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STONE & WEBSTER

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Subject: Docket Number 070-03098
Duke Cogema Stone & Webster
Mixed Oxide Fuel Fabrication Facility
Responses to Site Description, Instrumentation, and Criticality Open Items/Additional NRC Questions on Construction Authorization Request (CAR) Revision

Reference:
1. NRC to DCS letter dated 13 January 2003, January 2002 Monthly Open Item Status Report (NRC-DCS-000105)
2. DCS to NRC letter dated 29 October 2002, Responses to the Request for Additional Information on the Environmental Report, Revisions 1 and 2 (DCS-NRC-000116)

Enclosed are responses to Nuclear Regulatory Commission (NRC) questions and open items related to the draft safety evaluation report (SER) for the Mixed Oxide Fuel Fabrication Facility (MFFF). Responses are provided in the subject areas of Site Description, Instrumentation and Control, and Criticality. The enclosed responses are based on information previously provided (Ref. 2), and information discussed at public meetings with the NRC staff December 10-12, 2002 and January 15-16, 2003. Revisions to the Construction Authorization Request described in the attachment will be provided under separate cover letter.

If you have any questions, please contact me at (704) 373-7820.

Sincerely,

Peter S. Hastings, P.E.
Manager, Licensing & Safety Analysis

NM5501

Enclosure: Responses to Site Description, Instrumentation, and Criticality Open Items/Additional NRC Questions on Construction Authorization Request (CAR) Revision

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Site Description Open Items

<u>SD-01</u>: **Provide the sensitivity of field and laboratory radiation measurements used to determine the extent of existing soil radioactivity. (DSER Section 1.3.1.4)**

Clarification of SD-1. For the Pre-operational Environmental Monitoring Program described at CAR §10.3, explain whether the Preconstruction Environmental Monitoring includes more sensitive measurements of alpha-emitting radioactivity concentrations in soils than those described for the CY 2000 geotechnical investigations at CAR §1.3.4.6.

<u>Response</u>:

The Preconstruction Environmental Monitoring Report was submitted to NRC on 29 October 2002 (DCS-NRC-000116). Table 17 provides a summary of the isotopes investigated including Minimum Detectable Concentrations (MDCs) or Practical Quantification Levels (PDLs) for each isotope. The MDCs or PQLs for alpha emitting isotopes are generally lower than those reported as part of the CY 2000 geotechnical investigations reported in CAR §1.3.4.6.

<u>Action</u>:

None

Instrumentation and Control Open Items

IC-01: **Clarify commitment to IEEE 603 for seismic sensors and seismic trip actuation. (December 10-12, 2002 Meeting Summary, item 34)**

Response:

The seismic monitoring and trip system includes monitoring and recording functions and a seismic trip function.

The design of the process safety controls and the emergency controls will be according to the requirements of IEEE 603, IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations. This includes the seismic monitoring and trip system.

The seismic monitoring and trip system is designed to satisfy the requirements of Regulatory Guide 3.17, Earthquake Instrumentation for Fuel Reprocessing Plants. The regulatory guide requires that the seismic system record the ground motion and the response of the buildings to the ground motion, and that a plan exist for the timely utilization of this data. The recording system is not a PSSC because it performs no part in satisfying the performance requirements of 10CFR70.61 (b), (c) or (d).

The design of the MFFF includes a seismic trip function to stop the manufacturing and processing systems and close the utilities, gases and reagents seismic isolation valves in the event that the building response to ground motion exceeds predetermined limits.

The trip system has been designated as PSSC because it stops the movement of fissile material in a safe position and does perform a role in satisfying the performance requirements of 10CFR70.61 (b), (c) or (d). Once the trip system has performed its safety function, it has no further performance requirements.

This system has two independent channels, either of which is capable of independently performing the safety function, which is to ensure that the AP and MP systems are stopped in an analyzed safe state.

The common instruments to both the trip and recording system are the 3-axis accelerometers and the electronics associated with the accelerometers. The signals from the accelerometers are sent to both the trip system and the recording system through appropriate electrical isolation.

Action:

None.

Criticality Open Items

NCS-1: **"The need for specific Pu/MOX experience for NCS staff involved in the design phase"**

DSER 6.1.1: "Given the lack of experience relevant to Pu processing, the staff concluded that the experience levels cited were not sufficient without additional justification. Moreover, comparable industry experience is likely to consist of experience at low- and high-enriched uranium fuel fabrication and enrichment plants. Much of criticality safety is practiced by "skill-of-the-craft" and requires an intuitive understanding of the neutron physics and margins of safety for the materials and systems being evaluated. Therefore, the staff recommends that plutonium (Pu) or MOX-specific experience be included for at least senior NCS positions."

Response:

DCS' design of the MFFF includes significant participation by COGEMA and its related subsidiaries (e.g., SGN); COGEMA and SGN personnel constitute over half of the criticality safety function during the design phase. COGEMA has been involved in the French nuclear industry for many years, and they have over twenty years of plutonium processing and and MOX fuel production experience. Accordingly, DCS personnel include some of the world's most extensive experience in Pu- and MOX-based fuel fabrication, including criticality safety functions. Specifically, COGEMA/SGN individuals in senior NCS positions have over five years of Pu/MOX experience during the design, construction, and operation of nuclear facilities such as UP2-400, UP2-800, and URP at La Hague, as well as the MELOX facility at Marcoule. Further, DCS also has access to the safety staffs at these operating facilities on an ongoing basis as regards experience in the concept, design, methodology, and nuclear criticality safety of the MFFF.

