with respect to the Topical Report, Rev. 01 configuration classes (called primary Features, Events, and Processes). These have a direct correspondence with one or more Topical Report, Rev. 01 configuration classes

Configuration Classes and Features, Events, and Processes database (Continued)

- **Basis for resolution (Continued)**
  - To facilitate future comparisons by the NRC staff, the following tables are provided as part of the Technical Exchange (Continued)
    - Table listing the secondary criticality Features, Events, and Processes, together with the mapping to primary Features, Events, and Processes. This table will be included in the Features, Events, and Processes database to ensure no analyses are conducted with respect to the secondary Features, Events, and Processes
- **References**
  - Table of primary criticality Features, Events, and Processes and the corresponding configuration class(es)
  - Table listing secondary Features, Events, and Processes and their mapping to primary Features, Events, and Processes
- **The tables supplied with this presentation have clarified the Features, Events, and Processes correspondences such that further work is not required**

Conclusions

- **DOE believes the status of Acceptance Criterion 3, Configuration Classes that have Potential for Criticality, is closed-pending only the completion of those validation reports, which will include the evaluation of the accuracy of the models used in the methodology of the Topical Report, Rev. 01**

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Container Life and Source Term Subissue 5, Acceptance Criterion 4: Method for Assigning Probability Values

Presented to:
DOE/NRC Technical Exchange on the Key Technical Issues and Subissues Related to Criticality

Presented by:
Peter Gottlieb
Civilian Radioactive Waste Management System Management and Operating Contractor

October 23-24, 2000
Las Vegas, NV

YUCCA MOUNTAIN PROJECT

Outline

- **Presentation Objectives**
- **Current Subissue Status**
- **For items identified in the Container Life and Source Term Issue Resolution Status Report, Rev. 02 in the Safety Evaluation Report, this presentation will:**
  - Summarize technical basis for item resolution
  - Identify basis documents (References)
  - Summarize technical adequacy of basis
- **Conclusions**

Note: Additional summary information is provided in the delta analysis

Presentation Objectives

- Describe the basis for resolving Acceptance Criterion 4, criticality Subissue 5 of the Container Life and Source Term Key Technical Issue
- Acceptance Criterion 4: Department of Energy (DOE) developed a technically defensible, transparent, and traceable method in assigning probability values to each of the scenario classes, scenarios, configuration classes, and configurations

Current Subissue Status

- **Container Life and Source Term Issue Resolution Status Report, Rev. 02 indicates technical acceptance criterion applicable to this subissue are OPEN**

Acceptance Criterion 4

- **Action or information needs identified**
  - Some questions such as the accounting for the correlation sampled parameters [drip rates, barrier lifetimes] have been raised. Container Life and Source Term Issue Resolution Status Report, Section 5.5.3, Criticality Probability, and Request for Additional Information 4-35
  - Determine if the excess computing time associated with very multi-dimensional table lookup and interpolation will adversely impact the precision of a Monte Carlo calculation requiring a large number of realizations

Acceptance Criterion 4
(Continued)

- **Basis for Closure**
  - Response to Request for Additional Information 4-35 indicates dependencies between probabilistically sampled variables is likely to be weak
  - Monte Carlo configuration generating calculations thus far have used up to 4 simultaneous lookup and interpolation parameters, without experiencing great increase in running time
- **This Acceptance Criterion should be closed-pending confirmation by NRC staff review of the example references**

Potential Correlation of Sampled Parameters

- **Basis for resolution**
  - DOE believes the response to Request for Additional Information 4-35 explains little correlation exists
    - Between the drip rate before waste package breach (which is a strong determinant of waste package breach time, but is only sampled in the WAPDEG runs), and
    - The drip rate after breach (which is the only drip rate sampled in the Monte Carlo configuration generator runs)
- **References**
  - Brocoum, S. 1999. U.S. Department of Energy (DOE) Response to U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information on the DOE Topical Report on Disposal Criticality Analysis Methodology. Letter from S. Brocoum, (DOE) to C.W. Reamer (NRC), November 19, 1999, with enclosures. ACC: MOL.20000119.0208

Potential Correlation of Sampled Parameters (Continued)

- **The response to the Request for Additional Information was sufficient. Therefore, this item should be resolved**

Computing Time for Monte Carlo Realizations

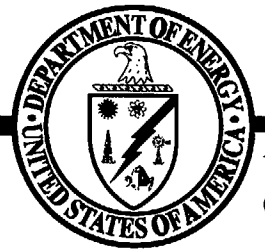
- **Basis for resolution**
  - DOE believes the example Monte Carlo calculations with up to 4 simultaneous lookup and interpolation parameters that have not experienced great increase in running time, adequately demonstrate the general effectiveness of this methodology
- **Reference**
  - *Probability of Criticality for MOX SNF.* CAL-EBS-NU-000007 REV 00
  - Brocoum, S. 1999. U.S. Department of Energy (DOE) Response to U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information on the DOE Topical Report on Disposal Criticality Analysis Methodology. Letter from S. Brocoum, (DOE) to C.W. Reamer (NRC), November 19, 1999, with enclosures. ACC: MOL.20000119.0208

Computing Time for Monte Carlo Realizations (Continued)

