February 11, 2014

Dennis Madison
Southern Nuclear
Chairman, BWR Vessel and Internals Project
3420 Hillview Avenue
Palo Alto, CA 94304-1395

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR BWRVIP [BOILING WATER REACTOR VESSEL AND INTERENALS PROJECT]-62, REVISION 1, "BWR VESSEL AND INTERNALS PROJECT, TECHNICAL BASIS FOR INSPECTION RELIEF FOR BWR INTERNAL COMPONENTS WITH HYDROGEN INJECTION" (TAC NO. ME8538)

Dear Mr. Madison:

By letter dated March 7, 2012, the Boiling Water Reactor Vessel and Internals Project (BWRVIP) submitted to the U.S. Nuclear Regulatory Commission (NRC) staff for review Licensing Topical Report BWRVIP-62, Revision 1, "BWR Vessel And Internals Project, Technical Basis For Inspection Relief For BWR Internal Components With Hydrogen Injection," (Agencywide Documents Access and Management System Accession No. ML12072A370.

Upon review of the information provided, the NRC staff has determined that additional information is needed to complete the review. The additional information needed is detailed in the enclosed Requests for Additional (RAIs).

In an email dated February 3, 2014, Mr. Chuck Wirtz, representing BWRVIP, agreed that the NRC staff will receive your response to the enclosed RAI within six months of the date of this letter, approximately August 30, 2014. If you have any questions regarding the enclosed RAIs, please contact me at 301-415-7297.

Sincerely,

/RA/

Joseph J. Holonich, Senior Project Manager
Licensing Processes Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 704

Enclosure:
RAI questions

Dennis Madison
Southern Nuclear
Chairman, BWR Vessel and Internals Project
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SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR BWRVIP [BOILING WATER REACTOR VESSEL AND INTERENALS PROJECT]-62, REVISION 1, "BWR VESSEL AND INTERNALS PROJECT, TECHNICAL BASIS FOR INSPECTION RELIEF FOR BWR INTERNAL COMPONENTS WITH HYDROGEN INJECTION" (TAC NO. ME8538)

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ADAMS Accession No.: ML14030A375 **NRR-106**

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REQUEST FOR ADDITIONAL INFORMATION ON LICENSING TOPICAL REPORT BWRVIP-62, REVISION 1, "BWR VESSEL AND INTERNALS PROJECT, TECHNICAL BASIS FOR INSPECTION RELIEF FOR BWR INTERNAL COMPONENTS WITH HYDROGEN INJECTION"

By letter dated Aril 18, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12114A102), the Electric Power Research Institute submitted for U.S. Nuclear Regulatory Commission (on a fee billable basis) staff review and approval Boiling Water Reactor (BWR) Report 1022844 (BWRVIP-62), Revision 1, "BWR Vessel Internals Project (BWRVIP), Technical Basis for Inspection Relief with Hydrogen Injection." This revised version included the technical basis for inspection relief for the BWR vessel internal components. The staff reviewed this report, and a set of requests of additional information (RAI) is addressed below.

RAI-1 One of the advantages proposed for online noble chemical addition is smaller particles sizes and, therefore, smaller interparticle distances for a given amount of platinum (mass) applied. It is our understanding evidence for this smaller particle size is based primarily, if not exclusively, on laboratory data. It is also our understanding that one of the requirements for small particle size is rapid heating of the platinum solution from temperatures at which the chemical reaction which generates the platinum particles does not occur to temperatures at which the reaction occurs very rapidly. Given that this temperature change is likely to occur more slowly under plant injection conditions, please provide evidence that the particle size distribution obtained in the laboratory is also obtained under all in-plant injection conditions for all locations for which inspection relief may be desired