The US component of the criticality safety function in the design phase includes individuals in senior NCS positions with over three years of Pu/MOX experience (as a result of work on the MFFF project) as well as having many years of criticality safety for low- and high-enriched uranium experience.

There is obviously no fundamental difference in neutron physics for evaluation of Pu or MOX material and that of low- or high-enriched uranium. Analytical techniques used to evaluate criticality safety for the MFFF are virtually identical to those used for LEU and HEU, and nuances of Pu- or MOX-specific evaluations are more than accounted for, given the substantial Pu and MOX experience base of DCS' COGEMA and SGN resources. DCS fully intends to maintain the appropriate level of education and experience for criticality safety (as with all other disciplines), consistent with the requirements and commitments of Sections 2 and 3 of the MOX Program Quality Assurance Plan. DCS will train all criticality safety staff in the characteristics of Pu and MOX materials as necessary for criticality safety purposes.

The general and additional contents of a license application (including construction approval) as indicated by 10 CFR §§70.22 and 70.65, respectively, are silent on the need for a specific commitment to Pu- or MOX-specific training for NCS staff at the design phase of the facility. In addition, the NCS review compliance with 10 CFR §§70.24, 70.61, 70.62, 70.64, 70.72, and Appendix A of 10 CFR Part 70 do not appear to require such a commitment. DCS also has reviewed NUREG-1718, the standard review plan (SRP) for the MOX facility, and applicable guidance (e.g., ANSI/ANS-8 series standards), and has found that they also do not contain such a requirement or recommendation specifically.

Accordingly, consistent with applicable regulation and available guidance and precedent, DCS has not identified a specific commitment to isotope-specific experience. DCS has committed extensively to the recommended guidance in the MOX SRP regarding: responsibilities and authorities for organizations and individuals implementing the NCS program (including education and experience commitments clarified in the recent revision to the CAR for NCS staff during the design phase); criteria related to NCS in SRP §4.4.3 (i.e., clear and unambiguous controls and communications between the organizational groups for designing and constructing the facility; clearly delineated lines of communication, responsibility, and authority between organizational groups; and a corporate officer responsible for activities related to design and construction of principal SSCs); the establishment of formal management measures as described in SRP Chapter 15.0 as necessary and appropriate to provide reasonable assurance of the availability and reliability of the items relied on for safety; organizational positions, functional responsibilities, experience, and adequate qualifications of persons responsible for NCS; and the use of technical practices in accordance with the acceptance criteria of SRP §6.4.3.3.

These commitments, coupled with the extensive experience of personnel performing the DCS criticality safety function, should support a favorable NRC Staff conclusion regarding NCS qualification and experience. In particular, these commitments should support a conclusion that the establishment of an NCS organization and administration in accordance with the acceptance criteria of §6.4.3.1, and of management measures for NCS in accordance with the acceptance criteria of §6.4.3.2 (including organizational positions, functional responsibilities, and experience qualifications of persons responsible for NCS), are in broad agreement with regulatory acceptance criteria; that adequate implementation of these and other NCS commitments provides reasonable assurance that the MFFF will be found acceptable without major reengineering or redesign.

Action:

None.

<u>NCS-2</u>: **"Definition of NCS design basis controlled parameters for AP and MP process auxiliary systems (specifically including process ventilation, isotopic dilution, and high-alpha waste)"**

<u>DSER 6.1.3.4.1</u>: "While CAR Tables 6-1 and 6-2 provide design basis controlled parameters for the main AP and MP steps, design bases are not defined for auxiliary systems, such as ventilation and waste processing. Therefore, definition of NCS design basis controlled parameters for AP and MP process auxiliary systems (specifically including process ventilation, isotopic dilution, and high-alpha waste) has not been adequately resolved and is considered an open item."

<u>Response:</u>

Table 6-1 and 6-2 are intended to represent only a preliminary view of the criticality controlled parameters for the main AP and MP process units. Tables 6-1 and 6-2 have been updated in the revised CAR to provide more detail on the main AP and MP process units, to clarify isotopic dilution (i.e., to show the units where isotopic dilution occurs), and to add discussion of the high-alpha waste auxiliary systems.

With respect to other auxiliary systems such as chemical and water addition, these will be treated like the facility ventilation system which is designed to prevent significant Pu from reaching the system. DCS will design the facility to prevent significant Pu from reaching the auxiliary systems including suitable IROFS controls such as passive design features and dual independent sampling. A potential criticality in these auxiliary systems will be shown to be highly unlikely using these controls and other features. However, these are not process units and, as such, are not included in Tables 6-1 or 6-2; rather, they will be addressed in an NCSE for auxiliary systems.

<u>Action:</u>

Clarify in the CAR tables where the U235 isotopic dilution occurs and the fact that fissile material including U235 is considered.

Criticality Open Items (continued)

NCS-3: **"Justification for the bounding density values assumed in Tables 6-1 and 6-2"**

DSER 6.1.3.4.1: "CAR Table 6-1 assumes specific densities of PuO_2 powder...but [is] not identified as a control. These bounding assumptions on the incoming materials are relied on for criticality control, but not justified in CAR Table 6-1. The applicant has agreed to provide additional justification for those parameter values which are assumed less than optimal but not specifically controlled. ...the applicant...stated that the justification for bounding densities would be submitted at a later date."

