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QA: N/A

SEP 27 2002

OVERNIGHT MAIL

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U.S. Nuclear Regulatory Commission
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TRANSMITTAL OF REPORT ADDRESSING KEY TECHNICAL ISSUE (KTI) AGREEMENT CONTAINER LIFE AND SOURCE TERM (CLST) 5.05

Reference: Ltr, Schlueter to Brocoum, dtd 2/14/02

This letter transmits a report entitled *KTI Letter Report Agreement CLST 5.05, Revision 02,* which provides information to satisfy the subject KTI agreement. This KTI agreement states:

> CLST 5.05: "Provide information on how the increase in the radiation fields due to the criticality event affects the consequence evaluation because of increased radiolysis inside the waste package and at the surfaces of nearby waste packages or demonstrate that the current corrosion and dissolution models encompass the range of chemical conditions and corrosion potentials that would result from this increase in radiolysis. DOE stated that the preliminary assessment (calculation) of radiolysis effects from a criticality event will be available to the NRC during February 2001. The final assessment of these conditions will be available to NRC prior to LA."

In the enclosure the U.S. Department of Energy (DOE) presents information pertaining to a CLST KTI agreement on criticality. CLST 5.05 was made before promulgation of the U.S. Nuclear Regulatory Commission's (NRC) final regulation that allows screening of low probability events including criticality [10 CFR 63.114 (d)], and that specifies a standard of reasonable expectation (10 CFR 63.304). The enclosure references preliminary scoping evaluations that indicate that criticality events (for all waste forms) will be screened from the performance assessments on the basis of low probability (i.e., less than one chance in 10,000 of occurring over 10,000 years). For the License Application, DOE plans to demonstrate compliance with 10 CFR 63.114 (d), and therefore, based on the preliminary scoping

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evaluations, criticality would be screened from further evaluation and no consequence evaluations would be required. If screening of criticality cannot be demonstrated in accordance with 10 CFR 63.114 (d), then criticality consequence evaluations including radiolytic effects would be performed. Therefore, DOE considers CLST 5.05 and the additional questions of the reference letter to be fully addressed by the enclosed information and pending review and acceptance by the NRC, the agreement and additional questions should be closed.

There are no new regulatory commitments in the body or the enclosure to this letter. Please direct any questions concerning this letter and its enclosure to Timothy C. Gunter at (702) 794-1343 or Paige R.Z. Russell at (702) 794-1315.

Joseph D. Ziegler
Acting Assistant Manager, Office of
Licensing and Regulatory Compliance

OL&RC:TCG-1839

Enclosure:
KTI Letter Report Agreement CLST 5.05, Revision 02

cc w/encl:
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KTI LETTER REPORT
AGREEMENT CLST 5.05
REVISION 02

September 2002

Preparation:

John A. McClure, Lead, Criticality Configuration and Consequence — 09/26/2002 Date

Approval:

Thomas W. Doering, Project Manager, PA Engineered Systems — 9.26.02 Date

Reviewed by:

Douglas A. Brownson, Manager, Risk and Criticality Department — 9/26/02 Date

ENCLOSURE

CONTENTS

ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
CLST	Container Life and Source Term
DOE	U.S. Department of Energy
KTI	Key Technical Issue
NRC	U.S. Nuclear Regulatory Commission

AGREEMENT CLST 5.05

This letter report provides information to address a Key Technical Issue (KTI) agreement related to Subissue 5 of the Container Life and Source Term (CLST) KTI. Specifically, this letter report addresses KTI agreement CLST 5.05. This KTI agreement addresses consequence issues related to a potential postclosure criticality event.

The methodology for evaluating the potential for postclosure criticality at Yucca Mountain is outlined in the *Disposal Criticality Analysis Methodology Topical Report* (YMP 2000), and follows the requirements of 10 CFR Part 63. Based on 10 CFR Part 63 requirements and the Topical Report, criticality consequence evaluations are not required unless the total probability of criticality exceeds the event screening threshold established in 10 CFR 63.114(d), i.e., probability of one chance in 10,000 of occurring over 10,000 years. Based on analyses done to date, it is the expectation that the total probability of criticality will be demonstrated to be below the event screening threshold, thus removing requirements for making an assessment of the radiolytic impact of criticality consequences that is the central issue of CLST 5.05, pending the completion and formal documentation of the detailed criticality probability analysis, consistent with that outlined in the Topical Report.

The information in this letter report is provided in four sections. Section 1 provides the background related to the technical issues of interest to the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) that preceded the KTI agreement. Section 2 provides the wording of the agreement, its status, and associated requirements. Section 3 provides a summary of the findings. Section 4 lists references.

