Criticality Safety Meeting Summary (Public)

Date: April 25, 2005

Place: U.S. Nuclear Regulatory Commission (NRC) Offices; Rockville, Maryland.

Attendees:

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Purpose:

The purpose of this part of the meeting, which was open to the public, was to discuss USEC Inc.'s (USEC's) non-sensitive responses to the NRC's requests for additional information (RAIs) related to the nuclear criticality safety (NCS) program described in USEC's license application for the American Centrifuge Plant (ACP).

Discussion:

Several responses to the NRC's RAIs were discussed during the meeting. A summary of these discussions is provided below.

1. NRC's RAI NC-7 requested the applicant to clarify whether postings and/or labels were required for administrative controls whenever an in-hand procedure was not used. The applicant responded that postings and/or labels are not required when using in-hand procedures, but that they may still be used on occasion.

   The NRC staff indicated that this did not respond to the question about what was done when in-hand procedures are not used.

The applicant stated that it would document any instances in which postings were not considered necessary on a case-by-case basis, and that it would have similar written criteria for the placement of postings to what it has currently for the gaseous diffusion plants (GDPs). Postings would be most appropriate for areas in which operations were localized to small areas with limited operations. The NRC staff indicated that it would consider the specific implementation of posting requirements appropriate to review during the operational readiness review (ORR) that the NRC will conduct after any license is issued and prior to the commencement of operations.

2. NRC's RAI NC-10 requested the applicant to justify why annual walkthroughs of its fissile material operations are acceptable. The applicant responded that front-line managers (FLMs) provide real-time assessment of fissile material operations (FMOs) to ensure that NCS requirements are being adequately implemented.

   The NRC staff indicated that it was not clear whether FLMs are procedurally required to monitor NCS compliance among their other responsibilities or whether they are adequately trained to do so.

   The applicant stated that there would be NCS staff on the floor regularly, and that the FLMs would be provided with additional training in NCS sufficient to allow them to perform this duty. In addition, while there is a commitment to walk down every area at least annually, NCS staff would be expected to walk down portions of the facility on approximately a monthly basis. The NRC staff stated that it was initially unclear whether the annual walkdown meant that every area of the facility would be walked down at least once per year. The applicant agreed to clarify the intent and provide additional details on training of FLMs.

3. NRC's RAI NC-11 requested the applicant to state how often NCS Program audits would be performed. The applicant responded that NCS Program audits would be performed at least once every three years.

   The NRC staff indicated that the applicant had not adequately justified why a triennial frequency was acceptable.

   The applicant stated that, while external and independent audits of the NCS program would be performed on a triennial basis, there would also be an annual self-assessment of the NCS program, which is consistent with the self-assessment frequency for other safety programs. The applicant agreed to clarify this.

4. NRC's RAI NC-12 requested the applicant to clarify when a nuclear criticality safety evaluation (NCSE) was necessary. The applicant responded that there were a variety of situations in which requests for NCS evaluations were not necessary, including: (1) the

operation is obviously non-fissile, (2) the operation has not been funded, (3) the operation lies within the scope of an existing NCSE, (4) the operation is non-fissile due to limited inventory or enrichment, or (5) the operation cannot be shown to be doubly contingent or highly unlikely and therefore would not be approved.

The NRC staff indicated that these situations appeared reasonable but that the response was open-ended in that it did not provide comprehensive criteria addressing when an NCSE was not required and therefore cannot be approved.

The applicant stated that historically, in the experience of the GDPs, some operations had been overly conservative in requesting NCS evaluations and that there were many different instances in which they were not needed. The applicant also clarified that any operations exceeding 100 g ^{235}U or an enrichment of 1 wt% ^{235}U under either normal or credible abnormal conditions would be covered by an NCSE. The NRC staff stated that this would be adequate and no further response was needed beyond a written confirmation of USEC's statements made during the meeting as reflected above.

5. NRC's RAI NC-13 requested the applicant to describe how reliance is placed on the natural and credible course of events, and what "other means" may be used besides the use of administrative controls, engineered controls, and the natural and credible course of events. The applicant responded that the natural and credible course of events was relied on when implementing explicit NCS controls is unnecessary, impractical, or overly prescriptive. To qualify as the natural and credible course of events, no controls must be necessary to maintain them.

   The NRC staff indicated that the response did not justify why this type of event could be credited without establishing specific controls to maintain initial conditions, and did not address the question about use of "other means" of criticality control.

