DUKE COGEMA
STONE & WEBSTER

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

10 October 2003
DCS-NRC-000162

Subject: Docket Number 070-03098
Duke Cogema Stone & Webster
Mixed Oxide (MOX) Fuel Fabrication Facility
Response to Request for Additional Information – DSER Open Items MP-01 (UO_2) and AP-03 (Titanium Fires)

References:
1) R. C. Pierson (NRC), *Draft Safety Evaluation Report on Construction of Proposed Mixed Oxide Fuel Fabrication Facility, Revision 1*, Dated 30 April 2003

2) P. S. Hastings (DCS) letter to Document Control Desk (NRC), DCS-NRC-0000161, *Response to Request for Additional Information – DSER Open Items MP-01 (UO_2) and AP-03 (Titanium Fires),* dated 10 October 2003

As part of the review of Duke Cogema Stone & Webster's (DCS') Mixed Oxide Fuel Fabrication Facility (MFFF) Construction Authorization Request (CAR) documented in the Draft Safety Evaluation Report (Reference 1), NRC Staff identified open items related to UO_2 Burn back and Titanium fires. Reference (2) provided a proprietary response to Reference (1). To facilitate resolution to the request for additional information, this letter provides a non-proprietary version of the response.

If I can provide any additional information, please feel free to contact me at (704) 373-7820.

Sincerely,

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NMSS01

Enclosure 1: DSER Open Item Responses

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MP-01 Uranium Burnback

PSSC and design basis information associated with the pyrophoric nature of some UO2 powders (DSER Section 11.3.1.2.1). Footnote to the NRC's August 2003 Monthly Status Report reads as follows: DCS to determine if the HEPA filters would be damaged by the uranium burnback hazard.

Clarification:

In the NRC letter dated 29 August 2003, the NRC stated their concern in section 4, paragraph 3 as follows: "The staff's concern is that small particles may become hot in the ventilation system and there are no pre-filters to remove these small particles."

Response:

With regard to the staff's concern, DCS identifies the high strength prefilters (hereafter referred to as the prefilter) as PSSCs. The prefilter safety function is to protect the final HEPA filters by removing particles from the airstream so the final HEPA filters can perform their safety function. The design basis of the prefilters is to have a removal efficiency of greater than 90% for particles greater than 1 micron in diameter, resulting in a prefilter leak path factor (LPF) of 0.1 or less. Since the UO_2 particle size is approximately 100 microns prior to ball milling and greater than 2 microns after ball milling, the prefilters will remove the majority of any airborne UO_2.

There are no credible events whereby significant amounts of UO_2 powder reach the final HEPA filters. This conclusion is based on the following: the bounding micronized UO_2 material at risk (MAR) after ball milling is approximately 500 kg or less of powder (CAR Table 5.5-3b); the largest airborne release fraction (ARF) for any credible event is less than 0.01 (2E-3 for spills and 6E-3 for fires, as previously provided in CAR §5.4.4.1.1); and the prefilter LPF is less than 0.1 (see above). Multiplying the MAR by the ARF and the LPF, i.e., 500kg (MAR) * 0.006 (ARF) * 0.1 (LPF), shows that approximately 300 grams or less is available for deposition on the final HEPA filter media in either the VHD system, the HDE system, or both. Since the airflow in the VHD and HDE systems is distributed across a number of final HEPA filter elements, the UO_2 will spread across multiple final HEPA filter elements. Conservatively assuming that all of the airborne powder enters the VHD system, less than 80 grams will impact any single final HEPA filter element (based on 4 active HEPA filter elements in the final VHD filter unit).

An assessment of a burnback event involving 80 grams of UO_2 powder distributed over the surface area of one HEPA filter element (250 ft^2) indicates that the burnback event will not prevent the final HEPA filters from performing their intended safety function when needed. The assessment does not take credit for removal of the UO_2 powder by the multiple stages of glovebox HEPA filters, the HDE intermediate HEPA filters, deposition in the ductwork, or the fact that the prefilters will remove much more than 90% of the

UO_2 powder since most of the powder is greater than 2 microns after milling and the filter efficiency for this size is much higher than 90%.

