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GNRO-2014/00006

January 29, 2014

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

SUBJECT: Request for Information Regarding Request for Alternative in Accordance with 10 CFR 50.55a(a)(3)(i) Use of Boiling Water Reactor Vessel and Internals Project (BWRVIP) Guidelines in Lieu of Specific ASME Code Requirements (GG-ISI-017), dated June 27, 2013
Grand Gulf Nuclear Station, Unit 1
Docket No. 50-416
License No. NPF-29

REFERENCES:

1. Request for Alternative in Accordance with 10 CFR 50.55a(a)(3)(i) Use of Boiling Water Reactor Vessel and Internals Project (BWRVIP) Guidelines in Lieu of Specific ASME Code Requirements (GG-ISI-017), dated June 27, 2013, (Accession No. ML13179A041).

2. U.S. NRC Electronic Request, Grand Gulf Nuclear Station Request for Additional Information Regarding BWRVIP Relief Request, dated December 26, 2013, (TAC ME2357).

Dear Sir or Madam:

Entergy Operations, Inc. is providing, in the Attachment, the response to Reference 2, Request for Additional Information. The request for additional information due date was revised per discussion with the Nuclear Regulatory Commission Project Manager for Grand Gulf.

This letter contains no new commitments. If you have any questions or require additional information, please contact Thomas Thornton at 601-437-6176.

Sincerely,

JAS/slw

Attachments: 1 Response to Request for Additional Information
2 Revised Table 1
3 Table 2, ECP measurements for the Mitigation Monitoring Skid
4 Dry Tube Platinum Analysis Report

cc: (see next page)

cc: U.S. Nuclear Regulatory Commission
ATTN: Mr. Mark Dapas
Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
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NRC Senior Resident Inspector
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U. S. Nuclear Regulatory Commission
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Attachment 1 to

GNRO-2014/00006

Response to Request for Additional Information

The format for the Requests for Additional Information (RAI) responses below is as follows. The RAI is listed in its entirety as received from the Nuclear Regulatory Commission (NRC) with background, issue and request subparts. This is followed by the Grand Gulf Nuclear Station (GGNS) RAI response to the individual question.

RAI-1

Request

The NRC staff requests that the licensee identify whether there are any furnace-sensitized stainless steel vessel attachment welds associated with the RVI components in GGNS. It is requested that the licensee provide an explanation regarding the type of inspection program and any additional augmented inspection programs that are implemented for any existing furnace-sensitized stainless steel attachment welds in GGNS.

Response

The information that was requested in RAI-1 could not be obtained and compiled within 30 days of receipt of the RAI. The requested information for RAI-1 will be provided in a separate communication by April 30, 2014.

RAI-2

Request

Since the following BWRVIP reports are used by the BWR licensees, the staff requests that GGNS should either include or provide an explanation for not including the following BWRVIP reports in Section 5.0 of its submittal dated June 27, 2013.

- BWRVIP-138, "BWRVIP Updated Jet Pump Beam Inspection and Flaw Evaluation."
- BWRVIP-139, "BWR Vessel Internals Project, Steam Dryer Inspection and Flaw Evaluation Guidelines"
- BWRVIP-183, "BWR Vessel Internals Project, Top Guide Grid Beam Inspection and Flaw Evaluation Guidelines"

Response

Subsection Proposed Alternative of Section 5.0 **Proposed Alternative and Basis for Use** has been revised below:

Entergy requests authorization to utilize the alternative requirements of the BWRVIP Guidelines in lieu of the requirements of ASME Code Section XI Table IWB-2500-1. The proposed alternative is detailed in Table 1 for Examination Category B-N-1 and B-N-2.

Entergy will satisfy the Examination Category B-N-1 and B-N-2 requirements as described Table 1 in accordance with BWRVIP guideline requirements. This request for alternative proposes to utilize the identified BWRVIP guidelines in lieu of the associated Code requirements, including examination method, examination volume, frequency, training, successive and additional examinations, flaw evaluations, and reporting.

The guidelines applicable to the subject Code Components in this proposed alternative are the following. Not all the components addressed by these guidelines are ASME Code Section XI components.

