December 3, 2003

MEMORANDUM TO: Joseph G. Giitter, Chief
Special Projects and Inspection Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

THRU: Brian W. Smith, Section Chief **/RA/**
Special Projects Section
Special Projects and Inspection Branch
Division of Fuel Cycle Safety
and Safeguards, NMSS

FROM: Andrew Persinko, Sr. Nuclear Engineer **/RA/**
Special Projects Section
Special Projects and Inspection Branch
Division of Fuel Cycle Safety
and Safeguards, NMSS

SUBJECT: NOVEMBER 13, 2003, MEETING SUMMARY: MEETING WITH DUKE COGEMA STONE & WEBSTER TO DISCUSS NUCLEAR CRITICALITY SAFETY RELATED TO MIXED OXIDE FUEL FABRICATION FACILITY REVISED CONSTRUCTION AUTHORIZATION REPORT

On November 13, 2003, U.S. Nuclear Regulatory Commission (NRC) staff met with Duke Cogema Stone & Webster (DCS), the mixed oxide fuel fabrication facility (MFFF) applicant, to discuss nuclear criticality safety related to the revised construction authorization request (CAR or revised CAR) submitted to NRC on October 31, 2002. The meeting agenda, summary, attendance list, and NRC-provided information are attached (Attachments 1, 2, 3, and 4 respectively).

Docket: 70-3098

Attachments: 1. Meeting Agenda
2. Meeting Summary
3. Attendance List
4. NRC Information

cc:

P. Hastings, DCS	L. Zeller, BREDL
J. Johnson, DOE	D. Silverman, DCS
H. Porter, SCDHEC	G. Carroll, GANE
J. Conway, DNFSB	D. Curran, GANE

December 3, 2003

MEMORANDUM TO: Joseph G. Giitter, Chief
Special Projects and Inspection Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

THRU: Brian W. Smith, Section Chief **/RA/**
Special Projects Section
Special Projects and Inspection Branch
Division of Fuel Cycle Safety
and Safeguards, NMSS

FROM: Andrew Persinko, Sr. Nuclear Engineer **/RA/**
Special Projects Section
Special Projects and Inspection Branch
Division of Fuel Cycle Safety
and Safeguards, NMSS

SUBJECT: NOVEMBER 13, 2003, MEETING SUMMARY: MEETING WITH DUKE COGEMA STONE & WEBSTER TO DISCUSS NUCLEAR CRITICALITY SAFETY RELATED TO MIXED OXIDE FUEL FABRICATION FACILITY REVISED CONSTRUCTION AUTHORIZATION REPORT

On November 13, 2003, U.S. Nuclear Regulatory Commission (NRC) staff met with Duke Cogema Stone & Webster (DCS), the mixed oxide fuel fabrication facility (MFFF) applicant, to discuss nuclear criticality safety related to the revised construction authorization request (CAR or revised CAR) submitted to NRC on October 31, 2002. The meeting agenda, summary, attendance list, and NRC-provided information are attached (Attachments 1, 2, 3, and 4 respectively).

Docket: 70-3098

Attachments: 1. Meeting Agenda
2. Meeting Summary
3. Attendance List
4. NRC Information

cc: P. Hastings, DCS — L. Zeller, BREDL
J. Johnson, DOE — G. Carroll, GANE
H. Porter, SCDHEC — D. Silverman, DCS
J. Conway, DNFSB — D. Curran, GANE

Docket: 70-3098
DISTRIBUTION: SPIB r/f FCSS r/f Hearing File
RPierson JHolonich JHull, OGC WGloersen, RII NRC Attendees
ML033370965
G:\SPB\AXP1\MeetingSummaries\MOXmtgsumm 11-13-03_R2_(critsafety).wpd

OFC	SPIB	SPIB	SPIB	SPIB
NAME	APersinko:dw	LGross	MChatterton	BSmith
DATE	12/ 002 /03	12/ 01 /03	12/ 03 /03	12/ 03 /03

OFFICIAL RECORD COPY

MEETING AGENDA
MOX FUEL FABRICATION FACILITY
November 13, 2003

November 13, 2003

12:30 PM	Introduction
12:40 PM	Discussions of nuclear criticality safety validation report
4:50 PM	Summary / Actions
5:00 PM	Adjourn

Attachment 1

MEETING SUMMARY
MOX FUEL FABRICATION FACILITY
November 13, 2003

Purpose

The purpose of the meeting was to discuss the unresolved nuclear criticality safety issue related to the Mixed Oxide (MOX) Fuel Fabrication Facility Construction Authorization Request (CAR) submitted by DCS on October 31, 2002, identified as NCS-4 in the NRC staff's Draft Safety Evaluation Report (DSER) dated April 30, 2003.

Summary

In her opening remarks, Muffet Chatterton provided a summary of the chronology of the criticality safety review. She described the initial traditional approach to validation taken by DCS, a subsequent revision by DCS to use the sensitivity/uncertainty (S/U) approach in order to potentially include additional benchmark experiments, a DCS decision not to use the S/U method since it is still not a mature method, and now use of the traditional approach again.

