

## PMSTPCOL PEmails

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**From:** Tomkins, James [jjetomkins@STPEGS.COM]  
**Sent:** Wednesday, October 20, 2010 5:09 PM  
**To:** Joseph, Stacy  
**Subject:** Draft RAI 6.2.2-30  
**Attachments:** 06 02 02-30 Response final R4 DRAFT.pdf

Here is a draft response to RAI 6.2.2-30.

**Hearing Identifier:** SouthTexas34Public\_EX  
**Email Number:** 2719

**Mail Envelope Properties** (582CA7E05607F14F8D433C5CE43C030A01B968F106)

**Subject:** Draft RAI 6.2.2-30  
**Sent Date:** 10/20/2010 5:08:53 PM  
**Received Date:** 10/20/2010 5:08:57 PM  
**From:** Tomkins, James

**Created By:** jetomkins@STPEGS.COM

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

**Post Office:** exgmb2.CORP.STPEGS.NET

| <b>Files</b>                            | <b>Size</b> | <b>Date &amp; Time</b> |
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| MESSAGE                                 | 41          | 10/20/2010 5:08:57 PM  |
| 06 02 02-30 Response final R4 DRAFT.pdf |             | 80058                  |

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**Priority:** Standard  
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**RAI 06.02.02-30****QUESTION:**

The July 21, 2010, response, to RAI 06.02.02-27 described laboratory testing performed for South Texas Project 3 & 4 to determine if sodium aluminum silicate would precipitate in the postulated post-LOCA environment. Please provide the following additional information about this testing:

- a) Describe the basis for performing a test designed to measure dissolution of an existing solid rather than a test designed to detect the formation of the precipitate from solution.
- b) Explain how the sodium aluminum silicate used in the South Texas Project 3 & 4 benchtop testing is equivalent to the sodium aluminum silicate precipitate ( $\text{NaAlSi}_3\text{O}_8$ ) modeled in WCAP-16530-NP. The chemical used in the STP 3 & 4 solubility tests is described in the Sigma-Aldrich Material Safety Data Sheet as “aluminum silicate” and “silicic acid, aluminum sodium salt.” The highly hydrated  $\text{NaAlSi}_3\text{O}_8$  precipitate generated according to WCAP-16530-NP is prepared from aluminum nitrate and sodium silicate. It is not clear to the staff that the two aluminum solids are identical, or at least equivalent in terms of their dissolution/precipitation characteristics.
- c) Describe how the experimental procedure accounts for precipitates less than the 0.45 micrometer ( $\mu\text{m}$ ) filter size. It is not clear to the staff that the measured cation concentrations accurately or conservatively represent the concentrations at the test conditions. Prior testing under the GSI-191 program has concluded that aluminum-based precipitates may be less than 0.2  $\mu\text{m}$  in size and cause high head losses in laboratory testing.

**RESPONSE:**

- a) The purpose of the STP 3&4 bench test described in this RAI is to determine an aluminum solubility limit. Sodium aluminum silicate (SAS) to ion products is a reversible reaction. At equilibrium, the forward, or dissolution, reaction is equal to the reverse, or precipitation, reaction. The soluble aluminum ion concentration at equilibrium is the same for either case. References 1 and 2 show that the dissolution of major cations increases very rapidly within the first 24 hours and then increases slowly, reaching equilibrium after 24 days. For albite, a SAS, the aluminum concentration in solution after 1 day appears to be about 10% of the final concentration after 24 days. Because the aluminum solubility determined in the STP 3&4 bench testing was based on the measured aluminum concentration after 1 day of exposure, this indicates that the measured solubilities reported for that test are conservative.
- b) The two aluminum solids, as noted in the RAI, are not identical. The material that was used in WCAP-16530-NP-A was freshly prepared and would have yielded higher aluminum solubility than aged material. The STP 3&4 bench test program used aged material. Therefore, the STP 3&4 bench test yields a conservative value of solubility for aluminum.

- c) The 0.45 micron filters used in the STP 3&4 bench tests are the industry standard to separate soluble and insoluble fractions. This information is included in EPRI Report No. 1014986, "Pressurized Water Reactor Primary Water Chemistry Guidelines," Volume 1, Rev 6, page F-3, dated December 2007. Thus, the 0.45 micron filters are consistent with industry practice.

The filter used for WCAP-16530-NP-A work was a 1 micron filter. Thus, had the same sized filters used for the WCAP 16530-NP-A work been used in the STP 3&4 bench testing, the result would have been a higher apparent aluminum solubility because more precipitate would pass through the filter and show up as soluble aluminum. The use of the 0.45 micron filter in the STP 3&4 bench tests is therefore conservative.

In summary, the purpose of the STP 3&4 bench test program is to assess aluminum solubility, not to assess head loss across a debris bed. To that end, the use of aged material that results in lower solubility and the use of an industry standard filter size provide assurance that the recent test program yields a conservative value for aluminum solubility.

The above testing conservatively demonstrates that, with  $4.5\text{ft}^2$  of aluminum exposed to recirculating coolant post-LOCA, the amount of dissolved aluminum in solution will be under the solubility limit for aluminum by at least a factor of 10 from the minimum solubility limit. With controls in place to assure the surface area of latent aluminum does not exceed  $4.5\text{ft}^2$ , the amount of dissolved aluminum is not expected to exceed this minimum solubility. Therefore, no aluminum chemical precipitates are expected following a LOCA at STP 3&4.

However, STPNOC will include aluminum chemical precipitates in downstream fuel effects testing. The amount of precipitate for this testing will be based on the conservative assumption that all of the aluminum that corrodes and forms SAS will exist in precipitate form and not remain dissolved in solution. The response to RAI 06.02.02-11 Supplement 2 (STPNOC Letter No. U7-C-STP-NRC-100044 dated February 22, 2010) demonstrates that aluminum oxy-hydroxide will remain sufficiently below the solubility limits such that precipitate from this compound is not expected. Therefore, precipitate from aluminum oxy-hydroxide will not be used in the downstream fuel effects testing.

The impact of SAS 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 SAS precipitate debris on the large recirculation screen area.

Therefore, the head loss testing performed for the RJ-ABWR suction strainers, which includes such materials as fiber and calcium silicate which are prohibited at STP 3&4, remains a valid design basis for the STP 3&4 suction strainers.

A COLA markup providing a revision to Appendix 6C, which will include the amount of SAS to be assumed in the downstream fuel effects test, will be provided as part of a supplemental response to RAI 04.04-3. This supplemental response will be provided no later than November 2, 2010.

### References

1. Wen H. Huang and Wen C. Kiang, American Minerologist, Volume 58, pages 1016-1022, 1973.
2. W. H. Huang and W.C. Kiang, American Minerologist, Volume 57, pages 1849-1859, 1972.