- BWRVIP-03, "BWR Vessel and Internals Project, Reactor Pressure Vessel and Internal Examination Guidelines"

- BWRVIP-18, Revision 1, “BWR Core Spray Internals Inspection and Flaw Evaluation Guidelines”
- BWRVIP-25, “BWR Core Plate Inspection and Flaw Evaluation Guidelines”
- BWRVIP-26-A, “BWR Top Guide Inspection and Flaw Evaluation Guidelines”
- BWRVIP-27-A, “BWR Standby Liquid Control System/Core Plate ΔP Inspection and Flaw Evaluation Guidelines”
- BWRVIP-38, “BWR Shroud Support Inspection and Flaw Evaluation Guidelines”
- BWRVIP-41, Revision 3 “BWR Jet Pump Assembly Inspection and Flaw Evaluation Guidelines”
- BWRVIP-42, Revision 1, “Low Pressure Coolant Injection (LPCI) Coupling Inspection and Flaw Evaluations”
- BWRVIP-47-A, “BWR Lower Plenum Inspection and Flaw Evaluation”
- BWRVIP-48-A, “Vessel ID Attachment Weld Inspection and Flaw Evaluation Guidelines”
- BWRVIP-76, Revision 1, “BWR Core Shroud Inspection and Flaw Evaluation Guidelines”
- BWRVIP-94, Revision 2, “BWRVIP Vessel and Internals Project Program Implementation Guide”
- BWRVIP-100-A, “Updated Assessment of the Fracture Toughness of Irradiated Stainless Steel for BWR Core Shrouds”
- BWRVIP-138, Revision 1-A, “BWR Vessel and Internals Project, Updated Jet Pump Beam Inspection and Flaw Evaluation”
- BWRVIP-139-A, “BWR Vessel and Internals Project, Steam Dryer Inspection and Flaw Evaluation Guidelines”
- BWRVIP-183, “BWR Vessel and Internals Project, Top Guide Grid Beam Inspection and Flaw Evaluation Guidelines”

Note: If flaw evaluations are required for BWRVIP-76 examinations, the fracture toughness values of BWPVIP-100-A will be utilized.

Table 1 (see Attachment 2) compares current ASME Code Section XI IWB-2500-1, Examination Category B-N-1 and B-N-2 requirements with the above current BWRVIP guideline requirements, as applicable, to Entergy's BWR-6 units.

In addition, the Entergy reactor vessel internals inspection programs have been developed and implemented to satisfy the requirements of BWRVIP-94, "BWRVIP Vessel and Internals Project Program Implementation Guide." It is recognized that the BWRVIP executive committee periodically revises the BWRVIP guidelines to include enhancements in inspection techniques and flaw evaluation methodologies. BWRVIP-94, Revision 2 states that where guidance in existing BWRVIP documents has been supplemented or revised by subsequent correspondence approved by the BWRVIP Executive Committee, the vessel and internals program shall be modified to reflect the new requirements and implement the guidance within two refueling outages, unless a different schedule is specified by the BWRVIP. However, if new guidance approved by the Executive Committee includes changes to NRC approved BWRVIP guidance that are less conservative than those approved by the NRC, this less conservative guidance shall be implemented only after NRC approves the changes, which generally means publication of a "-A" document or equivalent. Therefore, where the revised version of a BWRVIP inspection guideline continues to also meet the requirements of the version of the BWRVIP inspection guideline that forms the safety basis for the NRC authorized proposed alternative to the requirements of 10 CFR 50.55a, it may be implemented. Otherwise, the revised guidelines will only be implemented after NRC approval of the revised BWRVIP guidelines or a plant-specific request for alternative has been approved. Table 1 below only represents the most current comparison.

Any deviations from the referenced BWRVIP Guidelines for the duration of the proposed alternative will be appropriately documented and communicated to the NRC, per the BWRVIP Deviation Disposition Process. Currently, Entergy deviations from the subject guidelines above are summarized in Table 1 below.

Inspection services, by an Authorized Inspection Agency, will also be applied to the proposed alternative actions of this Request for Alternative.

RAI-3
Request
The NRC staff requests that the licensee confirm whether NUREG-0619, "BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking", will be used for the inspection of feedwater sparger tee welds and feedwater sparger piping brackets.

Response
The Inservice Inspection program does use the requirements of NUREG-0619 for weld inspection. However, these requirements are limited to only the six (6) feedwater nozzle inner radii. The control rod drive line at Grand Gulf Nuclear Station has been cut and capped and as such is not subject to these examinations. The feedwater sparger tee welds and the sparger piping brackets are being examined by utilizing the requirements of BWRVIP-48-A. Examination of these welds using the EVT-1 techniques are scheduled and tracked under the plant ASME Code Section XI Inservice Inspection Program, Category B-N-2 welds.

RAI-4
Request
Since Inconel 182 welds are more prone to intergranular stress corrosion cracking (IGSCC) than the austenitic stainless steel 308/316 welds, the staff requests that the licensee provide information how this aging degradation is effectively monitored in identifying the extent of aging degradation in these welds in a timely manner.