1. BACKGROUND FOR AGREEMENT CLST 5.05

CLST Subissue 5 KTIs are focused on evaluating the adequacy of the methodology and modeling used in investigations related to the potential for criticality events internal to the waste package.

The technical bases for the criticality subissues and the rationale behind each subissue are explained in detail in NRC's "Issue Resolution Status Report (Key Technical Issue: Container Life and Source Term, Revision 3)" (Reamer 2001). KTI agreement CLST 5.05 seeks information concerning the effects of increased radiation fields from in-package criticality events on consequence evaluations of such events. This agreement item was reached during the NRC/DOE Technical Exchange and Management Meeting on Subissues Related to Criticality held October 23–24, 2000 (Reamer and Williams 2000).

2. NRC REQUIREMENTS AND PROPOSED KTI RESOLUTION

NRC requirements are listed in Section 2.1. The text of the relevant KTI agreement is provided in Section 2.2. The status of the agreement and the approach for closure of this KTI agreement is provided in Section 2.3.

2.1 APPLICABLE REQUIREMENTS

10 CFR 63(b) provides the requirements for preapplication review. These preapplication reviews constitute informal conferences between a prospective applicant and the NRC staff, as described in 10 CFR 2.101(a)(1). Consistent with these requirements and in accordance with the memorandum of understanding between the DOE and the NRC, *Agreement Between DOE/OCRWM and NRC/NMSS Regarding Prelicensing Interactions* (Barrett et al. 1999), a series of interactions was undertaken to identify information needed for a prospective license application. At these meetings, agreements by the DOE to provide the NRC with information were recorded as KTI agreements.

2.2 KTI AGREEMENT

The KTI agreement that is the subject of this letter report is quoted below. The purpose of the KTI agreements is to ensure that sufficient information is available on an issue to enable the NRC to docket a license application. Wording of CLST KTI agreement is based on Summary Highlights of NRC/DOE Technical Exchange and Management Meeting on Subissues Related to Criticality (Reamer and Williams 2000).

> CLST 5.05
>
> Provide information on how the increase in the radiation fields due to the criticality event affects the consequence evaluation because of increased radiolysis inside the waste package and at the surfaces of nearby waste packages or demonstrate that the current corrosion and dissolution models encompass the range of chemical conditions and corrosion potentials that would result from this increase in radiolysis. DOE stated that the preliminary assessment (calculation) of radiolysis effects from a criticality event will be available to NRC during February 2001. The final assessment of these conditions will be available to NRC prior to LA.

2.3 STATUS OF AGREEMENT

The NRC has reviewed (Schlueter 2002) the calculation *Radiolytic Specie Generation from Internal Waste Package Criticality* (BSC 2001a). This review stated, in part:

> The NRC reviewed the Radiolytic Specie Generation from Internal Waste Package Criticality (CAL-EBS-NU-000017). The conclusion of this report is that the generation of nitric acid from the increased radiation fields associated with the criticality event could significantly change the pH of the water in the waste package and potentially increase the degradation rate of cladding in the waste package, pending further analysis of the scavenging effects of other materials in the waste package. This could lead to significant increases in the dose rate at the receptor group location and, therefore, this process needs to be incorporated into the analysis of the consequences of a steady-state criticality event unless further analyses are sufficient to show that this process is not important.

Additionally, three items were listed in this NRC review for DOE consideration (Schlueter 2002, Section 6):

1) "The power level of the criticality in the calculation is 1 kW, which is lower than the power level calculated in Rev. 0 of the Topical Report (2.2 kW). A higher power level would lead to greater production of nitric acid."

2) "The report assumes that the generation factor for nitrogen dioxide for neutrons is equal to the generation factor for gamma rays without sufficient basis. This assumes that the linear energy transfer (LET) of the radiation does not affect the quantity of nitrogen dioxide produced per unit energy absorbed by the material. However, for the radiolytic generation of hydrogen, [Spinks and Woods (1990)] found that the G-value for alpha radiation (a high-LET radiation) is about three times higher than the G-value for beta/gamma radiation. Additional basis needs to be provided to support the G-value for high-LET radiation for the production of nitrogen dioxide."

3) "The report does not consider the potential for the generation of nitrogen dioxide by alpha radiation. This could be a significant contribution to the total nitric acid generation due to the higher G-values associated with alpha radiation."

These comments are concerned with the radiolytic consequences of a waste package criticality. However, based on preliminary scoping evaluations documented in Appendix J of the *Technical Update Impact Letter Report* (BSC 2001b), it is expected that criticality events (for all waste forms) will be screened from the performance assessments on the basis of low probability (i.e., less than one chance in 10,000 of occurring over 10,000 years).