   The applicant stated that its position on use of the natural and credible course of events was consistent with the approach previously found acceptable between the NRC and USEC for the GDPs. The applicant agreed to provide the NRC staff with documentation of this agreement for its review. The applicant also stated that it included use of the words "other means" from American National Standards Institute/American Nuclear Society (ANSI/ANS) 8.1 for completeness because it could not envision all possible types of situations that may arise in the future, and that whatever means the applicant uses, it would still need to ensure that criticality is highly unlikely and that the operation is doubly contingent. The applicant further stated that it does not currently use "other means," and that any change that resulted in their use would necessarily require NRC pre-approval, because it would constitute a new accident sequence or change to an existing accident sequence under 10 CFR 70.72. The NRC staff stated that this would be acceptable as it could then make a determination of adequacy of these controls on a case-by-case basis.

6. NRC's RAI NC-14 requested the applicant to describe how it will ascertain whether a change in process conditions is sufficiently "unlikely" to meet the double contingency principle (DCP). The applicant responded that the criterion for determining when process conditions are sufficiently unlikely to meet the DCP is engineering judgement, combined with a peer review and the rest of the NCSE approval process.

   The NRC staff indicated that citing engineering judgement alone is too subjective and that more specificity was needed.

   The applicant stated that the FLMs were required to check criticality controls to ensure that they were capable of being implemented and performing their intended safety functions. In addition, the applicant cited the many layers of reviews and available operating history to provide assurance that double contingency controls would be unlikely to fail. The NRC staff indicated that the reliance on engineering judgement and the approval process was subjective and did not provide any objective criteria that could be used to unambiguously determine whether the failure of the controls was in fact unlikely. The applicant stated that it would revise its response but would discuss it with the NRC before responding.

7. NRC's RAI NC-15 requested the applicant to clarify the meaning of the paragraph on page 5-9 discussing "items related to NCS." The applicant responded that "items related to NCS" meant either (a) items maintained by non-NCS programs (e.g., Health Physics, Industrial Safety); or (b) chains of events that are inherently unlikely without specifying explicit controls.

   The NRC staff indicated that the examples did not support the statement that items related to NCS do not require explicit controls. In the first example, that of five different valves that must be misaligned, the fact that there are five valves is a feature of the design that must be recognized as important for NCS. In the second example, the threat of imminent death or injury is a deterrent to deliberate acts but not necessarily to accidental acts.

   The applicant stated that, with regard to crediting the five valves, a configuration change would involve review by NCS, because NCS has a permanent position on the Plant Safety Review Committee (PSRC) that reviews all changes, not just changes to FMOs. The applicant stated that the example of the threat of imminent death or injury was intended to address situations that were obviously hazardous to life and health, as opposed to the broader spectrum of accidental actions. The examples cited were driving a forklift into a filled UF_6 cylinder or cutting into a UF_6 pipe. The NRC staff agreed that the examples were reasonable, given the additional details provided by the applicant, and that no further response was necessary beyond a written confirmation of USEC's statements made during the meeting as reflected above.

8. NRC's RAI NC-17 requested the applicant to remove the statement from its application in Section 5.4.2.1 discussing controls used to preclude areas from being classified as fissile material operations. The applicant responded that controls relied on to prevent areas from meeting the criteria for being an FMO under abnormal conditions would not be double contingency controls or items relied on for safety (IROFS), but that such controls would be identified through a documented process.

   The NRC staff indicated that the status of such controls and how they are identified and maintained was not clear, and also that their inclusion in procedures or work instructions should not be left to the discretion of line managers.

   The applicant stated that controls to prevent exceeding the threshold for an FMO (enrichment greater than 1 wt% ^{235}U or greater than 100 g ^{235}U) would be identified as procedural controls, such as material control and accounting (MC&A) controls on cylinder movement credited with ensuring that only natural uranium is used initially in the feed facility. The applicant also stated that such controls would be uniquely identified in such procedures, in similar fashion to the way in which administrative NCS controls are stamped in operating procedures. The NRC staff agreed that this would be an acceptable way to prevent non-fissile operations from becoming FMOs, and that no further response was necessary beyond a written confirmation of USEC's statements made during the meeting as reflected above.

9. NRC's RAI NC-19 requested the applicant to clarify whether it would document exceptions to the preferred design philosophy in license application Section 5.4.3. The applicant responded that it did not intend to document the reasons for not following the preferred approach, such as when relying on administrative controls.

   The NRC staff indicated that, although it did not expect that engineered controls could be used in every instance, there should be a good reason for deviating from the preferred design philosophy and this reason should be documented.