Response
With regard to Examination Category B-N-1, there are no Alloy 182 welds. With regards to Examination Category B-N-2, the following locations have Alloy 182:

1. Guide Rod Bracket
2. Steam Dryer Support Bracket
3. Core Spray Bracket
4. Feedwater Sparger Bracket
5. Shroud Support (weld H9)
6. Shroud Support Legs (weld H12)

The guide rod bracket, steam dryer support bracket, core spray bracket and feedwater bracket inspections are specified in BWRVIP-48-A and the shroud support and shroud support legs inspections are specified in BWRVIP-38. It is noted in BWRVIP-48-A that brackets with Alloy 182 attachment welds would be most susceptible to stress corrosion cracking. No additional augmented inspections are performed on the Alloy 182 welds outside of that defined in BWRVIP-48-A and BWRVIP-38. No cracking has been identified in the Alloy 182 welds at Grand Gulf.

RAI-5

Request

The NRC Staff reviewed the previous inspection results for the various RVI components that are addressed in the Attachment 3 of the licensee's June 27, 2013 submittal and determined that additional information is required on the extent of aging degradation in the most susceptible areas of the weld connections in the following RVI components:

a) Top Guide-
Section 8.1 in BWRVIP-183 states that top guide rim areas and the grid beam cells are prone to irradiation assisted stress corrosion cracking (IASCC). If the top guide grid beam cells and rim areas at GGNS are exposed to a fluence value greater than $5x10^{20}$ n/cm^{21} during the third ISI interval, consistent with guidelines addressed in Section 8.1.2 of BWRVIP-183, inspections of the grid beam cells and rim areas containing the welds and heat affected zone should be performed every 6 years. Confirm that such inspections will be performed.

b) Core Spray and Core Spray Spargers-
The licensee reported that during the refueling outages from 2005-2010, all creviced welds and 25% of the remaining welds were inspected and no indications were found. With respect to the examinations of these welds, the staff requests that the licensee provide the following information: (1) the number of these welds that have Type 304 stainless steel material, (2) the number of these welds that have Type 304L stainless steel material, and, (3) the approximate area of inspection coverage. The licensee stated that during the 2012 outage an indication was discovered in P8A weld. The staff requests that the licensee provide a brief summary of the supporting analyses showing how this finding was dispositioned in the licensee's Corrective Action Program.

c) LPCI Coupling-
During the refueling outages from 1996-2007, loose part concern at 141° azimuth location was identified. The staff requests the licensee to provide a brief summary on: (1) how this issue was resolved, and, (2) future corrective action plans. The staff requests that the licensee provide the following information: (1) the number of the welds that have Type 304 stainless steel material with a creviced weld geometry, (2) the number of the welds that have Type 304L stainless steel material with a creviced weld geometry, (3) the approximate area of inspection coverage and, (4) the number of Inconel182 welds in the inspected population.

d) Other RVI Components:
Provide information for the number of Inconel 182 welds that have been inspected during past outages in the following RVI components and the approximate area of inspection coverage.

   (a) jet pumps; (b) in-core dry tubes; and (c) CRD housings Both in-core dry tubes and CRD housings are addressed in BWRVIP-47-A "BWR Lower Plenum Inspection and Flaw Evaluation Guidelines."

e) Dry Tubes:
During the 2010 outage, the licensee identified indications in four dry tubes (addressed in BWRVIP-47-A). The staff requests that the licensee provide information on the type of material e.g., austenitic stainless steel type 304 or 304L or Inconel 600, that was used in these tubes. Provide a brief summary of the supporting analysis showing how this finding was dispositioned in the licensee's Corrective Action Program.

Response
The following responses have been provided in each section:

a) Consistent with the requirements of BWRVIP-183 Section 8.1.2, the rim areas containing the weld and heat affected zone (HAZ) from the top surface of the top guide and two cells in the same plane/axis as the weld are inspected. Additionally, regions of the grid beam cells are inspected at the bottom 2 inches (50.8 mm) of the interior side surfaces. The first inspection was performed in 2012 and will be inspected every six years with the EVT-1 inspection technique.
b) Grand Gulf does follow BWRVIP-18 for inspection of Core Spray, however; this question is outside of the scope of this Relief Request because the Core Spray piping and sparger welds are not required inspections under ASME Section XI Table IWB-2500-1.
c) Grand Gulf does follow BWRVIP-42 for inspection of the LPCI Couplings, however; this question is outside of the scope of this Relief Request because the LPCI Couplings are not required inspections under ASME Section XI Table IWB-2500-1.
d) Grand Gulf does follow BWRVIP-41 for inspection of the Jet Pumps, SIL 409 Revision 3 for inspection of the in-core dry tubes, and BWRVIP-47 for inspections of the CRD housings. However, this question is outside of the scope of this Relief Request because these components are not required inspections under ASME Section XI Table IWB-2500-1.
e) The evaluation performed by GE Hitachi Nuclear Energy concluded that the condition would not affect the ability of control rod insertion, would not cause any damage to the surrounding fuel channels, would not result in loose pieces, and would not affect the ability to insert or remove fuel bundles and nuclear instrumentation. The Justification for Continued Operation explicitly stated that GGNS can be operated for one addition fuel cycle with cracked dry tubes with no adverse impact. All four dry tubes were replaced in RF18 (2012). However, the location of the crack is outside of the scope of this Relief Request because these components are not required inspections under ASME Section XI Table IWB-2500-1.