DSER 6.1.3.4.2: "Certain parameters ... have bounding values listed that are relied on for criticality control, but are not specifically credited as criticality control or justified in CAR Table 6-1 [sic]. The applicant has agreed to provide additional justification for those parameter values which are assumed less than optimal but not specifically controlled. DSER Reference 6.3.6 stated, however, that assumptions about bounding powder densities would be provided in a subsequent response."

Response:

This open item has been addressed in the recent revision to CAR Tables 6-1 and 6-2. These tables provide preliminary information regarding criticality control parameters for each criticality control unit. (The demonstration of criticality safety is performed in the Nuclear Criticality Safety Evaluations as supported by the criticality safety calculations.)

In the case of the AP process (Table 6-1), the bounding density is shown as "<7 g/cc" and "<3.5 g/cc" for various entries. 7 g/cc is a very large density for powder material required in the AP process. Nonetheless, calculations have shown that, even with material at its maximum theoretical density (11.46 g/cc for solid PuO_2), the decanning unit (through the pneumatic transfer departure criticality control unit) is subcritical. Prior to transfer to downstream process units, the material is sampled to ensure that the density is below <7 g/cc.

For entries assuming <3.5 g/cc (calcination furnace, homogenizing hoppers, and canning feed head), this density has been shown to be conservative for identical operations at the Cogema La Hague facility; these values will be confirmed during startup testing. Additionally, wherever the physical form changes, these densities less than maximum theoretical density will be shown to be conservative either by direct measurement or otherwise justified to be conservative such that no credible process upset can exceed the densities assumed.

All densities assumed in Table 6-1 will be justified in the appropriate NCSEs.

The recently revised CAR included revisions to Table 6-1 to add footnotes 9 and 10 (i.e., to reflect maximum bounding density values controlled by upstream measurement, and to reflect justification densities to be verified during startup testing). Further, for these cases, "NO" was changed to "YES" to reflect these as controls for the applicable control units.

Note that the electrolyzer, reception tank, and PuO_2 entries are inadvertently shown as "NO" (they should be "YES" in accordance with the discussion above). A change page to correct this administrative error will be transmitted as appropriate.

In the case of the MP process (Table 6-2), the densities have been shown to be bounding by direct measurement in a sampling program of identical operations in the MELOX facility. As above, these values will be verified during MFFF startup testing to ensure the measurements performed at MELOX are applicable to the MFFF (and to demonstrate these values are conservative). In the revised CAR, footnote 6 was amended in Table 6-2 to reflect this commitment. Also, as above, "NO" entries were changed to "YES" to reflect these assumptions as controls (i.e., wherever density is assumed to be less than 11 g/cc). As in the case of AP, wherever the physical form changes, densities less than maximum theoretical density will be shown to be conservative either by direct measurement or otherwise justified to be conservative such that no credible process upset can exceed the densities assumed.

In Table 6-2, the "PuO2 3013 storage pit" density entry has been changed to "d<11.46" and to reflect the analyses discussed above (i.e., where incoming material was reanalyzed at the maximum theoretical density).

<u>Action</u>:

None.

NCS-4: **"Determination of Design Basis USLs for each process type, and justification for the administrative margin; description of sensitivity methods to be provided in Part III of the Validation Report"**

DSER 6.1.3.5.2: "The staff has previously identified concerns with the administrative margin for AOA(1). Therefore, determination of the design basis USLs for AOA(1) has not been adequately resolved and is considered an open item."

DSER 6.1.3.5: "An additional Part III [of the validation report] covering plutonium oxalate systems (AOA(5)) is scheduled to be submitted in early 2002 [sic]. Therefore, the receipt of the Part III Validation report is considered an open issue."

Response:

As noted in DSER 6.1.3.5, the MFFF fissile materials have been divided into categories (e.g., Pu nitrates, rods, pellets, and assemblies, Pu powders, MOX powders, etc.) called Areas of Applicability (AOAs). As stated in the CAR, DCS has proposed an administrative margin of 0.05 for all AOAs which corresponds to an Upper Safety Limit (USL) of 0.95 (exclusive of biases and uncertainties).

In the case of AOA(2) (rods, pellets, and assemblies), NRC has concurred (in DSER 6.1.3.5.3) with an administrative margin of 0.05 (or a USL of 0.95, exclusive of biases and uncertainties) but has not yet agreed with DCS on the use of the same margin for the other AOAs for all conditions. In subsequent discussions, NRC has concurred with the USL of 0.95 as a limit to be imposed upon abnormal conditions, but has proposed an additional, lower USL of 0.92 for normal conditions (for AOAs other than AOA(2)).

NRC has requested that DCS provide justification why the DCS proposed margin (k_{eff}) is acceptable for normal conditions, or why it is appropriate to base a single k_{eff} limit on the limit for abnormal conditions. Further, NRC has requested DCS describe which other NRC-regulated facilities are most similar to the MFFF for the purpose of setting the subcritical margin and justify why.