- **The example calculations indicate the Monte Carlo technique can be applied with a moderately large number of simultaneous lookup and interpolation parameters without experiencing an unacceptably large running time. Therefore, this issue should be closed without further work**

Conclusions

- **DOE believes the status of Acceptance Criterion 4 should be closed-pending confirmation by NRC staff review of the example Monte Carlo calculation**



U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Container Life and Source Term Subissue 5, Acceptance Criterion 5: Computer Models for Calculating k_{eff}

Presented to:
DOE/NRC Technical Exchange on Key Technical Issues and Subissues Related to Criticality

Presented by:
David A. Salmon and Daniel A. Thomas
Civilian Radioactive Waste Management System Management and Operating Contractor

October 23-24, 2000
Las Vegas, NV

YUCCA MOUNTAIN PROJECT

Outline

- **Presentation Objectives**
- **Current Subissue Status**
- **For items identified in the Container Life and Source Term Issue Resolution Status Report, Rev. 02 and in the Safety Evaluation Report, this presentation will:**
  - Summarize technical basis for item resolution
  - Identify basis documents (References)
  - Summarize technical adequacy of basis
- **Conclusions**

Note: Additional summary information is provided in the delta analysis

Presentation Objectives

- Describe the basis for resolving Acceptance Criterion 5, criticality Subissue 5 of the Container Life and Source Term Key Technical Issue
- Acceptance Criteria 5: Department of Energy (DOE) has developed appropriate computer models, input parameters, and determined quantitative values for calculating the effective neutron multiplication factor (k_{eff}), including appropriate biases and uncertainties in the model

Current Subissue Status

- **Container Life and Source Term Issue Resolution Status Report, Rev. 02 indicates technical acceptance criteria applicable to this subissue are OPEN**

Acceptance Criterion 5
(Continued)

- **Action or information needs identified**
  - DOE must include effects of radionuclide migration from intact fuel assembly through pinholes and cracks in cladding, Safety Evaluation Report, Open Item 4
  - DOE must include a criticality margin when comparing k_{eff} values from regression analyses to Critical Limit values, Safety Evaluation Report, Open Item 5
  - DOE must present approach for developing criticality margin, Safety Evaluation Report, Open Item 6
  - DOE must demonstrate adequacy of one-dimensional modeling of three-dimensional neutron spectral effects or use two/three-dimensional calculations, Safety Evaluation Report, Open Item 7

Acceptance Criterion 5
(Continued)

- **Action or information needs identified (Continued)**
  - DOE must use cross-section data corresponding to temperature for waste package or critical benchmarks, Safety Evaluation Report, Open Item 8
  - DOE must include cross-dependency of configuration parameters for k_{eff} regression equations, Safety Evaluation Report, Open Item 9
  - DOE must provide technical basis for correction factor for boron remaining in solution, Safety Evaluation Report, Open Item 10
  - DOE must have acceptable methodology for establishing bias and uncertainty for isotopic depletion model, Safety Evaluation Report, Open Item 11
  - DOE must establish bias and uncertainty for isotopic loss through cracks or pinholes within intact spent fuel assemblies, Safety Evaluation Report, Open Item 12

Acceptance Criterion 5
(Continued)

- **Action or information needs identified (Continued)**
  - DOE should address types of criticality uncertainties and biases based on ANSI/ANS-8.17, Safety Evaluation Report, 3.5.3.2 & Safety Evaluation Report, Open Item 13
  - DOE must include a multi-parameter approach in bias trending analysis, Safety Evaluation Report, Open Item 14
  - DOE must include isotopic bias and uncertainties as part of Δk_c, if not included as isotopic correction factors, Safety Evaluation Report, Open Item 15
  - DOE must present validation methodology work scope for external criticality models, Safety Evaluation Report, Open Item 16

Acceptance Criterion 5
(Continued)

- **Action or information needs identified (Continued)**
  - DOE must subject method for extending trend to procedures defined in ANSI/ANS-8.1-1998, C4(a) and C4(b), Safety Evaluation Report, Open Item 17
  - DOE must verify and validate the regression equation or look-up table for all ranges of configuration and waste form parameters affecting k_{eff}, Safety Evaluation Report, Open Item 18
  - DOE must include all uncertainties and variabilities introduced by regression equation or look-up table, Safety Evaluation Report, Open Item 19

Acceptance Criterion 5
(Continued)

- **Basis for closure**
  - Rev. 01 of the *Disposal Criticality Analysis Methodology Topical Report* addresses all of the Safety Evaluation Report Open Items related to this acceptance criterion
  - NRC has accepted the Topical Report/Safety Evaluation Report, process for resolving issues
  - DOE has described the plan to develop validation reports supplemental to the Topical Report
- **No additional work required, pending closure of the Open Items identified in the Safety Evaluation Report, through the Topical Report/Safety Evaluation Report process**

Effects of Radionuclide Migration through Pinholes (Open Item 4)

- **Basis for resolution**
  - DOE believes this Open Item is proceeding toward resolution, because the loss of radionuclides will be established in geochemical analysis, including pinhole effects, and accounted for in the criticality analysis and the probability analysis
  - This item also addressed in the Open Item 12 of this presentation and Open Item 21 of the presentation for Acceptance Criterion 6