In his opening remarks, Christopher Tripp expanded on Ms. Chatterton's opening remarks. Dr. Tripp stated that over the last two years, several revisions to Part II of the MOX Validation Report have been submitted to NRC, each of them taking a different approach. Revision 0 used a traditional approach and identified 39 applicable benchmarks for AOA(3) and 14 for AOA(4). Since this approach did not result in enough benchmarks, Revisions 1 and 2 used the new S/U method developed by Oak Ridge National Laboratory to identify additional experiments; 90 experiments for AOA(3) and 66 for AOA(4). Revision 3, submitted October 10, 2003, returned to a traditional approach based on the methodology of NUREG/CR-6698, and identified 70 experiments for AOA(3) and 59 for AOA(4). NRC reviewed each of these submittals, and after two years of review, continues to have questions on the methodology and selected benchmarks.

Dr. Tripp continued his introductory remarks by stating that the current DCS approach has been to use the procedure of NUREG/CR-6698, but with a broader range of anticipated design applications. The screening criteria based on the design parameters have also been broadened. Even with the broader screening criteria, it has been necessary to include additional experiments based on a qualitative comparison of fission spectra. NRC staff has concerns with each of these extensions beyond the ranges justified by a strict adherence to NUREG/CR-6698.

Currently, the NRC staff believes that 26 benchmarks can be accepted as applicable to AOA(3) and 38 to AOA(4) without further justification (see Attachment 5). Further, the parametric range covered by the remaining 38 benchmarks in AOA(4) is significantly less than the validated range in the report. NRC staff is prepared to approve a maximum k-effective for both AOA(3) and AOA(4) but with an additional 2% margin to account for these weaknesses in the data.

Staff concerns fall into two major categories: (1) heterogeneous plutonium metal experiments; and (2) low-Pu content MOX experiments to validate plutonium applications and plutonium experiments to validate MOX applications. This meeting concentrated on addressing why these classes of experiments are applicable to systems covered by AOA(3) and AOA(4), and on justifying an appropriate margin to account for the shortage in the benchmark data. If DCS wants no additional margin to be added to the k-effective, then further technical justification will be necessary beyond that which has been provided.

DCS stated that it believes that it has provided sufficient justification for the benchmarks chosen since it believes that the 5% margin proposed would cover the data uncertainty. Staff responded that the administrative margin is separate from bias and other margin. If administrative margin is to cover data uncertainty, then it would have to be larger than proposed.

Staff concerns and questions regarding DCS' validation report were provided to DCS via phone and were documented in a memorandum from Muffet Chatterton to Joseph Giitter dated November 7, 2003 (Reference 1). Although some of these questions were discussed and clarified at the meeting, staff still expects written DCS responses to the questions in Reference 1 in order to justify the benchmarks chosen in validating the criticality computer code.

Discussion

Screening Criteria

Staff questioned the distinction between logarithmic and non-logarithmic parameters (e.g., neutron energy, plutonium content, H/Pu ratio), to which DCS responded that in some cases the physics is logarithmic. Staff stated that it did not understand this response. Staff asked DCS to justify its choice of extension factors of 2 and 5. DCS responded that NUREG-6698 does not describe a rigorous approach, so DCS tried to develop a process. Staff stated that the data is not well-behaved. DCS stated that it did not see a trend. This discussion relates to question 2 in Reference 1. DCS is to provide additional discussion and justification in its response to Reference 1.

Staff stated that step 4 in the DCS procedure does not appear to follow NUREG-6698 and asked DCS to justify any deviations. Staff stated that it appears that if there are not sufficient benchmarks, then DCS can expand the screening criteria beyond those in the NUREG. Staff also asked about the order of application of the steps in the DCS procedure and how the sequences compares to the NUREG sequence. Further, staff stated that step 4 in the DCS procedure is not the same as step 4 in the NUREG. DCS stated that it used NUREG-6698 as a guide.

NRC staff questioned the difference between "primary" and "secondary" parameters and whether DCS used secondary criteria. DCS responded that primary parameters can be quantified whereas secondary parameters cannot. Staff stated that it needs to know how the secondary criteria was used. DCS stated that it considers secondary criteria in addition to primary criteria in identifying benchmarks.

To address many of the staff questions regarding the DCS process in Reference 1 and above, it was concluded that DCS would provide a flowchart of the process and include in the flowchart application of the primary and secondary criteria.

Individual Benchmark Experiments

Metal vs. powder: DCS stated that it used the full theoretical density of the powder with no moderator (i.e., H/X = 0) because, in some array calculations, this was the most reactive case. Staff stated that DCS had committed in the CAR (Section 6.3.4.3.2.6) to assume at least 1wt% H_2O moderation in the powder calculations. DCS stated that it would provide a summary of its sensitivity study showing that, in some cases, an H/X = 0 was the most reactive case.