DCS has researched the use of a dual (abnormal plus a normal) USL at other facilities primarily the high-enriched uranium (HEU) processing facilities of BWXT and NFS. Clearly, the greatest similarity between these two facilities and the MFFF is the processing of highly-enriched material, although the majority of MFFF operations involving highly enriched material occurs within sealed process cells whose design would significantly reduce any exposure in the event of an accidental criticality. Further, the MFFF is unique to date among 10 CFR 70 facilities in its commitment to single-failure assumptions, applicability of a 10 CFR 50 Appendix B QA program, and applicability of reactor standards to much of the design in its effort to demonstrate the robustness of the design. Finally, while those ostensibly analogous facilities do indeed have a dual (abnormal plus a normal) USL, as a result of the timing of their licensure, their designs were not based on a demonstration that criticality is high unlikely.

Criticality Open Items (continued)

DCS has committed to demonstrating that criticality events are highly unlikely. The issuance of BWXT and NFS licenses were based on designs that met the double contingency principal and not a demonstration that criticality is highly unlikely. Such a demonstration should provide the additional confidence needed to obviate the extra assurance that demonstrating margin to normal operating conditions via a separate (i.e., normal-operation) USL is apparently anticipated to provide.

In particular, all potential credible criticality events in the MFFF will be shown to be highly unlikely to occur. Thus, the only question is that of the USL value for demonstrating that the events are highly unlikely. As the definition of event sequences will ensure that all normal and credible abnormal scenarios are addressed, and criticality will be demonstrated to be highly unlikely for all scenarios, then evaluating compliance with the bounding "abnormal" USL will ensure subcriticality within that limit for all normal and credible abnormal events. The evaluation of the event sequence inherently considers the operating margin for determination of highly unlikely. Operations are rarely expected to be conducted at the subcritical value. For instance, if a subcritical mass value is calculated for the system, and compliance with that mass limit is controlled by a set of controls that are less than highly unlikely to fail, additional operating margin in the mass parameter will be necessary to ensure that multiple failures are necessary before an accidental criticality is possible. It would be very difficult to show that the accident sequence is highly unlikely if normal operation allowed that system to operate near the subcritical mass value. Conversely, if the set of controls used to limit the mass parameter value are highly unlikely to fail, then additional safety margin is not necessary.

Further, the determination of the parameter limit for normal operation of the system is based on the amount of operating margin in the controlled parameter necessary to demonstrate highly unlikely and not based on an arbitrary additional k_{eff} margin. Basing operating margin on an arbitrary k_{eff} margin will not ensure that the credible accident sequences are highly unlikely but evaluating the available operating margin during the accident sequence evaluation will ensure that the events are highly unlikely.

Finally, imposing a normal-operation USL would not result in any additional safety margin being achieved. DCS maintains, therefore, that the value of USL at the point of where an event is at abnormal conditions, along with demonstrating that the event is highly unlikely, is appropriate. DCS proposes the use of a single USL of 0.95 (exclusive of biases and uncertainties) in combination with a demonstration that all credible criticality events be shown to be highly unlikely.

DCS will determine the additional safety margin needed for normal operations to ensure that the USL is not violated during credible abnormal conditions in the NCSEs. Additional safety margin for normal operations is typically based on the type of control used to demonstrate double contingency and highly unlikely. This is explained in the following examples:

1. Passive engineered controls – These controls involve vessel dimensions, spacing for storage units, and other passive design features. The criticality safety analysis of these

systems considers all credible changes in the design feature to ensure that the system will remain subcritical in a credible abnormal event. For example, items like corrosion, manufacturing tolerances, properties of materials of construction, fissile material concentration, fissile material composition, and reflectors are considered at the worst case upset condition to ensure that the system will remain subcritical for any credible abnormal event. Thus in this case, no additional safety margin is required to ensure that the USL is not exceeded during normal or credible abnormal conditions.

If the keff at the worst case conditions is greater than the USL for worst case conditions and an active engineered control is necessary to prevent encountering these worst case conditions, it is not possible to control the system with passive design features; consequently active or administrative IROFS are necessary.

The safety margin for these controls is discussed next.

2. Active engineered controls – These controls involve the active controlling of a criticality parameter necessary to ensure that exceeding credible abnormal conditions meets the requirements of the double contingency principle. The establishment of the limits for these active engineered controls must consider the following things: ability of the control to maintain the parameter within established limits, tolerances and uncertainty in measuring equipment, response times and lag times for equipment, and other factors that are important to ensuring that the active engineered control can maintain the criticality parameter below the limiting value of the controlled parameter.

   It is necessary to demonstrate that the system design is robust and considersthat all operational concerns are considered regarding the components in the active engineered control. This will most likely lead to setting the limit to which the parameter is controlled to a value lower than calculated by the criticality safety analysis. In the case of using active engineered controls to limit the value of a parameter, DCS will demonstrate that using failure detection or other means, sufficient safety margin exists such that the potential criticality events are highly unlikely.[1]

3. Administrative controls – Administrative controls involve an operator or other person performing a function that ensures that a criticality parameter limit is not exceeded. When establishing an operating limit for a criticality controlled parameter that is administratively controlled, the operation must be carefully examined to ensure that there is sufficient margin between the operating limit and the credible abnormal limit established by the criticality safety analysis. For purposes of establishing double contingency and demonstrating that potential criticality events are highly unlikely when administrative controls are involved, it is necessary to demonstrate that multiple errors would be necessary before the parameter limit is exceeded. The amount of safety margin necessary depends greatly on the type of process, quantity of material being processed, form of the material being processed, etc. In any case, credit is taken, and thus the

[1] The implication of this is that, using two independent, unlikely to fail engineered controls to prevent a potential criticality, the detection of the failure of the IROFS must be performed within a specific time period e.g., one month.

additional safety margin established, for the difference between the operating limit and the credible abnormal limit when establishing double contingency protection and determining an event is highly unlikely. The margin will be shown in the NCSEs.