RAI-6
Request
To assess the effectiveness of GGNS's implementation of hydrogen water chemistry (HWC) or HWC in conjunction with noble metal chemical addition (NMCA), the NRC staff requests that the licensee provide the following information:

a) Measurement of electrochemical potential (ECP) of stainless steel material that represents a typical RVI component. ECP measurement should be made when HWC or HWC and NMCA method is used.
b) Measurement of the amount of platinum deposit on a stainless coupon if HWC and NMCA method is used.

Response
The following responses have been provided in each section:

a) Table 2 (see Attachment 3) lists the ECP measurements for the Mitigation Monitoring Skid.
b) Grand Gulf does not change out coupons for the purpose of obtaining platinum deposit measurement. However, a Dry Tube Platinum Analysis (2013) was performed after the implementation of the Online Noble Chem Injection project (November 2010). The Dry Tube Platinum Analysis Report is provided in Attachment 4.

RAI-7
Request
Editorial correction: Please revise the reference from Figure 3-3 to Figures 2-2 to 2-5 in "shroud horizontal welds" item in Table 1, page 7 of the submittal dated June 27, 2013.

Response
Table 1 for Page 7 of the submittal dated June 27, 2013 has been updated to change the reference in "shroud horizontal welds" from Figure 3-3 to Figures 2-2 to 2-5. See updated table 1 page 7 in Attachment 2.

Attachment 2 to

GNRO-2014/00006

Revised Table 1

Table 1 (continued)
Comparison of ASME Code Section XI Table IWB-2500-1 Examination Category B-N-1 and B-N-2 Requirement to BWRVIP Guidance Requirements [1]

ASME Table IWB-2500-1 Item No.	Component	ASME Exam Scope	ASME Exam	ASME Frequency	Applicable BWRVIP Alternative	BWRVIP Exam Scope	BWRVIP Exam	BWRVIP Frequency
B13.40	Welded Core Support Structure - Shroud Support	Accessible Surfaces	VT-3	Each 10-year interval	BWRVIP-38 Section 3.1.3.2 Figures 3-2 and 3-5	Shroud Support Weld H8 / H9 and Leg Welds including gussets as applicable	EVT-1 or UT	Based on as-found conditions to a maximum 6 years for one side EVT-1, 10 years for UT where accessible
	Shroud Horizontal Welds				BWRVIP-76-R1 Section 2.2 Figure 2.2 to 2.5	Welds H1-H7 as applicable	EVT-1 or UT	Based on as-found conditions to a maximum 10 years for UT when inspected from both sides of the welds
	Shroud Vertical Welds				BWRVIP-76-R1 Section 2.3 Figure 3-3	Vertical and Ring-Segment Welds as applicable	EVT-1 or UT	Maximum 6 years for one-sided EVT1, 10 years for UT of horizontal welds
	Shroud Repairs(4)				BWRVIP-76-R1 Section 3.5	Tie-Rod Repair	VT-3	In accordance with designer recommendation per BWRVIP-76 R1

Note:
(1) This table provides only an overview of the requirements. For more details, refer to ASME Section XI, Table IWB-250Q-1 and the appropriate BWRVIP Document.
(2) In accordance with Appendix A of BWRVIP-38, a site specific evaluation will determine the minimum required weld length to be examined.
(3) When inspection tooling and methodologies are available, they will be utilized to establish a baseline inspection of these welds.
(4) No repairs have been performed on the shroud.