The detailed information needed to support the screening argument for low probability of the occurrence of a criticality is currently being developed. This information includes, but is not limited to, the following:

- Presence of water (including seepage into emplacement drifts, condensation under drip shield, and the free volume within waste package)
- Probability of early (before 10,000 years) waste package and drip shield failure (including coincidence of early waste package and drip shield failures)
- Probability that water will enter the waste package failure location
- Probability that sufficient water will enter the waste package to initiate waste form and waste package internals degradation
- Probability of waste form and waste package internals degradation into a critical configuration
- Removal/segregation of waste package and waste form degradation products

- Removal/segregation of neutron absorber materials
- Criticality potential of radionuclide inventory
- Accumulation of fissile radionuclides into a critical configuration.

This information will be documented in a features, events, and processes screening report that is the subject of another KTI Agreement, CLST 5.03. The development of this screening argument will be based on the methodology documented in the *Disposal Criticality Analysis Methodology Topical Report* (YMP 2000) and its applicable process report, i.e., *Configuration Generator Model Validation Report* (in progress). Accordingly, if the total probability of criticality is less than the event screening threshold in 10 CFR 63.114(d), no criticality consequence evaluations need to be performed, and the activities described in KTI agreement CLST 5.05 are not necessary to support a license application.

However, if the probability is not below the event screening threshold established in 10 CFR 63.114(d), then criticality consequence evaluations would be required, and an estimate of the radiolytic consequences of a criticality would be performed. The approach for the performance of consequence evaluations is presented in Section 3.7 of the Topical Report (YMP 2000).

3. SUMMARY

This report has presented information pertaining to a CLST KTI agreement on criticality. CLST 5.05 was made before promulgation of NRC's final regulation that allows screening of low probability events, including criticality (10 CFR 63.114(d)), and that specifies a standard of reasonable expectation (10 CFR 63.304). It is believed that the agreements are inconsistent with that regulation if it is possible to demonstrate that the total probability of criticality for the 10,000 years following permanent closure is less than one chance in 10,000 (10 CFR 63.114(d)). If it is possible to demonstrate compliance with 10 CFR 63.114(d), criticality would be screened from further evaluation and no consequence evaluations would be required. If screening of criticality cannot be demonstrated in accordance with 10 CFR 63.114(d), then criticality consequence evaluations, including radiolytic effects, would be performed.

It is believed the information submitted herein is sufficient for closing KTI agreement CLST 5.05.

4. REFERENCES

4.1 DOCUMENTS CITED

Barrett, L.; Virgilio, M.J.; Dyer, J.R.; and Greeves, J.T. 1999. *Agreement Between DOE/OCRWM and NRC/NMSS Regarding Prelicensing Interactions.* Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: HQO.19990811.0016.

BSC (Bechtel SAIC Company) 2001a. *Radiolytic Specie Generation from Internal Waste Package Criticality.* CAL-EBS-NU-000017 REV 00. Las Vegas, Nevada: Bechtel SAIC Company. ACC: MOL.20011017.0090.

BSC 2001b. *Technical Update Impact Letter Report.* MIS-MGR-RL-000001 REV 00 ICN 02. Las Vegas, Nevada: Bechtel SAIC Company. ACC: MOL.20011211.0311.

Reamer, C.W. and Williams, D.R. 2000. Summary Highlights of NRC/DOE Technical Exchange and Management Meeting on Subissues Related to Criticality. Meeting held October 23-24, 2000, Las Vegas, Nevada. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20001208.0097 through MOL.20001208.0110.

Reamer, C.W. 2001. "Issue Resolution Status Report (Key Technical Issue: Container Life and Source Term, Revision 3)." Letter from C.W. Reamer (NRC) to S.J. Brocoum (DOE/YMSCO), January 10, 2001, with enclosure. ACC: MOL.20010808.0024.

Schlueter, J. 2002. "Key Technical Issue Agreements Related to Criticality." Letter from J. Schlueter (NRC) to S. Brocoum (DOE/YMSCO), February 14, 2002, 0225021619, with enclosure. ACC: MOL.20020607.0085.

YMP (Yucca Mountain Site Characterization Project) 2000. *Disposal Criticality Analysis Methodology Topical Report.* YMP/TR-004Q, Rev. 01. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.20001214.0001.

4.2 CODES, STANDARDS, REGULATIONS, AND PROCEDURES

10 CFR (Code of Federal Regulation) 63. Energy: Disposal of High-level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada. Readily available.