Effects of Radionuclide Migration through Pinholes (Open Item 4)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.5.1.1: Material Composition, Subsection 3.5.2.1.1: Principal Isotopes for Commercial SNF Burnup Credit, Subsection 3.5.2.1.4: Isotopic Concentrations of Degraded Configurations
- **Topical Report, Rev. 01 describes the geochemical analysis which specifically includes the effects of pinholes. Details of the effects of pinholes will be provided in the Steady-state Criticality Consequence Model Validation Report**

Criticality Margin for Regression Analyses (Open Item 5)

- **Basis for resolution**
  - DOE believes this Open Item should be proceeding toward resolution because a k_{eff} margin will be applied to ensure no configuration class will be prematurely identified as acceptable for disposal
  - Use of subcritical margin not consistent with 10 CFR 63 and a risk-informed approach. DOE is not planning on using subcritical margin for the determination of the probability of critical configurations
  - Analysis process is used for establishing the probability of critical configurations, not the probability of subcritical configurations

Criticality Margin for Regression Analyses (Open Item 5)

- **Basis for resolution (continued)**
  - ANSI/ANS-8.17 intended for deterministic uses, not risk-informed
  - DOE understands necessity to perform fine parametric criticality evaluations and these will be performed in the application of the prescribed methodology in the Topical Report, Rev. 01

Criticality Margin for Regression Analyses
(Open Item 5)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q Rev. 01, Subsection 2.3.2: Industry Standards, Subsection 3.5.1.2: k_{eff} Evaluations
- **Topical Report, Rev. 01 provides the information necessary to resolve this Open Item. It identifies a criticality margin ensuring no configuration classes will be prematurely accepted for disposal and is consistent with a risk-informed approach in determining the probability of critical configurations**

Approach for Developing Criticality Margin
(Open Item 6)

- **Basis for resolution**
  - DOE believes this Open Item should be proceeding toward resolution because the k_{eff} margin to be applied will be established and documented in the waste form Criticality Model Validation Reports
  - DOE is proposing not to use a subcritical margin in the regression analysis/table lookup process in establishing the probability of critical configurations
  - Consistent with response to Safety Evaluation Report, Open Item 5

Approach for Developing Criticality Margin (Open Item 6)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q Rev. 01, Subsection 2.3.2: Industry Standards, Subsection 3.5.1.2: k_{eff} Evaluations
- **Topical Report, Rev. 01 provides the information necessary to resolve this Open Item by identifying the process of establishing the k_{eff} margin through the criticality model validation reports**

Adequacy of One-Dimensional Modeling of Spectral Effects (Open Item 7)

- **Basis for resolution**
  - DOE believes this Open Item is proceeding toward resolution because the isotopic depletion model will account for multi-dimensional neutron spectral effects through comparisons to multi-dimensional codes
  - Adequacy of the isotopic depletion model will be addressed in the Isotopic Model Validation Reports. These validation reports will contain comparisons to multi-dimensional codes used in operational reactor licensing calculations

Adequacy of One-Dimensional Modeling of Spectral Effects (Open Item 7)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.5.2.1.2: Initial Isotopic Concentrations of Commercial SNF, Subsection 3.5.3.1.1: Establishing Bias and Uncertainty in Isotopic Model
- **Topical Report, Rev. 01 describes how the Isotopic Model Validation Reports will address the adequacy of the modeling used. These Validation Reports will contain adequate information to resolve the Open Item**

Cross-Section Data at Temperature
(Open Item 8)

- **Basis for resolution**
  - DOE believes this Open Item is proceeding toward resolution because DOE plans to include temperature dependent cross-section data as appropriate and demonstrate the cross-section data used is conservative
  - Adequacy of cross-section data will be addressed in the Boiling Water Reactor, Pressurized Water Reactor, and DOE fuels Criticality Model Validation Reports

Cross-Section Data at Temperature

(Open Item 8)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.5.2.2: Criticality Modeling
- **Topical Report, Rev. 01 describes how the Criticality Model Validation Reports will address the adequacy of the cross-sections used. These Validation Reports will contain adequate information to resolve the Open Item**

Cross-Dependency of Configuration Parameters (Open Item 9)

- **Basis for resolution**
  - DOE believes this Open Item is proceeding toward resolution because the cross-dependency of configuration parameters will be included in the regressions
- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.6.1: Criticality Probability Methodology
- **Topical Report, Rev. 01 provides the necessary information to resolve this Open Item. DOE's approach includes parameter cross-dependency**

Technical Basis for Boron Correction Factors (Open Item 10)

- **Basis for resolution**
  - DOE believes this Open Item is resolved because no reactivity credit will be taken for neutron absorber in solution
- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.4.1.1, item 6
- **Topical Report, Rev. 01 contains the necessary information to resolve this Open Item. Credit for boron in solution will not be sought**

Methodology for Establishing Isotopic Model Bias and Uncertainty (Open Item 11)

- **Basis for resolution**
  - DOE believes this Open Item is proceeding toward resolution because the general methodology for establishing the isotopic bias and uncertainty is described in the Topical Report, Rev. 01
  - Establishment of bias and uncertainty for isotopic depletion will be addressed in detail in the Isotopic Model Validation Report

