December 31, 2002

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SUBJECT: AUGUST 28-30, 2002, IN-OFFICE REVIEW SUMMARY: DUKE COGEMA STONE & WEBSTER CONSTRUCTION AUTHORIZATION REQUEST SUPPORTING DOCUMENTS FOR THE MIXED OXIDE (MOX) FUEL FABRICATION FACILITY

On August 28-30, 2002, the U.S. Nuclear Regulatory Commission (NRC) conducted an in-office review of supporting documents and information associated with the construction authorization request (CAR) for the mixed oxide fuel fabrication facility (MFFF) submitted by Duke Cogema Stone & Webster (DCS) on February 28, 2001. NRC staff reviewed information in the areas of nuclear criticality safety and chemical safety. During the course of the review, NRC staff posed questions to DCS, most of which were answered during the review.

1. Nuclear Criticality Safety

The following items summarize the NRC Nuclear Criticality Safety (NCS) Staff In-Office-Review at DCS Headquarters in Charlotte, North Carolina on August 28-30, 2002:

DCS NCS Documents Reviewed by NRC:

DOCUMENT	DESIGNATION	DATE
Basis of Design for NCS	DCS01-AAJ-DS-Z-40115-D	06/13/02
NCS Methods Manual	DCS01-RRJ-DS-MAN-H-35001-A	10/28/97
Aqueous Polishing Criticality Control Flow Diagram	DCS01-RCB-CG-SCH-H-00177-B	03/16/01
MOX Process Criticality Control Flow Diagram	DCS01-ZJJ-CG-SCH-H-03884-A	03/16/01

NCSE(R) of Homogenization & Pelletizing Units	DCS01-NPE-CG-ANS-H-05177-C	02/27/02
NCS of Final Mix Homogenization/Pelletizing Station Units NPE & NPF	DCS01-NPE-CG-CAL-H-03165-C	03/29/02
Aqueous Polishing NCSE(R) - Dissolution Unit KDB	DCS01-KDB-CG-ANS-H-06389-C	10/29/01
NCS of Tanks in Cells C-210 & C-228 of Unit KDB	DCS01-KDB-CG-CAL-H-06053-C	05/31/02
NCS of Filter Glove Box GB1200 of Unit KDB	DCS01-KDB-CG-CAL-H-06322-B	10/25/01
NCS of Electrolyzer EZR1000/2000 of Unit KDB	DCS01-KDB-CG-CAL-H-06444-B	11/14/01
MFFF Design Requirements Document	DCS01-AAJ-DS-DOB-D-40101	05/30/02

NCS Staff Summary:

DCS supported the in-office review by having documents and staff available, as well as by responding to requests for additional documents or answering staff questions arising from review of the documents. The documents reviewed provided information on the following topics: (1) how the Aqueous Polishing and MOX Process processes are being designed, (2) how the NCS analyses are being performed, (3) how the overarching NCS principles are being applied, and (4) how the NCS calculations are being performed. Most of the information provided was background for the Construction Authorization Request (CAR) review.

NCS Conclusion:

The information provided to the NRC NCS Staff was useful background for the CAR review, especially the Criticality Safety Flow Diagrams. However, the information did not close-out any NCS Open Items from the CAR Draft Safety Evaluation Report (DSER). NRC NCS staff look forward to reviewing the upcoming DCS writeups on the NCS Open Items, including the future Updated Validation Report; however, there was NRC concern about the timing of the submittals. It is NRC's understanding that: (1) DCS intends to have further discussions with NRC before providing a writeup on 'highly unlikely' (as discussed during a previous MOX meeting); (2) DCS intends to have a teleconference with NRC before providing a writeup on 'subcritical margin' (as discussed during a previous teleconference); (3) DCS agrees with NRC that a meeting is needed to discuss 'training and experience'; and (4) besides the validation update and those three issues discussed above, DCS intends to close-out the NCS CAR DSER Open Items via the Updated CAR submittal, which is expected in October 2002.