RAI-2 The mechanism by which the platinum solution reacts to form platinum particles on the surfaces to be protected is not clear to us. It is also not clear to us that the data concerning particle distribution and adherence are based on all of the surface conditions that may be reasonably expected for the surfaces to be protected. Prior data (BWRVIP-193, "BWR Vessel and Internals Project, Noble Metal Durability Under High Pressure Flushing, EPRI Technical Report,") appear to be based primarily on cleaned and polished surfaces. It appears that differences in the location/mechanism of platinum particle producing reaction will affect the manner in which the particles are bonded to the surface to be protected (chemical bond or physically adsorbed). This distinction could reasonably be expected to affect both the particle distribution and the particle adherence depending on whether the substrate was new (relatively unoxidized), old (more heavily oxidized), zinc treated, or crud covered.

a. Please describe the mechanism/location for the platinum particle forming reaction.

b. Please describe the mechanism by which the particles are bonded to the surface to be protected.

c. Please provide plant data to support the statement that particles are uniformly distributed on all surfaces to be protected irrespective of the condition of the surface (including the effects of oxidation, zinc, and crud).

ENCLOSURE

d. Please provide plant data to support the position that the particles deposited are long lived under all the flow conditions for which inspection relief may be requested

RAI-3 In his paper "Online Catalytic Mitigation of stress corrosion cracking (SCC) at Parts per Trillion Level (ppt)" (National Association of Corrosion Engineers (NACE) Corrosion 2008 paper 08601) Andresen addresses the concept of "throwing power" of particles, i.e., the maximum interparticle distance at which protection of the surface to be protected can be achieved as a function of boundary layer thickness. It is not clear to us that either the actual or required interparticle distance or the actual boundary layer thickness is known for all surfaces to be protected for which relief will be sought. Please provide sufficient information for actual plant conditions which demonstrates that interparticle distances (for both online and traditional noble chemical addition) are sufficiently small that full protection of the surfaces to be protected is achieved.

RAI-4 In his paper "Online Catalytic Mitigation of SCC at Parts per Trillion Level" (NACE Corrosion 2008 paper 08601) Andresen addresses the concept of electrochemical potential measurement. In this paper he points out that electrochemical potential (ECP) represent the average potential measured over an area and that the area over which the potentials are measured is a function of electrode placement. In this paper he also describes an experiment in which areas which are known to have different ECPs were either detected or not detected based on reference electrode placement. Given the apparent importance of interparticle distance and boundary layer thickness, for each area for which inspection relief will be requested, please provide plant data to indicate that electrochemical potentials have been or are being measured on a scale which will identify insufficient particle density.

RAI-5 In his paper "The Effects of Dissolved Oxygen Depletion on BWR External Sample Line ECP Measurements and the Need for Dissolved Oxygen Addition" which was presented at the 16th Environmental Degradation Conference, Varela addresses the concept that at certain plants with long sample lines and a history of prior treatment with traditional noble chemistry, sufficient platinum is present in the sample line to reduce all oxygen present in the line irrespective of the success or failure of an online noble chemical addition. To resolve this issue Varela proposes to replace the sample manifold just prior to the online noble chemical addition and to add oxygen to the sample line just upstream from the manifold. In the absence of noble metal addition a high ECP will be recorded. Following a successful noble metal addition, the ECP will drop. The replacement of the manifold is anticipated only prior to the first online noble metal chemical addition. Given that the sample line, and potentially, therefore, the manifold, have a demonstrated history of retaining platinum particles and that the retention of platinum particles on other surfaces to be protected may be more or less than that in the manifold, it is not clear whether the continuation of a low ECP following subsequent online noble metal chemical additions indicates a successful application of platinum to all areas for which inspection relief is sought or whether it merely indicates that platinum has not been lost from the area of the manifold.

a. Please provide plant based information concerning the rate of desorption of platinum particles in all areas for which inspection relief will be sought relative to the manifold.

b. Please justify why a single (or small number) of ECP measurements which may be substantially influenced by retained platinum particles provide adequate assurance of an acceptable platinum addition in areas where particle desorption may be faster than at the locations at which ECP measurements are made.