Methodology for Establishing Isotopic Model Bias and Uncertainty (Open Item 11)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.5.3.1.1: Establishing Bias and Uncertainty in Isotopic Model
- **Topical Report, Rev. 01 and the Isotopic Model Validation Reports will provide the information necessary to resolve the Open Item**

Bias and Uncertainty for Isotopic Loss through Pinholes (Open Item 12)

- **Basis for resolution**
  - DOE believes this Open Item is proceeding toward resolution because the loss of radionuclides will be established in geochemical analysis and accounted for in the criticality analysis and the probability analysis
  - Consistent with resolution for Open Item 4 and also discussed in the presentation for Acceptance Criteria 6 for Open Item 21
  - Uncertainty represented in probability distributions for configurations analyzed for criticality

Bias and Uncertainty for Isotopic Loss through Pinholes (Open Item 12)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.5.3.1.1: Establishing Bias and Uncertainty in Isotopic Model
- **Topical Report, Rev. 01 and the Geochemistry Model and Isotopic Model Validation Reports will provide the information necessary to resolve this Open Item**

Types of Criticality Biases and Uncertainties (Open Item 13)

- **Basis for resolution**
  - DOE believes this Open Item is proceeding toward resolution because the Topical Report, Rev. 01 addresses the issue of criticality biases and uncertainties
  - Topical Report, Rev. 01 follows ANSI/ANS-8.17 guidelines for establishing biases and uncertainties
  - System, calculation, and experimental effects are accounted for, including penalties for extending the range of applicability

Types of Criticality Biases and Uncertainties (Open Item 13)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.5.3.2.5 to 3.5.3.2.10: Determination of Bias and Uncertainty to Criticality Acceptance Criteria for the Isotopic and Criticality Models
- **Topical Report, Rev. 01 provides the information necessary to resolve this Open Item. It describes the types of bias and uncertainty and how they are to be used**

Multi-Parameter Approach
(Open Item 14)

- **Basis for resolution**
  - DOE believes this Open Item is proceeding toward resolution because the Topical Report, Rev. 01 presents a multi-parameter approach
  - k_{eff} trended vs. one or more parameters
  - Approach based on documented methods for multiple regression tolerance limits (Lieberman and Miller, Biometrika 50, 1963)

Multi-Parameter Approach
(Open Item 14)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.5.3.2.7: Regression Methods
- **Topical Report, Rev. 01 provides the information necessary resolve the Open Item. It describes how a multi-parameter approach is to be used**

Isotopic Bias and Uncertainties in Δk_c (Open Item 15)

- **Basis for resolution**
  - DOE believes this Open Item is proceeding toward resolution because the criticality acceptance criteria includes isotopic bias and uncertainty
  - DOE will use same statistical approach for radiochemical assays as used for criticality experiments to obtain the bias and uncertainty associated with the isotopic model (Δk_I)

Isotopic Bias and Uncertainties in Δk_c (Open Item 15)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.5.3.2.10: Criticality Acceptance Criteria for the Isotopic and Criticality Models
- **Topical Report, Rev. 01 provides the information necessary to resolve this Open Item. It describes a criticality acceptance criteria and how isotopic bias and uncertainty is included there**

Validation Methodology for External Criticality (Open Item 16)

- **Background**
  - This Open Item belongs with the Evolution of the Near-Field Environment, and Radionuclide Transport Key Technical Issues, for which criticality has already been determined to be close-pending. It is included here for completeness (of discussing the Safety Evaluation Report Open Items)
- **Basis for resolution**
  - DOE believes this Open Item is proceeding toward resolution because the same validation methodology is used for internal and external criticality models - only different experiments
  - Validation of external criticality model will be presented in the External Criticality Model Validation Report

Validation Methodology for External Criticality (Open Item 16)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.5.3.2: Criticality Validation
- **Topical Report, Rev. 01 and the External Criticality Model Validation Report will provide the information necessary to resolve this Open Item, although not germane to Container Life and Source Term**

Method for Extending Trend
(Open Item 17)

- **Basis for resolution**
  - DOE believes this Open Item is proceeding toward resolution because DOE will use the procedures defined in ANSI/ANS - 8.1, C4(a) and C4(b) for extending trends
- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.5.3.2.3: Extension of the Range of Applicability
- **Topical Report, Rev. 01 provides the information necessary to resolve this Open Item. It describes how trends will be extended consistent with ANSI/ANS-8.1**

Verify and Validate the Look-Up Table
(Open Item 18)

- **Basis for resolution**
  - DOE believes this Open Item is proceeding toward resolution because the uncertainty in k_{eff} values will be established as characterized by statistical tolerance limits
  - Adequacy of regression equations and look-up tables be addressed in the Criticality Model Validation Reports

Verify and Validate the Look-Up Table

(Open Item 18)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.5.3.3: Regression Analysis Validation
- **Topical Report, Rev. 01 and the Criticality Model Validation Reports will provide the information necessary to resolve this Open Item. The Criticality Model Validation Reports will document the validation for the look-up tables**

Uncertainties in the Look-Up Table
(Open Item 19)