   The applicant stated that administrative controls were used mainly in maintenance operations, in which use of passive or active engineered controls is impractical due to the hands-on nature of these operations. Examples of other operations involving administrative controls are the vacuuming of spills, container handling, and equipment transport. The requirement to ensure that criticality is highly unlikely under 10 CFR 70.61 drove the vast majority of ACP processes to rely on engineered controls. The NRC staff agreed that the design of the majority of the ACP facility relies extensively on inherently safe, passive equipment design, consistent with the applicant's commitment to the preferred design philosophy. As with other facility changes, replacement of an engineered control with an administrative control would require NRC pre-approval under 10 CFR 70.72. No further response was necessary beyond a written confirmation of USEC's statements made during the meeting as reflected above. Attachment 1

10. NRC's RAI NC-21 requested the applicant to remove the statement from license application Section 5.4.4 stating that exemptions from criticality accident alarm system (CAAS) coverage are documented in its NCS evaluations based on a conclusion that criticality is not credible. The applicant responded that the intent of the cited text was merely to point out that USEC would use form NCSEs to ensure that areas which do not have CAAS coverage will not contain greater than 700 g ^{235}U, and that the criteria immediately following were taken from the (700 g ^{235}U) mass limit in 10 CFR 70.24, the (50 g ^{235}U/m^2) areal density limit in ANSI/ANS-8.3, and the (5 g ^{235}U in any 10-liter volume) concentration limit in 10 CFR 71.53.

    The NRC staff indicated that these two statements were inconsistent, in that the rule (10 CFR 70.24) does not allow for areal density or concentration based limits, but only contains a mass limit. Therefore, the use of areal density and concentration limits goes beyond what is allowed in the rule. Furthermore, the areal density criterion in ANSI/ANS-8.3 has not been endorsed by NRC as it is not in agreement with the rule; the concentration limit from 10 CFR 71.53 as applied to transportation packages has not been demonstrated applicable in a processing facility. Whereas mass is conserved by physical law, process conditions could result in consolidating or concentrating uranic materials under abnormal conditions.

    The applicant stated that an example of where the areal density limit would be used would be a warehouse with contaminated equipment; an example of where the concentration limit would be used would be wastewater treatment. The applicant further stated that CAAS coverage would be provided if a credible concentration or accumulation mechanism existed, and that it would add the words "non-credible that those conditions change" to the words concerning the areal density and concentration criteria. The NRC staff stated that use of criteria beyond the 700 g ^{235}U limit from 10 CFR 70.24 requires an exemption request and should be included with the applicant's exemption request for the cylinder yards.

11. NRC's RAI NC-22 requested the applicant to provide technical justification for exemptions from CAAS coverage based on the criteria of less than 700 g ^{235}U, 50 g ^{235}U/m^2, or 5 g ^{235}U in any 10-liter volume, and state whether this is applied to only normal or credible abnormal conditions as well. The applicant responded by referring to its response to question NC-21, and stated these criteria did apply to credible abnormal conditions.

    The NRC staff indicated that the response to question NC-21 did not adequately justify use of the areal density or concentration criteria. As with question NC-21, an exemption request is needed to address the areal density and concentration criteria.

12. NRC's RAI NC-23 requested the applicant to clarify whether all areas not covered by a

CAAS exemption will be covered by two alarms, and also to state what compensatory measures would be used if dual alarm coverage is lost. The applicant responded that the CAAS system is required to provide dual coverage at all times, and that appropriate compensatory measures would be imposed until CAAS coverage was restored.

The NRC staff indicated that the response did not provide the requested clarification as to what compensatory measures would be used.

The applicant stated that the CAAS system was designed so that conditions in which CAAS coverage is lost are not anticipated and that appropriate facility-specific compensatory measures will be planned and documented as part of the design of the operation. The NRC staff stated that this would be adequate and no further response was needed beyond a written confirmation of USEC's statements made during the meeting as reflected above. The NRC staff indicated that it was not clear how or where the compensatory measures would be documented, but that it planned to review them as part of the ORR.

13. NRC's RAI NC-24 requested the applicant to provide the technical basis for limiting the installation of evacuation horns and radiation warning lights to facilities within 200 feet of facilities with CAAS coverage. The applicant responded that the 200-foot evacuation zone is sufficient to ensure personnel are not exposed to doses exceeding regulatory limits.