2. Chemical Safety

Status Document and Open Item Folders:

The applicant provided a copy of a letter, dated 8/23/2002, to the NRC reviewers. The letter had been mailed to NRC (ADAMS Document Accession Number ML022410015). The letter provided the applicant's perspective of status and a path forward listing for DSER open items. The NRC staff noted several open items were not listed in the letter and requested clarification. The applicant stated the responses to these open items will take additional time beyond the submittal of the CAR revision and are currently scheduled for resolution in January 2003. As the specific resolution of these items progresses, the schedule may change and the applicant intends to keep the NRC apprised of such changes as they occur. The additional information

will be provided in letter-style reports as they become available. The applicant provided a list and short summary of these “January 2003" items as follows:

AP-8 - Flammable Gases and Vapors. The applicant is working on appropriate design bases and PSSCs for flammable gases and vapors in the Offgas Unit.

AP-9 - Maintain Temperatures below Solvent Flashpoint. Design bases and PSSCs will be identified. These may take partial credit for the presence of water in the solvent.

AP-10 - Offgas Unit. The applicant will identify design bases and PSSCs for toxic gas removal.

CS-1 - Red Oil Safety Strategy. The revised strategy may involve temperature, venting requirements, properties of diluents, and other parameters. The applicant has a test program underway to identify the minimum temperature for runaway reactions and to explain the Tomsk event.

CS-2 - HAN/Hydrazine. The original response will be refined to include margin in the instability index and other parameters deemed necessary.

CS-3 - HAN/Hydrazine/Azides. The safety strategy will be revised to identify PSSCs for concentration control.

CS-4 - pH Control (for azide prevention). The safety strategy will be revised to identify PSSCs to control sodium azides and related compounds (e.g., from solvent washing). This may involve administrative controls for destruction of azides via sodium nitrite additions.

CS-9 - Solvent Temperature Design Basis. A design basis with margin will be identified.

MP-3 - Steam Explosions in the Sintering Furnace. The applicant will provide the design bases and PSSCs for preventing these steam explosions.

Staff reviewed folders prepared by the applicant on several of the chemical and process safety open items identified in the second and third groups of open items (above). These folders contained a chronology of the open items, documentation (or references to documentation), and the route the applicant was following to address and close the open item. Staff requested and received clarifications from the applicant on many of the folders. These are summarized using the DSER designations.

AP-1 - Protecting the electrolyzer against the overtemperature event. The folder contained copies of the open item and the relevant sections from the CAR, DSER, the applicant’s 4/23/2002 letter, the NRC’s 6/27/2002 letter, and the applicant’s 7/9/2002 letter. The folder also contained copies of Request for Additional Information (RAI) Responses 50 and 141. The staff review of this information concluded that the assertions of no additional reactions and effective natural cooling were not substantiated, and it was not clear if refinements from the French experience has been incorporated. The staff requested clarification. The applicant responded by stating the 70 C temperature limit identified as the design basis is really the result after a setpoint analysis that considered electrolysis, potential exotherms, and natural cooling. The applicant intends to elucidate these facets with additional text in the revised CAR. This text will identify design bases and PSSCs that show the electrolyzer is shut down in a timely manner such that natural cooling is effective and 70 C is not exceeded. In addition, the applicant

indicated silver recovery was no longer part of the process and the silver recovery electrolyzers were no longer in the design based upon economic analyses.

AP-3 - Events involving titanium, such as titanium fires. The folder contained copies of the open item and the relevant sections from the CAR, DSER, the applicant's 4/23/2002 letter, the NRC's 6/27/2002 letter, and the applicant's 7/9/2002 letter. The folder also contained a copy of RAI 50. The documents refer to a bounding fire event based upon a fire within the PuO2 buffer storage area. The fire would not be prevented but would be mitigated by the PSSCs of the C3 ventilation and fire barriers that limit fire to a localized area. The NRC asked the applicant to clarify and explain how the buffer storage fire would bound a potential titanium fire; the latter would have much higher temperatures and potentially greater energetics. The applicant stated the reactions in the electrolyzer were driven by the voltage and this would be terminated upon an overtemperature event. The methodology for fires is in the CAR/revised CAR, but the actual analysis of specific fire events would not be available until the Integrated Safety Analysis (ISA) stage. The applicant might follow a prevention strategy (show or render highly unlikely), address the titanium fire issues by a commitment, or justify that it is bounded by the existing buffer storage area fire. The applicant indicated they would re-examine the situation and include an analysis and explanation in the revised CAR. The applicant also indicated the silver recovery unit was being eliminated in the design for economic reasons.