- **Basis for resolution**
  - DOE believes this Open Item is proceeding toward resolution because uncertainty will be added to k_{eff} value obtained from regression equation or look-up table prior to comparison with the Critical Limit
- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 01, Subsection 3.5.3.3: Regression Analysis Validation
- **Topical Report, Rev. 01 provides the information necessary to resolve this Open Item. It documents that uncertainty will be added prior to comparison with the critical limit**

Conclusions

- **DOE believes the status of Acceptance Criterion 5 for the Container Life and Source Term Subissue 5, criticality, is closed-pending confirmation, because all of the issues relative to the Safety Evaluation Report Open Items related to this Acceptance Criterion have been addressed in the Topical Report, Rev. 01 and the validation report plans are presented therein**

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Container Life and Source Term Subissue 5, Acceptance Criterion 6: Computer Models for Criticality Consequences

Presented to:
DOE/NRC Technical Exchange on Key Technical Issues and Subissues Related to Criticality

Presented by:
Peter Gottlieb
Civilian Radioactive Waste Management System Management and Operating Contractor

October 23-24, 2000
Las Vegas, NV

YUCCA MOUNTAIN PROJECT

Outline

- **Presentation Objectives**
- **Current Subissue Status**
- **For items identified in the Safety Evaluation Report this presentation will:**
  - Summarize technical basis for item resolution
  - Identify basis documents (References)
  - Summarize technical adequacy of basis
- **Conclusions**

Note: Additional summary information is provided in the delta analysis

Presentation Objectives

- Describe the basis for resolving Acceptance Criterion 6, criticality Subissue 5 of the Container Life and Source Term Key Technical Issue
- Acceptance Criterion 6: Department of Energy (DOE) developed appropriate computer models, evaluated input parameters, and determined quantitative values for calculating the radionuclide inventory, heat, kinetic energy, and other parameters that would change as a result of k_{eff} exceeding the subcritical limit developed under Criterion 1

Current Subissue Status

- **Container Life and Source Term Issue Resolution Status Report, Rev. 02 indicates technical acceptance criteria applicable to this subissue are OPEN**

Acceptance Criterion 6

- **Action or information needs identified**
  - In developing the methodology for steady-state criticality consequences, the DOE must consider other types of moderators, especially with respect to external criticality.
    Safety Evaluation Report, Section 3.7.1.1, Open Item 20
  - The DOE must also consider the loss of soluble neutron absorbing isotopes through pinholes and cracks in the spent fuel cladding, and its effect on steady-state criticality consequence. Safety Evaluation Report, Section 3.7.1.1, Open Item 21

Acceptance Criterion 6
(Continued)

- **Action or information needs identified (Continued)**
  - The DOE must also include other types of steady-state criticality consequences, especially with respect to internal criticality, in its consequence analysis approach. Safety Evaluation Report, Section 3.7.1.1, Open Item 22
  - DOE must develop the modeling approach for external steady-state consequences. Safety Evaluation Report, Section 3.7.2.1, Open Item 23
  - The DOE must develop and present request for approval of a methodology for transient criticality consequence, Safety Evaluation Report, Section 3.7.1.2, Open Item 24. Already addressed by Open Item 2, removal of consequence criterion

Acceptance Criterion 6
(Continued)

- **Action or information needs identified (Continued)**
  - The DOE needs to develop and present, for NRC acceptance, the modeling approach for transient criticality consequence. Safety Evaluation Report, Section 3.7.2.2, Open Item 25
  - The DOE needs to develop a validation approach for the power model for steady-state criticality consequence. Safety Evaluation Report, Section 3.7.3.1, Open Item 26
  - The DOE needs to develop a validation approach for a transient criticality consequence model. Safety Evaluation Report, Section 3.7.3.2, Open Item 27

Acceptance Criterion 6
(Continued)

- **Basis for Closure**
  - Topical Report, Rev. 01 has provided additional information on the computer models, input parameters, and the calculation of radionuclide inventory, heat, kinetic energy, and other parameters that would change as a result of k_{eff} exceeding the subcritical limit developed under Criterion 1
  - The additional information on the modeling and validation approach demonstrates the application of the methodology will adequately address the issues raised in Safety Evaluation Report open items related to Acceptance Criterion 6 (Open Items 20 through 27)
- **No additional work required, pending closure of the Open Items identified in the Safety Evaluation Report, through the Topical Report/Safety Evaluation Report process**

Consider moderators other than water (Open Item 20)

- **Basis for resolution**
  - DOE believes that specific sections of Topical Report, Rev. 01 show potentially critical configurations will be evaluated with respect to credible moderators, in addition to water.
  - The Topical Report, Rev. 01 recognizes that carbon in any form can serve as a neutron moderator, but the likelihood of its presence in the Monitored Geologic Repository in sufficient quantities to act as a moderator is negligible
  - The effect of silica moderation has already been considered in a number of criticality evaluation reports, both internal (silica in clay) and external (silica in tuff)
- **References**
  - *Disposal Criticality Analysis Methodology Topical Report,* YMP/TR-004Q REV *01*, Section 3.7.2, Criticality Consequence Modeling

Consider moderators other than water (Open Item 20) (Continued)