    The NRC staff indicated that the technical basis was not sufficient in that the analysis to show this fact was not provided. The applicant stated that this was the same criterion as currently used for the GDPs, and agreed to provide the technical basis for this criterion.

14. NRC's RAI NC-29 requested the applicant to commit that process variables that can affect moderation will be identified as IROFS, when moderator control is relied upon. The applicant responded that moderator controls relied upon to ensure that criticality is highly unlikely would be identified as IROFS.

    The NRC staff indicated that this response did not adequately address the question, which concerned process variables (e.g., temperature, pressure) were used to establish moderator control.

    The applicant stated that, in the ACP, the main moderation control is the pressure boundary for both process equipment and UF_6 cylinders, and that all moderator controls in the facility are passive, and therefore the use of process variables does not apply.

The NRC staff stated that this is acceptable if moderator controls are all passive, and no further response was necessary beyond a written confirmation of USEC's statements made during the meeting as reflected above.

15. NRC's RAI NC-32 requested the applicant to clarify what management measures will be used when relying on geometry control. The applicant responded that pre-operational verification walk-downs and pre-use verification would be used to ensure that geometry control for permanently installed equipment is implemented. In addition, permanently installed equipment may be subject to periodic surveillance if the equipment may credibly degrade.

    The NRC staff indicated that the response should state that permanently installed equipment credited for geometry control will be subject to periodic surveillance if the equipment may credibly degrade.

    The applicant stated that it will change "may" to "will" in the text cited above.

16. NRC's RAI NC-33 requested the applicant to clarify that, when parameters other than mass are relied on in setting mass limits, control of these parameters in conjunction with mass will only be credited as one leg of double contingency, and that if these items are not credited as IROFS, the associated parameter will be evaluated at its most reactive credible value. The applicant responded that highest credible or optimum moderation will be assumed when geometry, enrichment, or composition is used as the primary control.

    The NRC staff indicated that this response only addresses moderation, and not other parameters, and does not address the underlying question which is whether both mass and the parameters used to determine safe mass could be credited as two distinct controls for meeting the DCP.

    The applicant stated that, if mass limits are dependent on another controlled parameter, then this combination of controls will only be counted as one control for meeting the DCP. The NRC staff agreed that this is appropriate, and no further response was necessary beyond a written confirmation of USEC's statements made during the meeting as reflected above.

17. NRC's RAI NC-39 requested the applicant to describe whether minimum reflector conditions are used to account for the presence of nearby structural or transient materials in facility calculations. The applicant responded that reflection conditions are described and justified in each NCSE, and that when operations involve the routine presence of personnel at the operating floor level, full water reflection or interstitial moderation combined with full density water blocks to simulate personnel may be used.

However, for operations in which the routine presence of personnel is not considered credible, full water reflection is not considered.

The NRC staff indicated that this response states that full water or interstitial reflection may be used, but does not state that one of these assumptions will be used, in evaluating the effect of personnel as reflectors. In addition, the response did not contain a justification for not having a minimum reflector condition to account for other transient reflectors.

The applicant stated that, in indicating that it may use option A (full water reflection) or B (interstitial moderation combined with full density water blocks to simulate personnel), the intent was not that it may use one of these options or some other option, but that it would commit to using either option A or B. The applicant stated that whatever reflection conditions were assumed would be justified to be bounding. The NRC staff questioned why the applicant did not commit to a minimum reflection condition for transient reflectors or structural materials that may be present in addition to operations personnel. The applicant stated that it did not consider this appropriate because there would be no solution processing in the facility, and that it would analyze any specific reflectors present in a given operation. The NRC staff agreed that this was acceptable, and no further response was necessary beyond a written confirmation of USEC's statements made during the meeting as reflected above.

18. NRC's RAI NC-44 requested the applicant to describe the amount of margin used when deriving subcritical limits based on handbooks, and to describe the associated validation process. The applicant responded that handbooks are used as the starting point for establishing NCS limits, and that handbook limits may be used as written, incorporated into an operation-specific calculation, or applied in reduced fashion based on credible upset conditions. In addition, handbook data derived from experiment requires no validation, and handbook data derived from a calculational study is subject to the same validation requirements as other calculations.

The NRC staff indicated that this response appears to be inconsistent with that of question NC-31, which indicates that handbook limits are always supplemented by calculations. The response did not address the methods of validating handbook data that is used directly in lieu of operation-specific calculations, or how much margin of subcriticality is applied.

The applicant stated that the handbooks it used are based mostly on experimental data, rather than calculations, but that any handbooks used would be "vetted" prior to using them as the starting point for establishing NCS limits. The applicant agreed to provide an example of this.