Action:

None.

Criticality Open Items (continued)

NCS-5: **"The definition of 'highly unlikely' for criticality hazards"**

DSER 6.1.4.2: "The staff has determined that the definition of the DCP (taken from ANSI/ANS-8.1-1983 (R1988)) is insufficiently detailed to support the conclusion that criticality is necessarily 'highly unlikely' to occur... In the public meeting on March 27, 2002, the applicant presented a summary description of a methodology for determining acceptable likelihoods for criticality accidents. While the method appears to approximately agree with the appropriate acceptance criteria, the staff requested that a more detailed description of the plan be submitted. The applicant has not yet submitted this description. Therefore, the definition of 'highly unlikely,' and the appropriate level of protection against accidental criticality in 10 CFR 70.64, has not been adequately resolved and is considered an open item."

Response:

In the March 2002 meeting, DCS provided a generic proof indicating that compliance with our other commitments with regard to the demonstration of IROFS effectiveness for all credited IROFS and event scenarios effectively provides a qualitative demonstration that high-consequence events are highly unlikely without further analytical demonstration. This discussion was consistent with the response to RAI question 39.

In the recent CAR revision, section 5.4.3 was updated to reflect the additional details discussed above, and to be consistent with the previous Staff agreements surrounding the response to RAI 39. The updated language focuses primarily on the analyses conducted as part of the ISA process, analyses which will demonstrate that the application of DCS' commitments provide for effective qualitative demonstration of meeting the highly unlikely threshold (consistent with the generic proof discussed above, but not including the specific frequency domain analysis). These analyses (i.e., of the demonstration of the effectiveness of IROFS) will be applied to each event sequence with the potential to exceed 10 CFR §70.61 requirements (including criticality events, without regard to actual dose consequences). The analyses verify that single failure criterion or double contingency principle is effectively applied, that there are no common mode failures, that the IROFS will be effective in performing their intended safety function, that the conditions that the IROFS will be subjected to will not diminish the reliability of the IROFS, and also identify and verify appropriate IROFS failure detection methods. Each of the event sequences and the accompanying specific measures provided by the aforementioned deterministic criteria will be documented in the ISA and summarized in the ISA summary. This combination of analyses will demonstrate that the likelihood requirements of 10CFR70.61 are satisfied.

Specifically, the nuclear criticality safety evaluations contain the following information:

1. For each event for which a potential criticality is credible, the following will be described and analyzed to demonstrate adherence to the double contingency principle:

    a. Description of the potential event

Criticality Open Items (continued)

   b. Control challenge

   c. Methods of prevention

   d. Listing of potential initiating event

   e. At least two independent IROFS controls to prevent the event including the safety functions of the controls

   f. Description of redundancy and diversity

   g. Description of safety margin involved

   h. Description of failure mode, detection of failure, and surveillance

2. For each IROFS control identified in item 1 above, the following will be described:

   a. Description of the IROFS control

   b. Listing of the safety functions for the control

   c. Quality classification (e.g., QL-1a or QL-1b)
   d. Process Operating Range and Limits
   e. Emergency Capabilities
   f. Testing and Maintenance
   g. Environmental Design Factors (as applicable)
   h. Natural Phenomena Response
   i. Instrumentation and Controls required
   j. Applicable Codes and Standards

   The NCSEs will reference/summarize analyses, as necessary, that demonstrate that the IROFS are effective and perform the intended function.

3. For each event for which a potential criticality is credible as described in item 1, the event will be shown to be highly unlikely as follows:

   a. Cross correlation with the events as described in item 1 above including description of the initiating event,

   b. Summary description of each of the IROFS controls with cross reference to the IROFS information (item 2 above),

   c. Description and justification of the failure of each of the IROFS being unlikely,

   d. Description of failure detection or safety margin involved providing justification that the potential event is highly unlikely to occur.

For passively controlled units such as tanks, vessels, and storage areas for which the failure of the equipment is not credible to fail, this means that a potential event is not credible. For this to be true, the following must be shown:

a. The passively controlled component must be specified to be quality level Ql-1a.

b. The passively controlled equipment must be evaluated and shown to be sub-critical under all credible process conditions.

c. The passively controlled equipment must have management measures to ensure that the configuration is controlled and unchanging under the facility's configuration management program.

For other units for which potential events are credible, the basic criteria for judging that the event is highly unlikely is as follows:

1) At least two independent robust (i.e., unlikely to fail) controls must be provided.

2) Active or passive engineered controls must be unlikely to fail. This means that they must be classified at least Ql-1b. The engineered control must be independent from other credited controls.

3) Administrative controls must be robust and must also be unlikely to fail. This means that administrative controls must be simple and unambiguous. The administrative control must also be independent from other credited controls.