Attachment 3 to

GNRO-2014/00006

Table 2, ECP measurements for the Mitigation Monitoring Skid

Table 2: Electrochemical Potential for Cycle 19 from Mitigation Monitoring Skid

Sample DateTime	ECP	Sample DateTime	ECP	Sample DateTime	ECP
6/19/2012 15:42	118	9/17/2012 9:19	-268.8	3/25/2013 14:20	-450
6/19/2012 21:12	123	9/19/2012 12:22	-276.4	3/27/2013 11:03	-453
6/20/2012 2:12	128	9/20/2012 10:07	-280.1	3/29/2013 10:35	-450.6
6/20/2012 6:57	134	9/21/2012 10:53	-277.5	4/1/2013 9:35	-449
6/20/2012 7:12	-231	9/23/2012 9:05	-261.9	4/3/2013 4:24	-449.2
6/20/2012 11:30	-492	9/24/2012 6:52	-279.3	4/8/2013 9:35	-470
6/22/2012 3:00	-488	9/24/2012 11:22	-280	4/12/2013 11:02	-470.4
6/22/2012 10:29	-492.6	9/26/2012 10:45	-280.4	4/15/2013 10:54	-463.7
6/22/2012 22:45	-488.4	9/27/2012 16:25	-279.9	4/17/2013 10:20	-458
6/23/2012 9:44	-491	9/28/2012 9:44	-278.3	4/19/2013 11:24	-465.7
6/24/2012 3:09	-491	9/29/2012 15:14	-279.5	4/22/2013 10:09	-463.8
6/24/2012 8:58	-485	9/30/2012 15:29	-279.9	4/29/2013 9:50	-455.9
6/25/2012 4:10	-453.7	10/1/2012 10:30	-280.8	5/3/2013 9:55	-457.4
6/25/2012 9:40	-447.4	10/2/2012 9:41	-281.2	5/6/2013 16:32	-455.5
6/26/2012 3:00	-466.8	10/5/2012 10:44	-280.7	5/8/2013 11:00	-453.9
6/27/2012 1:55	-451.6	10/6/2012 17:45	-282.1	5/13/2013 9:54	-456.2
6/27/2012 10:49	-442	10/7/2012 17:15	-282.6	5/15/2013 8:50	-451
6/28/2012 3:28	-437.6	10/8/2012 10:12	-295	5/17/2013 9:15	-451
6/28/2012 8:55	-434.3	10/10/2012 9:20	-290.7	5/22/2013 9:35	-448
6/29/2012 1:33	-437.1	10/12/2012 9:30	-277.5	5/27/2013 12:50	-447.4
6/29/2012 14:34	-434.1	10/14/2012 10:25	-301.9	5/29/2013 6:17	-448
6/30/2012 1:53	-433.8	10/15/2012 9:59	-278.4	6/5/2013 10:09	-438.3
7/1/2012 5:57	-430	10/16/2012 17:20	-276.3	6/12/2013 13:30	-436.6
7/2/2012 1:02	-426	10/17/2012 9:15	-279.6	6/14/2013 9:58	-437.6
7/2/2012 10:13	-428.6	10/18/2012 9:15	-279.3	6/17/2013 10:44	-441.3
7/2/2012 20:13	-428.9	10/19/2012 10:30	-280	6/19/2013 10:40	-427.3
7/3/2012 3:00	-426.2	10/22/2012 0:42	-276.5	6/19/2013 12:24	-397
7/3/2012 15:20	-449.5	10/22/2012 10:00	-275.7	6/19/2013 14:21	-373
7/4/2012 12:20	-427.2	10/23/2012 9:40	-273	6/19/2013 16:37	-465.8
7/5/2012 13:15	-417.5	10/24/2012 9:35	-274.8	6/28/2013 10:43	-464.4
7/6/2012 13:55	-416.9	10/25/2012 13:43	-274.6	7/1/2013 10:50	-443
7/7/2012 12:43	-415	10/26/2012 10:30	-274.6	7/5/2013 9:25	-442.2
7/8/2012 8:24	-416	10/27/2012 9:31	-271.4	7/8/2013 10:30	-438.1
7/9/2012 9:55	-400.8	10/28/2012 11:22	-275.2	7/10/2013 10:34	-433.5
7/10/2012 13:31	-410	10/29/2012 9:11	-274	7/12/2013 10:40	-446.6
7/12/2012 18:48	-405	10/30/2012 14:55	-274	7/19/2013 10:15	-461.2
7/13/2012 10:31	-407.5	10/31/2012 12:00	-273.3	7/22/2013 10:14	-454.2
7/14/2012 11:59	-392.6	11/2/2012 10:50	-270.8	7/26/2013 14:49	-451.8
7/15/2012 11:22	-400.6	11/3/2012 10:44	-270.4	7/29/2013 10:23	-449.7
7/16/2012 9:15	-398.1	11/4/2012 8:20	-272.5	7/30/2013 8:34	-448
7/17/2012 9:35	-391.5	11/5/2012 11:40	-310	8/5/2013 14:09	-461
7/18/2012 11:18	-392	11/5/2012 15:20	-322.9	8/12/2013 15:51	-425
7/19/2012 9:23	-385	11/5/2012 19:24	-347.1	8/13/2013 20:04	-442.6
7/20/2012 9:48	-384.9	11/6/2012 3:24	-414	8/14/2013 1:34	-456
7/21/2012 10:18	-379.1	11/6/2012 10:55	-441.8	8/14/2013 5:34	-461.6
Sample DateTime	ECP	Sample DateTime	ECP	Sample DateTime	ECP