- **References** (Continued)
  - *Waste Package Related Impacts of Plutonium Disposition Waste Forms in a Geologic Repository.* TDR-EBS-MD-000003 REV 01
- **Topical Report, Rev. 01 prescribes the consideration that should be given to moderators other than water, and the cited calculations demonstrate the results of such considerations. This open item should be resolved pending the NRC staff review of the Topical Report, Rev. 01 and the application examples**

Neutron absorber loss through pinholes (Open Item 21)

- **Basis for resolution**
  - DOE believes the Topical Report, Rev. 01, shows a comprehensive approach to evaluating the probability of neutron absorber loss through cladding defects. Processes affecting neutron absorber loss through cladding will include mass transport, which is diffusion limited, through matrix pores
  - There is little likelihood for pinholes to affect consequence, since pinholes occur in only 0.16 % of Commercial Spent Nuclear Fuel cladding
  - Experimental pinhole-release reduction-factors for soluble fission products, relative to bare, unclad fuel will be used to validate transport models. (e.g., ^{99}Tc - 1/5 to 1/460, ^{129}I - 1/74 to 1/700,000)

Neutron absorber loss through pinholes (Open Item 21) (Continued)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report,* YMP/TR-004Q REV 01, Section 3.7.3.1, Steady-State Criticality Consequence Methodology Validation Approach
  - Wilson, C.N. 1990. "Results from NNWSI Series 3 Spent Fuel Dissolution Tests." PNL-7170. pp. 3.41, 3.50.
  - Ann T.M., 1998. "Cladding Credit" for presentation at DOE/NRC Performance Assessment Technical Exchange, March 1998. p. 10
- **Experimentally determined reduction-factors lead to conservative estimates of release for low and medium solubility absorbers. Therefore, this Open Item should be resolved pending the development of the pinhole release sub-model in the Degradation Model Validation Reports**

Other types of steady-state criticality consequences (Open Item 22)

- **Basis for resolution**
  - DOE believes that specific sections of Topical Report, Rev. 01 show a comprehensive approach to evaluating the corrosion enhancing stress on waste package barriers from the prolonged elevated temperature resulting from a steady-state criticality. Project database of degradation rate parameters will ensure that thermal effects are accounted for at their appropriate values
  - A consequence that can exacerbate the radionuclide mobility for internal criticalities is an increase in the corrosion rate of the Engineered Barrier System resulting from increased local temperatures
  - Coupled processes involving temperature, corrosion rates, and nuclide mobility will be considered in evaluating steady-state criticality consequences

Other types of steady-state criticality consequences (Open Item 22) (Continued)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report,* YMP/TR-004Q REV 01, Section 3.1, Overall Methodology, Section 3.7.1, Criticality Consequence Methodology, Section 3.7.1.1, Type of Criticality Event, and Section 3.7.1.2, Evaluating Direct Criticality Event Consequence

Other types of steady-state criticality consequences (Open Item 22) (Continued)

- The Topical Report, Rev. 01 provides specific instruction for consideration of thermal and pressure effects of criticality, and project documents/databases provide parameters for accounting for such effects. This Open Item should be resolved pending the NRC staff review of the Topical Report, Rev. 01

Modeling approach for external steady-state consequences (Open Item 23)

- **Background**
  - This Open Item belongs with the Evolution of the Near Field Environment and Radionuclide Transport Key Technical Issues, for which criticality has already been determined to be closed-pending. However, the external steady-state consequences model is similar to the internal model so, it is appropriate to consider here
- **Basis for resolution**
  - Safety Evaluation Report, Section 3.7.2.1, acceptance of the internal steady-state criticality consequence model:
  - DOE believes the modeling approach for external steady-state criticality consequences is sufficiently similar to that for internal steady state criticality it should be accepted on the same basis. The principal differences of the external model are the absence of radiative heat loss and the possibility of sustaining the criticality by continued deposition of fissile material. As an additional validation of the external model, it will be checked for consistency with the most authoritative analyses of the Oklo natural reactor

Modeling approach for external steady-state consequences (Open Item 23) (Continued)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report,* YMP/TR-004Q REV 01, Section 3.7.2.3, Steady-State Criticality External
  - *Safety Evaluation Report for Disposal Criticality Analysis Methodology Topical Report, REV 0* Letter from C.W. Reamer (NRC) to S. Brocoum (DOE/OCRWM), June 26, 2000, with enclosure. ACC: MOL.20000919.0157, Section 3.7.2.1

Modeling approach for external steady-state consequences (Open Item 23) (Continued)

- The acceptance of the internal criticality consequence model, together with the description of the additional considerations for the external model given in the Topical Report, Rev. 01, should be sufficient to accept the external criticality consequence model approach. Therefore, this item should be resolved pending the NRC staff review of the Topical Report, Rev. 01

Methodology for transient criticality consequence (Open Item 24)

- **Basis for resolution**
  - DOE believes that specific sections of Topical Report, Rev. 01 adequately describe the methodology for transient criticality consequence evaluation. In particular:
    - The transient methodology uses codes that model both the neutronic evolution and the response of the physical system to any heat or pressure pulse caused by the criticality event
    - Consequences are either a high power pulse with short duration, or periodic pulsing leading to a cumulative buildup of radionuclide increments, and mechanical stressing effects. This is according to whether $\Delta\rho$ (fractional reactivity insertion) is greater than, or less than, β (delayed neutron fraction)