4) In addition to two controls (each independent and unlikely to fail) as described above, there must also at least be one of the following:

   i. A means to detect a failure of the control on a period of one month or less,

   ii. A safety margin must be shown which demonstrates that repeated failures of the controls does not lead to a loss of sub-criticality

   iii. Other means, with justification, to demonstrate that failure of the set of independent controls are highly unlikely.

Alternate means of demonstrating that events are highly unlikely can be used. However, justification must be provided.

The rational for demonstrating that an event is highly unlikely, is to be provided in the NCSEs.

Action:

None.

Criticality Open Items (continued)

NCS-6: **"For ANSI/ANS-8.1-1983 (R1988): What is meant by 'other justification' in the means for extending the code's area(s) of applicability beyond experimental data"**

DSER 6.1.4.3: "SRP Section 6.4 states that any variations from the requirements of a standard should be justified in the application. Therefore, what is meant by 'other justification' has not been adequately resolved and is considered an open issue."

Response:

In the recent revision to the CAR, DCS has rewritten this portion of section 6.4 to indicate (with respect to section 4.3.2 of this standard) that, in cases where an extension in the area(s) of applicability of a NCS analysis methodology is required, the method will be supplemented by other methods to provide a better estimate of bias in the extended area(s). As an alternative, the extension in the area(s) of applicability may be addressed through an increased margin of subcriticality.

Action:

To clarify this, the sentence will be revised to say "...other calculational methods" for consistency with RAI response.

Criticality Open Items (continued)

NCS-7: **"For ANSI/ANS-8.15-1981: The applicability of ANSI/ANS-8.1 limits to mixtures involving special actinide elements at the MFFF"**

DSER 6.1.4.3: "In DSER Reference 6.3.3, the applicant removed the statement about the "relatively low" concentration of special actinide elements, but did not clarify the criteria for applying the limits of ANSI/ANS-8.1. This was also not clarified in DSER Reference 6.3.6. Therefore, the applicability of ANSI/ANS-8.1 limits to mixtures involving special actinide elements at the MFFF has not been adequately resolved and is considered an open issue."

Response:

DCS understands from subsequent correspondence that this open item has been closed, pursuant to SRP §6.4.3.3.1.

DCS previously agreed to remove the text related to using the ANSI/ANS-8.1 limits and agreed to use only limits based on criticality calculations. With respect to this standard, the recent revision to the CAR included modified language indicating that this standard is not part of the MFFF criticality design basis, as it is applicable to operations with isolated units containing special actinide nuclides other than ^{233}U, ^{235}U, and ^{239}Pu. Nuclear criticality control of special actinide nuclides will be explicitly evaluated using validated NCS analysis methodology in accordance with ANSI/ANS-8.1-1983 (R1988).

Action:

None.

Criticality Open Items (continued)

NCS-8: **"For ANSI/ANS-8.17-1984: What is meant by 'other justification' in the means for extending the code's area(s) of applicability beyond experimental data"**

DSER 6.1.4.3: "SRP Section 6.4 states that any variations from the requirements of a standard should be justified in the application. Therefore, what is meant by "other justification" has not been adequately resolved and is considered an open issue."

Response:

In the recent revision to the CAR, DCS has rewritten this portion of CAR section 6.4 to indicate (with respect to section 5.1 of this standard) that, in cases where similar experiments are not available or are not similar in criticality safety significant respects to the design application, alternative analyses will be presented. Alternative analyses will further demonstrate similarity or, in cases where an extension in the area(s) of applicability of a NCS analysis methodology is required, the method will be supplemented by other methods to provide a better estimate of bias in the extended area(s). As an alternative, the extension in the area(s) of applicability may be addressed through an increased margin of subcriticality.

Action:

To clarify this, the sentence will be revised to say "...other calculational methods" for consistency with RAI response.

Criticality Open Items (continued)

NCS-9: **See Q8 including response**

NCS-10: **See Q4, Q9, and Q10 including responses**

Criticality Open Items (continued)

<u>Q1</u>: **"CAR Section 6.3.4.3.2.4 says 'all other impurities" are within the margin. Is this still valid for AFS?"**

Response:

Yes, it is still valid. ^{239}Pu is assumed to be 96%, which is larger than the specification value of 95%. As such, the calculations bound the actual fissile isotopic content, which actually includes trace amounts of all other plutonium isotopes. Besides ^{239}Pu, the main other isotope is ^{241}Pu, which is specified to be less than 1%. Preliminary calculations have shown that these values are bounding, even for AFS. For example, calculations have demonstrated that increasing the ^{239}Pu content by 1.0 wt % while decreasing the ^{240}Pu content by a corresponding amount is sufficient to offset any reactivity effect from the expected AFS isotopes including ^{241}Pu and ^{235}U, such that these isotopes can be omitted when performing application calculations.

Action:

None.

Criticality Open Items (continued)

Q2: **"Even though there is no revision bar in the revised CAR (page 6-26), the fraction of ^{235}U has been changed from 100% to 1%. Why? Is this correct?"**

Response:

The omission of the change bar was an oversight.

However, in fact, ^{235}U enrichment occurs in the AP process at an assumed three different bounding values.

First, the incoming ^{235}U enrichment is assumed to be a bounding 100%.

Second, after the dissolution of the powder (by the dissolution unit), the solution is mixed with depleted Uranyl nitrate such that the enrichment is about 30%. The criticality calculations assume a bounding 35%.