Staff stated that to use metal experiments, DCS needs to show:

- if modeled as heterogenous vs. homogenous, there is no difference;

- if H/Pu=0 and theoretical density of powder is used, that this is a reasonable model (e.g., modeled because it is the most reactive case);

- more information on the geometry and material composition of the design application to justify certain benchmarks as being applicable; and

- that the partitioning is reasonable (i.e., that it is appropriate to include low-density, moderated, homogeneous powder systems with high-density dry powder array systems).

Use of benchmarks with low Pu content (i.e., Pu content is lower than 100% (e.g., 52%, 29%)) for AOA (3) and high Pu content (i.e., 100%) for AOA (4): Staff stated that DCS used only fission spectra to justify these benchmarks. Staff stated that if one uses only fission spectra, that is not sufficient unless one shows that fission spectra is the only factor that affects bias. Staff stated that there are two options:

- if DCS believes that the neutron fission spectrum is the only factor that affects bias, then DCS needs to show that it dominates so that other factors can be neglected, or

- if DCS does not believe that the neutron fission spectrum is the only factor affecting bias, then DCS needs to show that it has considered neutron behavior, looking at all spectra of nuclear data (i.e., show that all neutron effects between systems are similar).

Staff stated that it would be willing to approve k-effective for AOA(3) and AOA(4) if an additional 2% margin is added. Staff believes that this additional margin is needed to cover a less than optimal number of applicable benchmark experiments. Staff believes that there are 26 applicable benchmarks for AOA(3) and that these benchmarks cover the parametric range in EALF. For AOA(4), staff believes that there are 38 applicable experiments and that these experiments cut off the high and low energy range. Further, if only 38 experiments are used, only a low H/X is covered.

Individual benchmarks that the staff considers acceptable for MOX validation are provided in Attachment 4. This information was provided to DCS subsequent to the meeting.

Conclusion

Although some of the questions in Reference 1 were discussed and clarified at the meeting, staff expects written DCS responses to the questions in Reference 1 in order to justify the benchmarks chosen in validating the criticality computer code.

Summary of information discussed at the meeting to be provided by DCS in its response to the questions in Reference 1 in order to justify the benchmarks chosen in validating the criticality computer code:

1. summary of calculations showing no k_{eff} difference for homogeneous vs. heterogeneous calculations;

2. summary of calculations showing H/X=0 is most reactive for some array cases;

3. table showing how the benchmarks compared to the screening criteria, and why it was included; and

4. flowchart of the process used to select benchmarks and include in the flowchart application of the primary and secondary criteria.

MEETING ATTENDEES

NAME	AFFILIATION
Andrew Persinko	Nuclear Regulatory Commission (NRC)
Muffet Chatterton	NRC
Christopher Tripp	NRC
Brian Smith	NRC
Joe Giitter	NRC
Dave McIntyre	NRC
Ken Ashe	Duke Cogema Stone & Webster (DCS)
Robert Foster	DCS
Thomas Doering	DCS
Bill Hennessy	DCS
Jamie Johnson	Department of Energy (DOE)
Joe Olencz	DOE
Dave Alberstein	DOE
Joe Roarty	Defense Nuclear Facilities Safety Board
Jim Clark	Gamma Engineering

Attachment 3

NRC INFORMATION PROVIDED TO DCS SUBSEQUENT TO THE MEETING

Attachment 4

Benchmarks Acceptable for MOX Validation

AOA(3) (26 total)

PCM001-02
PCM001-03
PCM001-04

PCM002-01
PCM002-02
PCM002-03
PCM002-04
PCM002-05
PCM002-06
PCM002-07
PCM002-08
PCM002-09
PCM002-10
PCM002-11
PCM002-12
PCM002-13
PCM002-14
PCM002-15
PCM002-16
PCM002-17
PCM002-18
PCM002-19
PCM002-20
PCM002-21
PCM002-22

PMF001-01

AOA(4) (38 total)

NSE55T5-01
NSE55T5-02
NSE55T5-03
NSE55T5-04
NSE55T5-05
NSE55T5-06
NSE55T5-07
NSE55T5-08
NSE55T5-09
NSE55T5-10

PU-29-1

PU-29-2
PU-29-3
PU-29-4
PU-29-5
PU-29-6
PU-29-7
PU-29-8
PU-29-9

BNWL2129T4-01
BNWL2129T4-02
BNWL2129T4-03
BNWL2129T4-04
BNWL2129T4-05
BNWL2129T4-06
BNWL2129T4-07
BNWL2129T4-08
BNWL2129T4-09
BNWL2129T4-10
BNWL2129T4-11
BNWL2129T4-12
BNWL2129T4-13
BNWL2129T4-14
BNWL2129T4-15
BNWL2129T4-16
BNWL2129T4-17
BNWL2129T4-18
BNWL2129T4-19