Methodology for transient criticality consequence (Open Item 24) (Continued)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report,* YMP/TR-004Q REV 01, Section 3.7.1.1, Types of Criticality Events, Section 3.7.2, Criticality Consequence Modeling
- **The description of the transient criticality consequence methodology in the referenced sections of the Topical Report, Rev. 01 is adequate. Therefore, this Open Item should be resolved pending the NRC staff review of the Topical Report, Rev. 01**

Modeling approach for transient criticality consequence (Open Item 25)

- **Basis for resolution**
  - DOE believes that Topical Report, Rev. 01 adequately describes the model for transient criticality consequence evaluation. In particular:
    - Spent Nuclear Fuel inside the waste package is sufficiently similar to in-reactor configurations that RELAP5/MOD3.2 code is applicable
    - RELAP5 adequately reflects Doppler broadened absorption cross sections and moderator inventory changes; it can also be enhanced for cross-flow by appropriate junction models
    - Considerations prescribed for mechanical effects from transient criticalities, which can result from pressure and temperature cycling, leading to failures that possibly enhance the radionuclide inventory available for transport

Modeling approach for transient criticality consequence (Open Item 25) (Continued)

- **Reference**
  - *Disposal Criticality Analysis Methodology Topical Report,* YMP/TR-004Q REV 01, Section 3.7.2.2, Transient Criticality, Internal
- **The description of the transient criticality consequence modeling approach for internal criticality is adequate. Therefore, this Open Item should be resolved pending the NRC staff review of the Topical Report, Rev. 01**

Validation approach for the steady-state power model (Open Item 26)

- **Basis for resolution**
  - DOE believes that Topical Report, Rev. 01 adequately describes the validation approach for the power model for steady-state criticality consequences. The steady-state power model will be checked for consistency against appropriate natural analogs
- **Reference**
  - *Disposal Criticality Analysis Methodology Topical Report,* YMP/TR-004Q REV 01, Section 3.7.3.1, Steady-State Criticality Consequence Methodology Validation Approach

Validation approach for the steady-state power model (Open Item 26) (Continued)

- The description of the steady-state criticality consequence model validation approach for internal criticality is adequate. Therefore, this Open Item should be resolved pending the the NRC staff review of the Topical Report, Rev. 01

Validation approach for transient criticality consequence (Open Item 27)

- **Basis for resolution**
  - DOE believes Topical Report, Rev. 01 adequately describes the validation approach for the transient criticality consequence model. In particular, eight candidate comparison experiments have been identified and evaluated as having parameters similar to those that could occur in the repository. Validation of the transient criticality consequence models will be made against such experiments

Validation approach for transient criticality consequence (Open Item 27) (Continued)

- **Reference**
  - *Disposal Criticality Analysis Methodology Topical Report,* YMP/TR-004Q REV 01, Section 3.7.3.2, Transient Criticality Consequence Methodology Validation Process
- **The description of the transient criticality consequence model validation approach is adequate. Therefore, this Open Item should be resolved pending the NRC staff review of the Topical Report, Rev. 01**

Conclusions

- **DOE believes the status of Acceptance Criterion 6 is closed-pending the NRC staff review of the Topical Report, Rev. 01 and the model validation reports**

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Container Life and Source Term, Subissue 5, Acceptance Criterion 7: Risk

Presented to:
DOE-NRC Technical Exchange on Key Technical Issues and Subissues Related to Criticality

Presented by:
Peter Swift
Civilian Radioactive Waste Management System Management and Operating Contractor

October 23-24, 2000
Las Vegas, NV

YUCCA MOUNTAIN PROJECT

Outline

- **Presentation Objectives**
- **Current Subissue Status**
- **For items identified in the Container Life and Source Term Issue Resolution Status Report, Rev. 2 and in the Safety Evaluation Report, this presentation will:**
  - Summarize technical basis for item resolution
  - Identify basis documents (References)
  - Summarize technical adequacy of basis
- **Conclusions**

Presentation Objectives

- Describe the basis for resolving Acceptance Criterion 7, criticality Subissue 5 of the Container Life and Source Term Key Technical Issue
- Acceptance Criterion 7: Department of Energy (DOE) determined the risk contribution from the in-package criticality to the total repository system performance appropriately

Current Subissue Status

- **Container Life and Source Term Issue Resolution Status Report, Rev. 2 indicates technical acceptance criteria applicable to this subissue are OPEN**

Acceptance Criterion 7

- **Action or information needs identified**
  - DOE should describe the interface between Figure 1-1 of the Request for Additional Information responses (now Figure 3-1 of the Topical Report, Rev. 01) and the Total System Performance Assessment criticality risk analysis Open Item 28.
  - Need for a "What-if" evaluation of the impact of a non-mechanistic criticality during the first 10,000 years after repository closure

Acceptance Criterion 7
(Continued)

- **Basis for closure**
  - The process for evaluating criticality results is addressed in Topical Report, Rev. 01, Section 3.8
  - Only probability defined in the proposed 10 CFR 63.114(d) will be used for screening criticality events (Safety Evaluation Report 3.2.2) for repository performance
  - In package criticality has been excluded from the Total System Performance Assessment on the basis of low probability for the regulatory period
  - All probability/consequence pairs will be evaluated for inclusion in at least one Total System Performance Assessment sensitivity analysis
- **This Acceptance Criterion is closed-pending NRC review of work in progress and confirmatory Total System Performance Assessment sensitivity analyses of effects on dose**

