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Date: 5/16/02 5:07PM
Subject: Responses to Two NRC Questions Following the Root Cause AnalysisPresentation

Doug-
Attached below are the responses to the two questions you e-mailed me on 05/08/02 following the 05/07/02 Root Cause Analysis presentation.
-Dale Wuokko

(See attached file: Response to NRC Questions on corrosion stages.doc)

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According to slide 41, Nozzle 3 entered Stage 1 about 1990; Stage 2 about 1994-1996; and Stage 4 about 1998. When did nozzle 3 enter Stage 3?

Slide 41 (from the FENOC May 7, 2002 Root Cause Analysis NRC Presentation) provides a probable timeline of the sequence of events that occurred at nozzle 3. From this timeline, Stages 1 and 2 can be surmised to have taken place between 1990 and 1996. We have not attempted to predict when nozzle 3 entered Stage 3 corrosion. Instead, from a practical perspective, it was more reasonable to consider Stages 2 and 3 together.

What can be stated is that both Stages 2 and 3 produce visible quantities of boric acid deposits. In Stage 2, the deposits are smaller and white/powdery, whereas they are greater in volume, harder, and discolored as corrosion progresses through Stage 3. The video and interview evidence from the mid-90s suggests the leak at nozzle 3 was producing boric acid deposits in the 1996 timeframe, that were erroneously attributed to flange leaks The deposits observed in 1996 and 1998 would be consistent with corrosion in Stages 2 and 3. This evidence, coupled with the understanding that Stage 3 corrosion could only occur after a sufficiently sized annular gap developed from slower corrosion mechanisms, allowed us to estimate that Stages 2 and 3 together took 3 to 4 years at nozzle 3. Stage 2 can probably exist for several years, depending upon numerous variables (e.g., crack growth rate, number of cracks, crack leakage rate, crack size, crack opening displacement, annular gap, annular gap corrosion rates, etc.).

Progression to Stage 4 is mainly dependent upon crack leakage rate. Nozzle 3 is estimated to have progressed to Stage 4 about 1998, with general corrosion of the RPV head surface underway for at least 4 years.

What are your estimates for when nozzle 2 entered Stages 1,2 and 3?

To estimate when nozzle 2 would have entered Stages 1, 2, and 3, we must consider again how the estimates for nozzle 3 were constructed. Just as the evidence for nozzle 3 established the beginning of Stage 4 at about 1998, the only available evidence for nozzle 2 is that it progressed into Stage 3 in 2002. Because of boric acid deposits masking nozzle 2, resulting from a combination of CRDM nozzle flange leakage and leakage from nozzle 3, direct evidence for estimation of when nozzle 2 entered Stages 1 and 2 is nonexistent.

It can be estimated, however, that cracks that grow very slowly may take much longer to progress through Stages 2 and 3 than we have determined for nozzles 2 and 3 at Davis-Besse. With less moisture available during Stage 2, the leak would remain dry steam as it leaves the annulus. This would predict slower progress through Stage 2, and may in fact be the norm for many nozzles in the industry (i.e., consistent with the large majority of the leaks and cracks reported to date).