7/22/2012 9:43	-377
7/23/2012 10:46	-377
7/25/2012 12:16	-386.2
7/27/2012 14:57	-368
7/28/2012 10:00	-418
7/29/2012 14:45	-409
7/30/2012 10:42	-413
8/1/2012 11:12	-385.2
8/3/2012 9:30	-401.6
8/4/2012 22:50	-366.7
8/5/2012 22:35	-364.3
8/6/2012 11:05	-361.5
8/8/2012 10:16	-352.9
8/10/2012 11:12	-347.2
8/11/2012 14:57	-339.9
8/13/2012 10:52	-334
8/14/2012 10:23	-330
8/15/2012 10:42	-328
8/16/2012 11:12	-324.1
8/17/2012 11:15	-326
8/20/2012 10:10	-323
8/22/2012 9:45	-319.4
8/23/2012 10:40	-321
8/24/2012 9:51	-312.2
8/25/2012 22:43	-313.9
8/27/2012 2:30	-313.3
8/27/2012 9:30	-311.3
8/28/2012 11:11	-296.7
8/29/2012 9:25	-300.1
8/30/2012 16:30	-294.3
8/31/2012 10:57	-292
9/1/2012 22:15	-295.8
9/3/2012 0:51	-292.8
9/3/2012 9:55	-294.8
9/5/2012 9:15	-296
9/6/2012 10:35	-290
9/7/2012 9:37	-290.5
9/8/2012 16:23	-283.8
9/9/2012 16:54	-284.6
9/10/2012 9:22	-284
9/12/2012 10:07	-283.2
9/14/2012 10:25	-282.1
9/15/2012 11:40	-346.9
9/16/2012 11:37	-302.4

11/7/2012 3:10	-475.3
11/7/2012 14:40	-484.9
11/8/2012 2:53	-489.4
11/8/2012 11:40	-492
11/9/2012 3:27	-492.7
11/10/2012 3:02	-495.7
11/10/2012 11:18	-496
11/10/2012 23:15	-496.3
11/11/2012 11:16	-497
11/11/2012 23:40	-496.6
11/12/2012 11:25	-497.3
11/12/2012 23:40	-497.1
11/13/2012 9:34	-497
11/13/2012 22:26	-497.4
11/14/2012 10:40	-497
11/14/2012 21:58	-497.1
11/15/2012 11:15	-497.3
11/16/2012 11:00	-497
11/19/2012 9:15	-497
11/20/2012 19:03	-494.6
11/21/2012 9:15	-493.9
11/23/2012 9:40	-499.3
11/26/2012 11:17	-497.5
11/28/2012 9:30	-499
11/30/2012 8:45	-497.6
12/3/2012 2:18	-496.4
12/5/2012 2:55	-497.5
12/17/2012 9:45	-479.4
12/21/2012 2:35	-486.1
12/26/2012 10:30	-487.2
12/28/2012 11:03	-481.9
1/2/2013 10:03	-481.1
1/14/2013 9:35	-480.5
2/4/2013 15:25	-462
2/8/2013 10:20	-450.2
2/11/2013 10:20	-480
2/13/2013 14:05	-447.7
2/15/2013 12:00	-447.6
2/27/2013 9:35	-451.4
3/6/2013 4:09	-454.2
3/8/2013 10:38	-453.8
3/11/2013 9:16	-454.5
3/18/2013 9:21	-449
3/19/2013 9:00	-447
3/22/2013 11:36	-449.7

8/14/2013 9:47	-465.3
8/14/2013 21:46	-468.1
8/15/2013 9:34	-479.3
8/15/2013 21:52	-478.8
8/16/2013 10:30	-485
8/16/2013 21:53	-486.4
8/17/2013 22:30	-490.1
8/18/2013 9:55	-491.7
8/18/2013 21:40	-492.2
8/19/2013 22:15	-493.4
8/20/2013 11:35	-494.4
8/20/2013 22:09	-494.8
8/22/2013 0:20	-494.6
8/22/2013 22:03	-495.1
8/23/2013 9:33	-495.5
8/23/2013 14:18	-496
8/24/2013 11:48	-495.7
8/26/2013 9:48	-496.6
8/28/2013 9:33	-496.4
9/2/2013 9:10	-494.2
9/4/2013 10:15	-494.7
9/6/2013 11:32	-494.9
9/9/2013 11:26	-494.9
9/13/2013 8:50	-495
10/2/2013 11:00	-484.4
10/14/2013 11:30	-488
10/16/2013 10:23	-487.9
10/21/2013 11:40	-486
10/25/2013 9:22	-487.8
10/30/2013 10:59	-483
11/1/2013 12:14	-491.6
11/13/2013 9:53	-480.7
11/22/2013 21:57	-482
11/25/2013 11:35	-481.9
11/27/2013 12:48	-484.7
11/29/2013 9:36	-481.4
12/4/2013 10:06	-474.7
12/18/2013 9:30	-482.3
12/20/2013 12:06	-477
12/26/2013 1:38	-482
12/27/2013 9:41	-481.2
12/28/2013 1:49	-481.5
12/30/2013 9:50	-482.6
1/3/2014 11:00	-481
1/8/2014 10:50	-481.3