AP-4 - Design basis for the corrosion function of the fluid transport system PSSC. The folder contained copies of the open item and the relevant sections from the CAR, DSER, the applicant's 4/23/2002 letter, the NRC's 6/27/2002 letter, and the applicant's 7/9/2002 letter. This is related to AP-13 and the chemical consequences from leaks. The applicant intends to clarify the corrosion control program (essentially the silver(II) concern) and will do an analysis of potential leaks (related to AP-13); this would be provided in the revised CAR.

AP-7 - Parameters and design bases for the plutonium feed to the facility. The folder contained copies of the open item and the relevant sections from the CAR, DSER, the applicant's 4/23/2002 letter, the NRC's 6/27/2002 letter, and the applicant's 7/9/2002 letter. The applicant cited their 4/23/2002 letter as providing a design basis for the plutonium feed. The NRC noted this appeared to be based upon radiological species and isotopics only, and requested clarification about other potential design bases, such as chemical impurities. The applicant indicated a writeup on chemical impurities and any related design bases would be included in the revised CAR.

AP-11 - Design basis for the corrosion function of the fluid transport system PSSC as it applies to the Offgas Unit. The folder contained copies of the open item and the relevant sections from the CAR, DSER, the applicant's 4/23/2002 letter, the NRC's 6/27/2002 letter, and the applicant's 7/9/2002 letter. The applicant noticed there appeared to be a disconnect between the text and list of open items in the DSER. The NRC staff thought the differences were small but agreed to review the situation and provide the applicant with a clarification.

AP-12 - Provide PSSC and design basis information for the sampling systems. The folder contained copies of the open item and the relevant sections from the CAR, DSER, the applicant's 4/23/2002 letter, the NRC's 6/27/2002 letter, and the applicant's 7/9/2002 letter. The applicant stated sampling accidents were analyzed and found to be bounded by the loss of inventory of the entire tank or vessel. The applicant also noticed there appeared to be a disconnect between the text and list of open items in the DSER. The NRC staff thought the differences were small but agreed to review the situation and provide the applicant with a clarification.

AP-13 - Safety strategy for hazardous chemical releases from the loss of confinement of radioactive materials. The folder contained copies of the open item and the relevant sections from the CAR, DSER, the applicant's 4/23/2002 letter, the NRC's 6/27/2002 letter, and the applicant's 7/9/2002 letter. The folder referred to pages 51, 73, and 74 of the PAA (Preliminary Accident Analysis - DCS01-ZJJ-CG-ANS-H-38317A). The PAA concluded the following:

- in general, a chemical release (only) would not impact radiological safety and would not be regulated by 10 CFR 70;
- only operators in the Emergency Control Room required protection from chemical releases;
- for a combined chemical/radiological release, consequences to the public and site workers would be low and PSSCs would not be needed. For facility workers, PSSCs for radiological protection also protect against chemical releases and no additional PSSCs are needed.

Staff could not find in the CAR safety functions for radiological safety PSSCs that mentioned or addressed chemical releases. Staff requested the applicant to identify specific features of these PSSCs for chemical releases and clarify the situation. The applicant acknowledged that PSSCs for worker radiological protection were unlikely to prevent or mitigate a chemical release. The applicant agreed to include in the revised CAR: (1) a strategy for facility worker protection from a commingled, chemical/radiological release and (2) address the concerns raised in the DSER on chemical modeling and assumptions.

CS-5 - Modeling of hazardous chemical releases. The folder contained copies of the open item and the relevant sections from the CAR, DSER, the applicant's 4/23/2002 letter, the NRC's 6/27/2002 letter, and the applicant's 7/9/2002 letter. These indicate that no operator actions relied upon for radiological safety are expected to be impacted by a hazardous chemical release. Upon questioning by the NRC, the applicant repeated that there are no event sequences in the safety assessment of the design bases that include operator actions outside of the Emergency Control Room that are relied upon for mitigation of a chemical event. Even if an operator is disabled by a chemical release, the applicant indicated there would be no impact upon radiological safety. The applicant did acknowledge there were some likely operator actions for longer term events, such as closing fire dampers and valving in emergency scavenging air, but the applicant expected the effects of a chemical release would have dissipated by the time these operator actions might become necessary. The NRC inquired about N2O4 releases via the offgas system. The applicant thought these would be better handled via Open Item AP-13. The NRC staff thought this might close Open Item CS-5. Upon subsequent return to the NRC's offices and review of the information obtained from the applicant's calculation on chemical consequences from releases (DCS01-RRJ-DS-CAL-H-35604-A; see below), the NRC staff noted that the applicant's estimates for at least two chemicals - nitrogen tetra oxide and hydrazine - are multiple times the TEEL-3 values and would potentially result in major injuries, incapacitation, and fatalities. The applicant's concentration results are also similar to the NRC's results in Section 8 of the DSER. NRC staff and management are continuing internal discussions of this item.