Finally, at the end of the purification step, when the Uranium is extracted and prior to being sent to the waste stream, an additional dilution occurs with depleted Uranyl nitrate such that the enrichment is less than 1%.

Action:

To clarify the situation, the sentence ending in "the following bounding assumption is made:" will be changed to read "the following bounding assumption is made for the incoming feed material:" and the fraction of ^{235}U will be changed back to 100%.

Criticality Open Items (continued)

Q3: **"Table 6-1, pg 6-53. For the row for Dechlorination Columns, both the density and concentration are marked 'YES.' Is this correct? Usually one does not control density for liquid systems such as this."**

Response:

Correct. The primary means of control is concentration control to ensure that the concentration in these columns is low.

However, still further upstream of the point of concentration control, the density of the incoming feed material is controlled to ensure that it is below the indicated value. Consistent with previous NRC request, upstream parameter control is indicated as such in the table.

In fact, at this unit, there is no direct density control.

Action:

None.

Criticality Open Items (continued)

Q4: **"In Section 6.4, ANSI/ANS Standards, NRC did not understand the change in wording from the previous response (RAI-90) from 'MFFF operations will comply with the requirements and implement the recommendations of ANSI/ANS-8…' to 'MFFF operations will comply with the guidance and implement the recommendations of ANSI/ANS-8…' Is this a change in DCS commitment?"**

Response:

There was no change intended in DCS' commitment.

This change in wording was meant to more accurately portray the ANS standards and did not indicate any reduction in commitment to the information in the standards.

Action:

Change "MFFF operations will comply with the guidance and implement the recommendations of ANSI/ANS-8…' to "MFFF operations will comply with the guidance (shall statements) and implement the recommendations (should statements) of ANSI/ANS-8…'

Criticality Open Items (continued)

Q5: **"CAR Section 6.1.1, page 6-1. and 6.1.2, page 6-2. Comparison indicates differences, including omissions of functions: e.g., establishing procedures and training, review and approval of operating procedures"**

Response:

CAR Section 6.1.1, page 6-1. and 6.1.2, page 6-2 present the responsibilities of the criticality safety function broken out in " Design phase " and "Operations Phase " as previously requested NRC in RAI 68. The following table compares the different responsibilities and activities for the two phases (differences highlighted in bold):

#	Design phase (CAR 6.1.1, page 6-1)	Operations phase (CAR 6.1.2, page 6-2)
1	Establish the NCS design criteria	Establish the NCS **Program**, including design criteria, **procedures** and **training**
2	Provide CS support for ISA and configuration control	Provide CS support for ISA and configuration control
3	Assess normal and abnormal conditions	Assess normal and abnormal conditions
4	Determine criticality safety limits for controlled parameters	Determine criticality safety limits for controlled parameters
5	Develop and validate methods to support NCSEs	Develop and validate methods to support NCSEs
6	Perform criticality safety calculations and writes NCSEs	Perform criticality safety calculations, writes NCSEs **and approve proposed change-in-process conditions on equipment involving fissionable material**
7	Specify criticality safety control requirements and functionality.	Specify criticality safety control requirements and functionality.
8		**Provide advice and counsel on criticality safety control measures, including review and approval of operating procedures**
9		**Support emergency response planning and events**
10		**Assess the effectiveness of the Nuclear Criticality Safety Program through audit programs**
11		**Provide criticality safety postings that identify administrative controls for operators in applicable work areas.**

The additional responsibilities and activities shown in the table above will occur only in the "Operation phase" and startup activities related to operations, not in the "Design Phase."

Action:

None.

Criticality Open Items (continued)

Q6: **"CAR Section 6.1.1, page 6-1. The paragraph following the bulleted list is inconsistent with the previous DCS response on qualification of criticality manager. There is a missing sentence: "Have a familiarity with NCS programs at similar facilities". This is from DCS-NRC-00085 (08 Mar 2002 clarification letter). Please restore the sentence."**

Response:

DCS-NRC-00085 (08 Mar 2002 clarification letter) presents the following response :

NCS Function Manager requirements for the design phase are:

Draft 10 CFR Part 70 SRP	**August 31, 2001 Response**	**Changes as a result of information provided in NRC November 9, 2001 letter**
BS/BA or equivalent; and	BS/BA degree in science or engineering	BS/BA degree in **nuclear** science or engineering
	At least 2 years nuclear industry experience in criticality safety	**3 years** nuclear industry experience in criticality safety
Technical experience in NCS at a similar facility	An understanding and experience in nuclear criticality safety.	**Have experience in the understanding, application, and direction of NCS programs.**
		Have a familiarity with NCS programs at similar facilities

The typical NCS Manager in NRC's November 9, 2001 letter had an experience base that ranged from a BS/BA degree in engineering or the physical sciences or equivalent technical experience and 4 years general nuclear experience (PGDP-PDKY) to BA/BS degree in nuclear science or engineering and 3 years of experience in NCS (NFS-ERW).

DCS will revise the CAR for consistency with the RAI response.

Action:

Revise CAR 6.1.1 as follows:

"...A criticality safety function manager must have experience in the understanding, application, and direction of Nuclear Criticality Safety (NCS) programs and have a familiarity with NCS programs at similar facilities. ..."