Attachment 4 to

GNRO-2014/00006

Dry Tube Platinum Analysis Report

HITACHI

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February 18, 2013

eDRF Section 0000-0156-2398

GEH Letter # 0000-0156-2398 R0

Trey Reeves
Grand Gulf Nuclear Station

Subject: **Dry Tube Platinum Analysis Results – Second Campaign**

Dear Trey,

GEH has completed analysis of the dry tube and benchmark tube filter samples shipped from site. This letter presents the following:

- The filter analysis process and steps added to it for this project are described.
- The benchmark and dry tube platinum (Pt) deposition scrape results obtained from the filters are tabulated.
- The benchmark wet chemistry and scrape results are compared, yielding a collection efficiency for the BWRVIP tool at relatively low Pt deposition values.
- The expected dry tube Pt deposition is calculated based on the scrape results and the collection efficiency.

Filter Analysis Process

After the first round of filter analysis showed significant variation in results, GEH did a thorough evaluation of the filter digestion process. The filters are digested by putting them in Teflon tubes with nitric and hydrofluoric acid, then enclosing the tube in a vessel which undergoes microwave heating to promote filter digestion in the hot acid. The Teflon tubes had been previously used for fuel scrape work, and it was determined that the cleaning process was not complete, which could introduce significant variations at the low levels of Pt being evaluated on the dry tube filters. A new set of Teflon tubes was purchased and a more aggressive cleaning solution was formulated. Then several checks were performed before digesting any of the latest filters:

1. The new Teflon tubes were cleaned before first use – no Pt measured in the solution afterward.

2. Several Millipore filters, the same as used by RSI, were digested with the acid/microwave process – no Pt measured in the solution afterward.

3. A Pt recovery test was run – a known amount of a Pt standard was added to the filter and acid before digestion. The Pt added covered a range equivalent to a scrape deposit of 0.01-0.1 μg/cm² in four different tests. The recovery percentages were 96%, 99%, 110% and 133%, which is quite good for this type of test.

4. The filter analysis process was expanded so that after a filter was digested and analyzed, the Teflon tube would be cleaned and the cleaning solution would be analyzed. If any Pt were found, that Pt would be added to the filter result.

Benchmark Tube and Dry Tube Filter Pt Results

With these preparations complete, the filters from benchmark tube B3 were analyzed, showing reasonably consistent results. Based on that, the remaining benchmark tube filters and the dry tube filters were analyzed. The scrape results, in μg/cm² for the scrape areas, are presented in Table 1. Based on a limit of reliable detection of Pt at 0.1 ppb in the ICPMS, the lowest deposition quantity reported in Table 1 is 0.003 μg/cm², with anything lower reported as <0.003 μg/cm². The Pt concentrations in all of the water samples taken had <0.1 ppb Pt, so there was no adjustment for water "contamination" made to the scrape results in the table. The scrape IDs refer to scrapes with the stone (S) and scrapes with the brush (B).

Table 1. Benchmark and Dry Tube Scrape Filter Pt Results

Scrape ID	Distance from Top of Tube, cm (in)	Pt loading, μg/cm²
B3-1S	NA	0.015
B3-2B	NA	0.005
B3-2S	NA	0.008
B3-3S	NA	0.047
B4-1S	NA	0.050
B4-2B	NA	0.004
B4-2S	NA	0.023
B4-3S	NA	0.007
D1-1S	126 (49.5)	0.012
D1-2B	116 (45.5)	0.005
D1-2S	116 (45.5)	0.005
D1-3S	41 (16)	0.004
D2-1S	126 (49.5)	0.007
D2-2B	116 (45.5)	<0.003
D2-2S	116 (45.5)	<0.003
D2-3S	47 (18.5)	0.005
D3-1S	126 (49.5)	<0.003
D3-2B	116 (45.5)	<0.003
D3-2S	116 (45.5)	<0.003
D3-3S	41 (16)	<0.003
D3-4S	Bad Scrape	NA
D3-5S	197 (77.5)	<0.003

Benchmark Tube Evaluation

The scrape results for the benchmark tubes are considerably lower than the Pt deposition results obtained by the standard GEH wet chemistry method of acid stripping the oxide off of the tubing surface. Since the benchmark tubes were returned from Grand Gulf with the scrape filters, it was decided to obtain additional wet chemistry results from between the scrape locations. The results are shown in Figure 1.