Therefore, the impact of a burnback event will not prevent the final HEPA filters from performing their intended safety function when needed.

<u>Open Item AP-03 Titanium Fires</u>

The applicant's hazard and accident analysis did not include events involving titanium, such as titanium fires. Accident events should be evaluated and PSSCs identified as necessary. This applies to the dissolution unit (DSER Section 11.2.1.3.4)

<u>Clarification:</u>

In the 29 August 2003 internal NRC letter that provides the meeting minutes from the 29 July through 01 August 2003 public meeting with DCS, the following clarification was provided:

At the conclusion of the meeting, the staff requested that DCS:

(a) justify its design basis, proposed at the meeting, to limit leakage to 10mA for 1 second;

(b) justify the adequacy of the electrical protection device to protect against over-current that would cause a phase change in the titanium (believed to be around 450 degrees C); and

(c) consider the contact area of the electrodes on the electrolyzer in its analysis.

Reply:

As discussed in the above-referenced public meeting and in the 28 July 2003 letter from DCS to NRC, any concerns for drained electrolyzer scenarios have already been addressed satisfactorily. Therefore, the following response will address only the case in which the electrolyzer is filled with nitric acid for operations.

The electrolysis process takes place in the electrolyzer electrolysis pot. The configuration of the electrolysis pot is that of a vertical cylinder with a cathode compartment and an anode compartment. The cathode compartment is configured as a vertical cylinder at, and aligned with, the vertical axis of the electrolysis pot. The cathodic compartment is bounded by a sintered silicon nitride barrier which separates it from the anodic compartment. The anodic compartment surrounds the cathode compartment in an annular configuration.

The anode and anodic compartment circuit connects to the (+) positive terminal of the power rectifier. At the anode (a platinum electrode), the oxidation reaction oxidizes the silver ions in the anolyte solution. The cathode and cathodic compartment circuit connects to the (-) negative terminal of the power rectifier. At the cathode (a tantalum electrode), the reduction reaction reduces the H^+ and NO_3^- ions to HNO2. The sintered silicon nitride barrier between the anode and cathode compartments is non-conductive, has a high dielectric strength, and minimal porosity. It prevents the passage of physical material between the compartments while facilitating ionic transfer. Accordingly, it is designated as a passive PSSC (see attached sketch). In addition, the electrolyzer is geometrically safe and is seismically designed.

In addition to the PSSCs identified above and in Table 1 below it should be noted that the electrolyzer is operated with nitric acid which provides a liquid heat sink for cooling during operations. Additional protection features also exist to limit operations if there is current leakage to the titanium shell (anode +) during and after startup. The current leakage detection system is designed as a permissive signal and will stop the startup process (i.e., not allow the power to be turned on during startup) or cease operations (i.e., turn off power to the electrolyzer) if the normal operations set point of 10 mA is exceeded. Another protective feature during operations is the trip circuit of the rectifier. The rectifier (DC power source) supplies the electrolyzer a normal operating current density of 400 A at 30 V. The trip set point for the rectifier is 420 A, and based on current design, the rectifier is physically incapable of providing more than 900 A. However, even if these two normal protective features fail, the passive PSSCs identified above prevent over current events hypothesized to cause titanium fires.

Table 1

PSSC identified for the electrolyzer:

1. The sintered silicon nitride barrier

    - Physically separates the cathode from the anode in the nitric acid solution by serving as a dielectric barrier

2. Polytetrafluoroethylene insulator (PTFE)

    - Provides insulation/separation between the cathode and anode structures
    - Provides insulation/separation between the anode and the ground

3. Electrolyzer structure

    - Seismically designed
    - Withstands turbulent flow and will not induce vibrations
    - Maintains geometry (previously identified as geometrically safe for criticality purposes – a PSSC)