Criticality Risk

- **Basis for resolution**
  - Total System Performance Assessment sensitivity analyses including radionuclide inventory increment due to criticality will evaluate those criticalities determined potentially significant (by comparison with the doses expected from commercial spent nuclear fuel without a criticality event)
  - Any significant mechanical effects of the criticality will be evaluated by modifying the degradation characteristics of the affected barriers, and any affected model parameters will be modified
  - The resulting source term produced by the criticality will be used in a Total System Performance Assessment sensitivity analysis to evaluate the dose history to the average member of the critical group
  - Numerous realizations of the processes comprising the scenarios important to repository performance will provide a statistical representation of the effects of the variability and uncertainty

Criticality Risk
(Continued)

- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q REV 01
  - *Probability of Criticality Before 10,000 years*. CAL-EBS-NU-000014 (draft in progress)
  - Analyses to Support Screening of System-Level Features, Events, and Processes for the Yucca Mountain Total System Performance Assessment-Site Recommendation, ANL-WIS-MD-00019 (draft in progress)
- **Topical Report, Rev. 01 adequately addresses the information requested**

What-If Criticality

- **Not part of the licensing base case**
- **A sensitivity study to evaluate the impact of an early (non-mechanistic) criticality**
- **Analysis Assumptions**
  - Breach of 1 commercial fuel waste package, consistent with the Total System Performance Assessment early failure sensitivity study, at the time of repository closure
  - No Drip Shield
  - Nominal flow and transport following criticality
- **Topical Report Methodology, as appropriate**
- **Plan to report results with future Total System Performance Assessment sensitivity studies**

Conclusions

- **DOE believes the status of Acceptance Criterion 7 for the Container Life and Source Term Subissue 5, criticality, is closed-pending the NRC staff review of the Topical Report, Rev. 01, Features, Events, and Processes screening work, and Total System Performance Assessment sensitivity analysis**

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Evolution of the Near Field Environment Subissue 5 and Radionuclide Transport Subissue 4

Presented to:
DOE/NRC Technical Exchange on Key Technical Issues and Subissues Related to Criticality

Presented by:
Daniel A. Thomas
Civilian Radioactive Waste Management System Management and Operating Contractor

October 23-24, 2000
Las Vegas, NV

YUCCA MOUNTAIN PROJECT

Outline

- **Presentation Objectives**
- **Current Subissue Status**
- **For criticality subissues identified in Evolution of the Near Field Environment Issue Resolution Status Report, Rev. 03 and Radionuclide Transport Issue Resolution Status Report, Rev. 02, confirm their status as closed-pending, this presentation will:**
  - Summarize technical basis for item resolution
  - Identify basis documents (References)
  - Summarize technical adequacy of basis
- **Conclusions**

Presentation Objectives

- **Describe and confirm the status of external criticality subissues**
  - Evolution of Near-Field Environment Subissue 5: Effects of Coupled Thermal-Hydrologic-Chemical Processes on Potential Nuclear Criticality in the Near Field
  - Radionuclide Transport Subissue 4: Nuclear Criticality in the Far Field

Current Subissue Status

- Evolution of Near Field Environment Issue Resolution Status Report, Rev. 03 indicates status of Subissue 5 is closed-pending
- Radionuclide Transport Issue Resolution Status Report, Rev. 02 indicates status of Subissue 4 as closed-pending

External Criticality Subissues

- **Action or information needs identified**
  - Five Safety Evaluation Report Open Items (2, 16, 20, 22, and 23) have been identified as applicable to external criticality that need to be confirmed to close the subissues
- **Basis for closure**
  - Subissues are identified as closed-pending in Issue Resolution Status Reports
- **No additional work is required**
  - These subissues are closed-pending resolution of the Safety Evaluation Report Open Items and documentation of screening of criticality Features, Events, and Processes as identified in the Evolution of Near Field Environment Issue Resolution Status Report, Rev. 03 and Radionuclide Transport Issue Resolution Status Report, Rev. 02

External Criticality Subissues
(Continued)

Five Safety Evaluation Report Open Items

- **Basis for resolution**
  - DOE agrees with NRC that five items should be considered resolved-pending confirmation because the Open Items are being addressed in the Topical Report, Rev. 01 and will be resolved through the Topical Report/Safety Evaluation Report process
- **References**
  - *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q Rev. 01
- **The Topical Report, Rev. 01 and validation reports will provide the information necessary to resolve these Open Items**
  - These subissues are closed-pending resolution of the Safety Evaluation Report Open Items as identified in the Evolution of Near Field Environment Issue Resolution Status Report, Rev. 03 and Radionuclide Transport Issue Resolution Status Report, Rev. 02

Conclusions

- DOE believes the status of the five items for these subissues are resolved-pending confirmation of information in the Topical Report, Rev. 01 and validation reports
- Therefore, the subissues for Evolution of Near Field Environment (5) and Radionuclide Transport (4) should remain closed-pending

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