PMSTPCOL PEmails

From: Tomkins, James [jetomkins@STPEGS.COM]
Sent: Tuesday, October 26, 2010 10:05 PM
To: Joseph, Stacy
Subject: 6.2.2-29
Attachments: Response to 6.2.2-29 Draft.pdf

Here is a draft of our response to RAI 6.2.2-29. I will be working in my Office until noon your time, and can be reached on my cell phone until 5 PM your time, so feel free to call me if you have any questions.

Hearing Identifier: SouthTexas34Public_EX
Email Number: 2718

Mail Envelope Properties (582CA7E05607F14F8D433C5CE43C030A01B968F1EF)

Subject: 6.2.2-29
Sent Date: 10/26/2010 10:05:15 PM
Received Date: 10/26/2010 10:05:19 PM
From: Tomkins, James

Created By: jetomkins@STPEGS.COM

Recipients:
"Joseph, Stacy" <Stacy.Joseph@nrc.gov>
Tracking Status: None

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MESSAGE	214	10/26/2010 10:05:19 PM
Response to 6.2.2-29 Draft.pdf	42631	

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RAI 06.02.02-29

QUESTION:

The June 10, 2010, response, to RAI 06.02.02-27 states that the corrosion products from zinc are expected to be particulate, and that no new type of chemical precipitate would result from zinc (i.e., a type of precipitate different than the particulate evaluated for the reference Japanese ABWR). Please provide the technical basis for stating there will be no new type of precipitate, such as a gel-like precipitate. The next paragraph provides background information from the staff and is part of the basis for the need for additional information from the applicant.

It appears that the zinc in inorganic zinc (IOZ) coatings may corrode in a post-LOCA environment, but there is limited information about the rate and the form of the corrosion product. For example, the report from the Erlangen Tank Test Station (ML083510156) described pressure loss from an accumulation of zinc corrosion products in a mineral wool bed. The source of the zinc in that test was galvanized steel, but the zinc in IOZ coatings may also be subject to dissolution (corrosion) depending on water chemistry and temperature (e.g., NUREG-6873 and NUREG-6988). WCAP-16530-NP-A included a pH- and temperature-dependent corrosion-rate equation for zinc based on the test results for galvanized steel, but the amount was considered negligible for operating PWRs and not included in the chemical model. The Utility Resolution Guidance recommendation of 47 pounds of particles from IOZ coatings did not consider chemical dissolution (corrosion) of the zinc and subsequent precipitation in another form. The staff notes one source showing the solubility of amorphous and crystalline zinc hydroxide phases decreases by about four orders of magnitude when the pH increases from 7 to 9 at 25°C (Marcel Pourbaix, "Atlas of Electrochemical Equilibria in Aqueous Solutions," National Association of Corrosion Engineers, 1974).

RESPONSE:

The only source of zinc inside the STP 3&4 primary containment is the assumed destroyed inorganic zinc (IOZ) primer from the qualified coating within the break zone of influence. STP 3&4 design specifications prohibit the use of galvanized steel and any other source of zinc in the primary containment. The IOZ primer exists as 80% zinc particles and 20% zinc oxide particles (Reference 1). The corrosion of zinc in an aqueous environment yields zinc oxide, which, like zinc, is also a particulate for the elevated temperatures expected in the post-LOCA suppression pool (References 1 and 2). Because it is possible that the suppression pool temperatures may be lower than the temperature transient that is typically the bounding case (i.e., highest temperatures), it is possible that the zinc corrosion products that are produced during the 30-day post-LOCA period may not be particulate. Therefore, such corrosion products will conservatively be assumed to be gelatinous instead of particulate.

Westinghouse has performed a calculation of the quantity of the postulated 47 lbs. of zinc in the destroyed coatings primer that would corrode over 30 days during the bounding post-LOCA temperature profile (highest corrosion rate). The corrosion rate is a function of exposed surface area. The 47 lbs. of IOZ primer (which was assumed to be 604 sq. ft. of 0.005 in. thick primer

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before destruction) is assumed to be 10 micron spheres after destruction, which translates into a total surface area of over 20,000 sq. ft. Based on this exposed surface area of zinc, and the corrosion rates described in WCAP-16530-NP-A, the amount of zinc that becomes corrosion product is __ lbs. The WCAP-16530-NP-A corrosion rates for zinc are applicable to STP 3 & 4 for the following reasons:

- The test used galvanized steel coupons. The galvanizing material is a coating of elemental zinc on the carbon steel coupon. The use of a galvanized surface maximized corrosion rates compared to zinc primer.
- Testing was conducted at a range of pH values and temperatures, covering the range of such conditions that might occur for STP 3 & 4.
- The duration of the tests were sufficiently short in time as to preclude the development of a passivation layer on the coupons, i.e., there was no mechanism to reduce the rate of zinc corrosion of the galvanized surfaces.

Thus, the corrosion rates from the testing of galvanized steel coupons reported in WCAP-16530-NP-A are taken to be conservative compared with those that would be expected for post-LOCA conditions in STP 3 & 4.

Conservatively, no credit is taken for solubility of the zinc corrosion products, or the remaining particulate zinc.

For the downstream effects on fuel testing, the __ lbs. of non-particulate zinc corrosion product will be represented by the same quantity of aluminum oxyhydroxide. The use of this material as a surrogate for zinc corrosion products is based on the finding reported by Argonne National Laboratory that the aluminum oxyhydroxide generated using the method of WCAP-16530-NP-A (Reference 3) resulted in conservative pressure drops compared to the other corrosion products considered in the Argonne work (Reference 4).

The impact of zinc non-particulate precipitate on the STP 3&4 suction strainer head loss is minimal because:

(1) Fibrous materials in the STP 3&4 containment that could provide a fiber bed for accumulation of this precipitate is limited to latent fibrous debris, and this amount does not result in the formation of a contiguous fiber bed, and

(2) The amount of precipitate generated is small, which provides for a correspondingly small loading of non-particulate zinc precipitate debris on the large recirculation screen area.

The COLA changes associated with this response will be included in a supplemental response to RAI 04.04-03, which is scheduled to be submitted by November 2, 2010.

References

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1. Metals Handbook, Ninth Edition, Volume 13 Corrosion. ASM International Handbook Committee. Metals, Park, Ohio, 1987.
2. Zhang, Xiaoge Gregory. Corrosion and Electrochemistry of Zinc. New York: Plenum Press, 1996.
3. WCAP-16530-NP-A, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191, Ann E. Lane, Timothy S. Andreychek, William A. Byers, Richard J. Jacko, Edward J. Lahoda, and Richard D. Reid, Westinghouse Electric Company LLC, March, 2008.
4. "Technical Letter Report on Evaluation of Head Loss by Products of Aluminum Alloy Corrosion," C. B. Bahn, K. E. Kasza, W. J. Shack, and K. Natesan, Argonne National Laboratory, August 11, 2008

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