RAI-6 In his paper "Effect of Flow and Surface Structure on Platinum Deposition on Stainless Steel during Simulated Noble Metal Applications" which was presented at the 16th Environmental Degradation Conference, Grundler addresses the concept that particle size and turbulence (flow velocity) affect particle distribution.

a. Given the variations in flow rate over the surfaces to be protected for which inspection relief will be sought and the fact that these variations should result in variations in particle density, please provide plant data to support the concept that platinum particles will be deposited in all areas for which inspection relief will be sought to assure adequate protection of the surfaces to be protected.

b. Given that there is some reason to believe that platinum particles produced during actual plant injections may be larger and more varied in size than laboratory injections, provide plant data indicating that sufficient particle density will be achieved in all areas for which relief will be sought to assure adequate protection of the surfaces to be protected.

RAI-7 In one or more instances we are aware that the platinum injection line has plugged.

a. Provide information concerning how this problem can be detected so as to ensure that adequate platinum is injected.

b. Please describe the effect of injection line plugging (or partial plugging) on platinum particle size and particle distribution.

RAI-8 In his paper "Online Catalytic Mitigation of SCC at Parts per Trillion Level" (NACE Corrosion 2008 paper 08601) Andresen addresses the concept that platinum must penetrate into the mouths of cracks as far as oxygen. In light of the fact that micrographs of platinum particle distribution presented by Grundler (see question 6 above) appeared to show that the distances between platinum particles was larger on the sides of surface oxide particles perpendicular to the plane of the metallic substrate (as compared to surfaces parallel to the substrate), it seems reasonable to question whether platinum particle distribution from online noble chemical applications and especially from traditional noble chemical additions under plant conditions penetrate into crack mouths sufficiently to provide protection to the crack. Please provide plant data for all areas for which inspection relief will be sought to indicate that platinum particle distribution in crack mouths is sufficient to provide protection for the crack.

RAI-9 BWRVIP-219 “BWR Vessel and Internals Project Technical Basis for Online Noble Chemical Addition Migration and Effectiveness Criteria for Inspection Relief” proposes determining platinum loading and particle size distribution by electric discharge machining (category 4b)

a. Would the resulting electric discharge machining (EDM) surface (now no longer platinum protected) show a higher ECP and crack growth rate?

b. If platinum particles were removed from a section of a surface to be protected either for experimental purposes (e.g., EDM) or through plant operations (e.g., component replacement or cleaning), would platinum migrate to the unprotected area over time. Would this migration affect particle size? What would be the effect on the platinum distribution in the area surrounding the depleted area?

RAI-10 BWRVIP-190, “BWR Vessel Internals Project - BWR Water Chemistry Guidelines-2008 Revision,” states that for classical NMCA plants, NMCA is reapplied when the surface loading is projected to decrease to a value less than that was stated in page C-4 of this report. Is there a similar reapplication trigger value for online noble chemistry?

RAI-11 BWRVIP-190 states that the target ECP response is critical to the success of the application. However, the results for 10 parts per trillion Platinum addition and a 2.2 H_2 molar ratio in Fig. C-4 show that there is a high crack growth rate with an ECP of approximately - 300 mV. In light of these data, discuss how a low ECP (Category 4a) is a measure of success.

RAI-12 The staff notes that despite the use of hydrogen water chemistry and traditional noble metal chemical additions, that cracking of top guide components has continued at some plants. Please describe why this has occurred and how the use of online noble chemical addition/hydrogen water chemistry will resolve this issue.

RAI-13 In light of the fact that BWRVIP-25, “BWR Core Plate Inspection and Evaluation Guidelines,” still contains recommendations to inspect core plate hold down bolts, please describe the manner in which online noble chemical addition and traditional noble chemical addition, provide reduction in cracking due to intergranular stress corrosion cracking in the crevice between the bolt and the core plate given that platinum precipitation in this area is restricted by geometry.