CS-6 - Potential controls for the protection of a facility worker have not been identified. The folder contained copies of the open item and the relevant sections from the CAR, DSER, the applicant's 4/23/2002 letter, the NRC's 6/27/2002 letter, and the applicant's 7/9/2002 letter. The staff requested clarification, as it appeared the documentation was deferring analysis of laboratory explosions to the ISA stage without identification of design bases and PSSCs. The NRC also noted that the C3 ventilation system would not protect the facility worker. The

applicant stated their intent to provide a writeup in the revised CAR that would address laboratory explosions, most likely using Administrative Controls as the PSSC.

CS-8 - Potential toxicity impacts from depleted uranium fires and releases. The folder contained copies of the open item and the relevant sections from the CAR, DSER, the applicant's 4/23/2002 letter, the NRC's 6/27/2002 letter, and the applicant's 7/9/2002 letter. The applicant thought the open item was closed. The staff repeated the concerns with depleted uranium, as outlined in the DSER (e.g., use of fuel grade powder, MAR, ARF), and the need for the applicant to address these concerns. The applicant indicated they would re-evaluate the depleted uranium scenarios with these points in mind, and include the results in the revised CAR.

CS-10 - Design basis for habitability in the Emergency Control Room (ECR). The folder contained copies of the open item and the relevant sections from the CAR, DSER, the applicant's 4/23/2002 letter, the NRC's 6/27/2002 letter, and the applicant's 7/9/2002 letter. The documentation did not identify the needed design basis. The NRC staff requested clarification; the applicant indicated a standard or NRC regulatory guide would be identified as the design basis and included in the revised CAR. The applicant stated this design basis would be based upon a TEEL limit (probably TEEL-3) and the use of SCBA by the operators in the ECR.

MP-4 - PSSC and design basis information associated with the sintering furnace and hydrogen leaks. The folder contained copies of the open item and the relevant sections from the CAR, DSER, the applicant's 4/23/2002 letter, the NRC's 6/27/2002 letter, and the applicant's 7/9/2002 letter. This did not elucidate the situation. The NRC requested clarification of the documents by the applicant, given contradictory statements in the documentation (e.g., hydrogen flow terminated or not terminated) and the need for a strategy. The applicant stated that potential hydrogen leaks and explosions were prevented by the PSSC of the Process Safety I&C System. The NRC staff explained that might be sufficient for a simple strategy based upon avoiding hydrogen flammability limits. However, the applicant had elected to follow a more complex approach that included flammable ranges for hydrogen and multiple sensors and controls, and, thus, clarification at an appropriate level of detail was needed. The applicant agreed to verify hydrogen flow termination and sensor codes and standards, and will include a write-up in the revised CAR.

Other Referenced Documents and Calculations Reviewed:

DOCUMENT	DESIGNATION	DATE
Chemical Consequences for Potential Chemical Hazard Events, Quality Level 1A, IROFS	DCS01-RRJ-DS-CAL-H-35604-A	11/7/01
Input Values for Radioactive Release Calculations for the MFFF, QL-1	DCS01-ZJJ-DS-ANS-H-38309-A	7/26/01
Dispersion Factors (Chi/Q) Values for MFFF Accident Analysis, QL-1A, IROFS	DCS01-RRJ-DS-CAL-H-38308-B	6/17/02
Distances from MFFF to Surrounding Buildings and SRS Boundaries, QL-1A, IROFS	DCS01-RRJ-DS-CAL-H-38302-A	6/27/02

Docket: 70-3098

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