<u>Q7</u>: **"CAR 6.3.3.2.4 pg 6-13 says analysis will demonstrate that for our isotopic 241Pu can be neglected. There is a discrepancy between RAI 79 (bounding nature will be demonstrated in criticality calculations to be referenced in NCSEs) and what's in revised CAR on pg 6-13 ("demonstrated by analysis")"**

<u>Response</u>:

The text will be revised for consistency with the RAI response.

<u>Action</u>:

Revised CAR as follows (additional text underlined):

" ... Isotopics control includes both the $^{235}U/U$ concentration (enrichment) and the concentration of fissile and nonfissile plutonium isotopes (e.g., ^{239}Pu, ^{240}Pu, ^{241}Pu), as well as the relative abundance of plutonium to uranium. The presence of ^{240}Pu (5% to 9%) and ^{242}Pu (<0.02%) offsets any contribution from ^{241}Pu (<1%) such that it can be neglected for ^{239}Pu ranges from 90% to 95% as is expected to be the case for the MFFF. <u>This will be demonstrated in the criticality calculation to be referenced in the NCSEs. Justification will be provided in NCSEs and ISA summary.</u> ..."

Q8: **CAR Section 6.3.2, pg 6-7. The second paragraph ends with the following: "Specific areas qualifying for exemption from criticality accident monitoring requirements will be identified in the LA and the ISA. The basis for such exemptions shall be provided in the ISA." This is different that that previously provided by DCS in RAI response #74 which was the following: "Specific areas (if any) requiring exemption from criticality accident monitoring requirements will be identified in the LA. The basis for such exemptions will be provided." NRC disagrees with the new text and requests the text previously proposed by DCS be used (i,e., NRC approval for CAAS exemptions)**

Response:

The text will be clarified; justification will be provided with the exemption request, either in the LA or in a separate exemption request. The *basis* for that justification will, of course, be the supporting documents that are part of or supporting documents for the ISA.

Action:

Revise CAR revision as follows (changes underlined):

" ... Nevertheless, a criticality accident alarm system (CAAS) monitors areas in which SNM is handled, used, or stored. ~~CAAS coverage will be exempted from areas that are (1) limited to less than half of a minimum critical mass with no potential for double batching, and (2) used for storage of closed shipping containers.~~ Specific areas qualifying for exemption from criticality accident monitoring requirements will be identified and justified for the LA or in a separate exemption request. ~~The basis for such exemptions shall be provided in the ISA.~~

Q9: **Section 6.4, ANSI/ANS-8.7, -10, and -12. The way DCS is using the wording in reference to these standards is confusing to NRC. It is also changed from the previous response to NRC. We now say "This standard may be part of the design basis..." Please clarify whether these are or not part of the design basis.**

Response:

These standards are not part of the design basis of MFFF.

Action:

The CAR will be revised as follows (changes underlined):

"ANSI/ANS-8.7-1975, Guide for Nuclear Criticality Safety in the Storage of Fissile Materials

This standard is not part of the design basis of MFFF fissile material storage areas.

"ANSI/ANS-8.10-1983, Criteria for Nuclear Criticality Safety Controls in Operations with Shielding and Confinement

MFFF NCSEs performed for each process unit or area will demonstrate compliance with the double contingency principle consistent with guidance provided in Section 4.2.2 of ANSI/ANS-8.1-1983 (R1988). Therefore, the guidance and recommendations provided in ANSI/ANS-8.10-1983 are not part of the design basis of MFFF.

"ANSI/ANS-8.12-1987, Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors

This standard may be reaffirmed or withdrawn in future action by the ANS-8 working group (reference ANS-8 meeting minutes, Albuquerque, New Mexico, March 30, 2000). This standard is not part of the design basis of MFFF process design.

Criticality Open Items (continued)

Q10: **Section 6.4, ANSI/ANS-8.23. DCS changed the wording of this standard from "This standard is referenced as a basis for the design of MFFF processes and fissile material handling and storage areas. The standard provides guidance for minimizing risks to personnel during emergency response to a nuclear criticality accident outside reactors." Criticality accident emergency planning and response, while an important programmatic element, is not part of the safety basis." This seemed confusing to NRC".**

Response:

As shown in CAR and RAI-90:

"As discussed in Chapter 14, an NRC-approved Emergency Plan is not required for the MFFF. Nonetheless, MFFF operations will comply with the recommendations of ANSI/ANS-8.23-1997, without exception. While not considered part of the design basis of principal SSCs, this standard provides guidance for minimizing risks to personnel during emergency response to a nuclear criticality accident outside reactors."

(Note that a CAAS does not prevent or mitigate design basis events, and is therefore not considered a principal SSC.) (CAR Section 6.4).

As committed in the CAR, measures are taken by sufficiently reliable means to ensure that the occurrence of a criticality accident is prevented. Nevertheless, dispositions from ANSI/ANS-8.23-1997 are part of the design basis of MFFF. DCS commits to these recommendations as stated, without exception.

Action:

Clarify the CAR as follows:

1. Change the title of Section 6.4 from "DESIGN BASES" to "DESIGN BASES FOR PRINCIPLE SSCs."
2. Add a new section 6.5 to the end of chapter 6 text entitled "DESIGN BASES FOR NON-PRINCIPLE SSCs."
3. Move the two paragraphs under the Section 6.4 entitled "ANSI/ANS-8.23…" to the new Section 6.5.
4. Delete the two paragraphs referred to in the above item from Section 6.4 and delete the heading "ANSI/ANS-8.23…" as well.