MFFFPEm Resource

From: Tripp, Christopher
Sent: Wednesday, December 16, 2009 6:42 AM
To: Johnson, Timothy
Cc: Smith, Brian; Tiktinsky, David
Subject: RE: MOX criticality review

I believe this is still accurate. I have been on back-to-back travel the last couple weeks, so I didn't get a chance to get to this earlier. I can't vouch for the ventilation particulars, but the discussion of subcritical mass limits is correct. In addition to being conservative because of Pu isotopic content and density, the ANS-8.1 limits are also conservative because they assume spherical geometry and full reflection by water (12" tight-fitting reflection).

And yes, I am still one of the two criticality reviewers for MOX.

Chris

From: Johnson, Timothy
Sent: Thursday, December 10, 2009 4:07 PM
To: Tripp, Christopher
Cc: Smith, Brian; Tiktinsky, David
Subject: FW: MOX criticality review

Did you get a chance to look at the message below?? Thanks. I assume you are still the crit person for the MOX project.

From: Johnson, Timothy
Sent: Thursday, December 03, 2009 5:09 PM
To: Tripp, Christopher
Cc: Tiktinsky, David; Smith, Brian
Subject: MOX criticality review

Based on the MOX CAR SER, I have the following in my discussion of how the confinement and ventilation systems meet the baseline design criteria for criticality. Is this still the same??

The staff reviewed the proposed design bases of the ventilation and confinement system to ensure that it provides for criticality control and adherence to the double contingency principle. Based on experience from the MELOX site, the applicant assumed that up to 3 kg of plutonium dioxide could exist in the glovebox HEPA filter located in the pellet grinding glovebox, where material becomes airborne at a rate of 0.3 g/h (0.01 oz/h), assuming that the HEPA filters are replaced at 450-day intervals. This amount would be subcritical, as a quantity of 3 kg (6.6 lbs) of plutonium dioxide is substantially less than the minimum critical mass. The ANSI/ANS standard 8.1, “Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors,” issued 1988 (ANSI, 1988), contains single-parameter (i.e., always safe) subcritical limits for $^{239}PuO_2$ containing not more than 1.5 wt% water. At full density, the subcritical limit is 10.2 kg (22.5 lb); at half density, the subcritical limit is 27 kg (59.5 lb). This would bound the worst-case conditions that could be found in the HEPA filters, because the ANSI limits conservatively assume that all of the plutonium is ^{239}Pu (MOX plutonium will have at least 4 wt% ^{240}Pu), and the maximum density for unsintered plutonium dioxide powder falls within the density range covered by the limits in ANSI/ANS-8.1.

The moisture level of powder is limited to 1 wt% water, according to Section 6.3.4.3.2.6 and Table 6-2 of the revised CAR. The MP gloveboxes are under an inert atmosphere, and this quantity of water (approximately 10 percent by volume) would be readily noticeable to operators. The amount of organic additives in the final blend

is neutronically equivalent to 2 wt% water (discussed in Section 6.3.4.3.2.6 of the revised CAR). Although this slightly exceeds the bounding moderation level assumed in the ANSI/ANS-8.1 limits, this would not be sufficient moderation to exceed the subcritical mass limits. In addition, the plutonium dioxide would be spread over the surface of the filter medium and would not be accumulated in a spherical geometry. Therefore, application of the subcritical limits in ANSI/ANS-8.1 is considered appropriate. The only remaining source of water would be the possible intrusion of condensation via the ventilation system. Because the ventilation system is designed as a dry system, condensation would not be present. Moreover, the ventilation system complies with the double contingency principle because the design incorporates multiple confinement zones before accumulation outside the ventilation system is possible. It would require multiple upset conditions to accumulate an unsafe mass of plutonium oxides outside the process gloveboxes through airborne migration. Therefore, the staff has reasonable assurance that the MFFF ventilation system will be criticality safe. The staff's review of nuclear criticality safety is provided in Chapter 6 of this SER.

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From: Tripp, Christopher

Created By: Christopher.Tripp@nrc.gov

Recipients:
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Tracking Status: None
"Tiktinsky, David" <David.Tiktinsky@nrc.gov>
Tracking Status: None
"Johnson, Timothy" <Timothy.Johnson@nrc.gov>
Tracking Status: None

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