19. NRC's RAI NC-45 requested the applicant to describe how hand calculations are validated. The applicant responded that: (1) use of the modified two-group diffusion equation did not require validation because the method contains inherent conservatism and uses experimentally derived data; (2) use of buckling conversion is applicable to all types of material compositions and does not require validation; (3) comparative analysis refers to the use of handbook data is addressed in the response to question NC-44; (4) the use of the solid angle method is inherently very conservative and thus does not require validation; and (5) the use of the surface density method applies the reactivity of a single unit to an entire array, and that the single unit reactivity is determined using handbooks or validated methods, so that no specific validation is required.

    The NRC staff indicated that the validity and adequate margin of subcriticality must be shown for any calculational method used to derive NCS limits. In addition, some of these methods have variants and therefore are not uniquely described in the license application. A detailed description of the methodology, the summary of systems or parameters over which it is valid, any assumptions or limitations that must be adhered to, and demonstration of adequate margin of subcriticality are all needed for such methods. In addition, if the method cannot be validated using critical benchmarks, a reference showing that it is an accepted and established method should be provided.

    The applicant stated that it would provide a more detailed discussion of hand calculations and their use.

20. NRC's RAI NC-47 requested the applicant to justify using a 0.02 margin of subcriticality. The applicant responded that the 0.02 margin was based on historical use (as done at the gaseous diffusion plants), engineering judgement, and low-risk of criticality for the ACP.

    The NRC staff indicated that a determination of adequate margin depended in part on closing the issues associated with the validation report, and thus this issue would not be closed until the issues in questions PC-1 through PC-14 had been adequately resolved. The NRC staff also questioned the need for the 0.02 margin in light of statements about the low risk of ACP operations (i.e., no planned operations involving uranium solutions or more than a safe mass outside centrifuge processing equipment).

    The applicant stated that the phrase "outside centrifuge processing equipment" should more accurately be rendered "outside UF_6 processing equipment," because the UF_6 cylinders clearly contain more than a safe mass. The applicant clarified that while normal operations were very subcritical, under certain abnormal conditions (e.g., removed, moderated equipment), facility operations could approach the upper safety limit. The NRC staff agreed that this response was reasonable, but indicated that all questions on validation would have to be resolved before this question could be considered resolved.

21. NRC's RAI NC-48 requested the applicant to include in the license application a summary description of its validation report, including the ten items discussed in NUREG-1520, Section 5.4.3.4.1(7)(a)-(j). The applicant responded that it was not appropriate to specify this level of detail in the license application, because the details associated with its validation are not sufficiently fixed and unchanging to provide the specific description. The NRC staff indicated that many of the details (such as a description of the underlying methodology) were unlikely to change significantly or often and additional details were needed to provide assurance that validation would continue to be performed correctly in the future.

    The applicant stated that because validation can be a constantly evolving process, frequent amendments would be needed whenever changing the benchmarks, area of applicability, or the code platform. The applicant stated that it had incorporated the validation report by reference. The NRC staff stated that it would consider the impact of this and discuss with the applicant later.

22. NRC's RAI NC-50 requested the applicant to clarify to which of the currently NRC-endorsed ANSI/ANS-8 Series standards USEC is committing. The applicant responded that the details of what specific standards were being committed to are included in license application Section 1.4.

    The NRC staff indicated that the response did not address whether the applicant committed to all the recommendations ("should" statements) or only the requirements ("shall" statements) of the affected standards, and did not justify why the applicant did not commit to certain of the ANSI/ANS-8 Series standards. The staff reviewed the set of commitments in license application Section 1.4 and concluded that the applicant had mainly committed to those ANSI/ANS-8 Series standards that were applicable to the ACP. The exception was ANSI/ANS-8.23; it was unclear whether the emergency response provisions of this standard are applicable to ACP operations.

    The applicant stated that it would comply with all "shall" statements of the standards to which it was committing (except as qualified in license application Section 1.4), but that it would not necessarily comply with all "should" statements, with the exception of complying with the DCP in ANSI/ANS-8.1. The applicant further stated that a specific commitment to ANSI/ANS-8.23 was not necessary because its Emergency Plan compared favorably with the standard. The NRC staff stated that it would review the Emergency Plan and discuss with the applicant later.

Action Items

USEC to provide written responses/confirmations to close the NRC issues documented above. NRC to review information associated with items 21 and 22 above and provide USEC any additional need for clarification/confirmation.