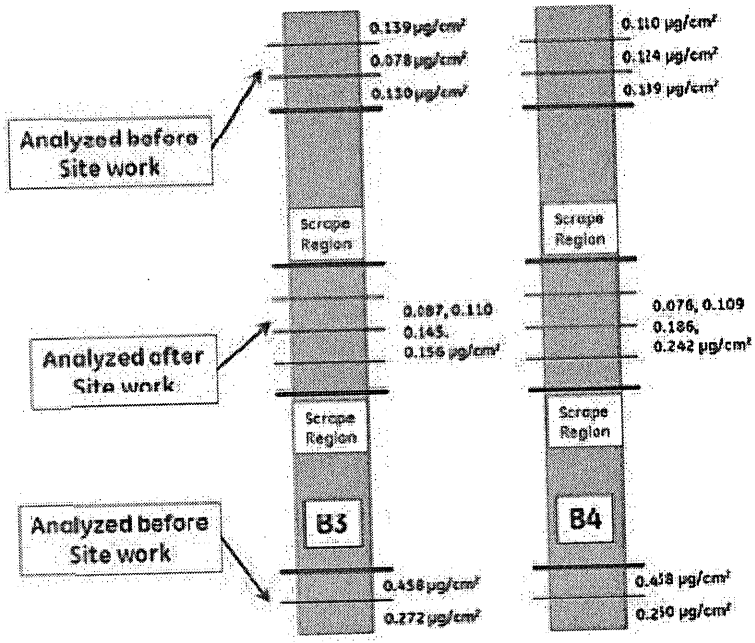

Figure 1. VNC Wet Chemistry Benchmark Tube Pt Analysis Results

The wet chemistry results show variation which is thought to be due to how the Pt solution flowed into the autoclave that held the benchmark tubes during their OLNC application. The benchmark tube scrapes also show variation, but there is not enough configuration information available to determine whether the high scrape results correlate with the high wet chemistry results. It is clear from the benchmark tube results, however, that at these low levels of Pt deposition the BWRVIP tool recovered a fairly low fraction of the total. Therefore, a collection efficiency for the tool was calculated from the benchmark results, and the inverse of it, called the recovery factor, was applied to the dry tube results.

A statistical analysis of the wet chemistry results was done as part of the BWRVIP report on this subject. The conclusion was that the Pt deposition values from the top and center of the tubes are equivalent and the values from the bottom of the tubes are a different, higher population. Therefore, the top and middle Pt deposition results were averaged for the overall wet chemistry Pt deposition value of 0.134 µg/cm². For the benchmark scrape samples, the brush and stone sample for scrape #2 were added together as one result. The six scrape results from tubes B3 and B4 averaged 0.026 µg/cm² Pt deposition. Using the two averages, the BWRVIP tool collection efficiency was 19.6% and the inverse factor to be applied to the dry tube scrape results is 5.11.

Expected Dry Tube Pt Deposition

The corrected values of Pt deposition for the IRM/SRM dry tubes are shown in Table 2. For the #2 samples where a brush and scrape were done, the filter values are added together and the total is multiplied by the 5.11 factor described above. As an additional step in the statistical analysis done for the BWRVIP report, the uncertainty in the scrape analyses at the 95% confidence interval, ±55%, was propagated to the corrected values.

Table 2. Corrected Dry Tube Pt Deposition Based on BWRVIP Tool Collection Efficiency

Scrape ID	Filter Pt Loading (μg/cm2)	Corrected Dry Tube Pt Loading (μg/cm2)	Dry Tube Pt Loading Uncertainty (±μg/cm2)
D1-1S	0.012	0.06	0.03
D1-2B	0.005	0.05	0.03
D1-2S	0.005		
D1-3S	0.004	0.02	0.01
D2-1S	0.007	0.04	0.02
D2-2B	<0.003	<0.015	NA
D2-2S	<0.003		
D2-3S	0.005	0.03	0.01
D3-1S	<0.003	<0.015	NA
D3-2B	<0.003	<0.015	NA
D3-2S	<0.003		
D3-3S	<0.003	<0.015	NA
D3-4S	Bad Scrape	NA	NA
D3-5S	<0.003	<0.015	NA

Of the four IRM/SRM dry tubes removed from the core, two were somewhat centrally located and two were closer to the periphery of the core. IRM/SRM tubes D1 and D2 show more Pt than D3, which may indicate that they were centrally located tube. The Pt values are higher at the #1 location, ~6 feet below the top guide, than they are at the #3 location, ~3 feet below the top guide. This deposition trend is consistent with the scenario that Pt is depleted from the water as it flows past surfaces where Pt deposits. Of course, at these low Pt values the trend could also be a coincidence in the variation of the results.

Evaluation of Results

If the OLNC process is considered a once-through process, meaning that all the Pt in the reactor water deposits after one circulating cycle through the reactor and core, then the dry tubes are near the end of that circulation cycle. Figure 2 shows schematically the water flow path after the Pt chemical is injected in the feedwater.

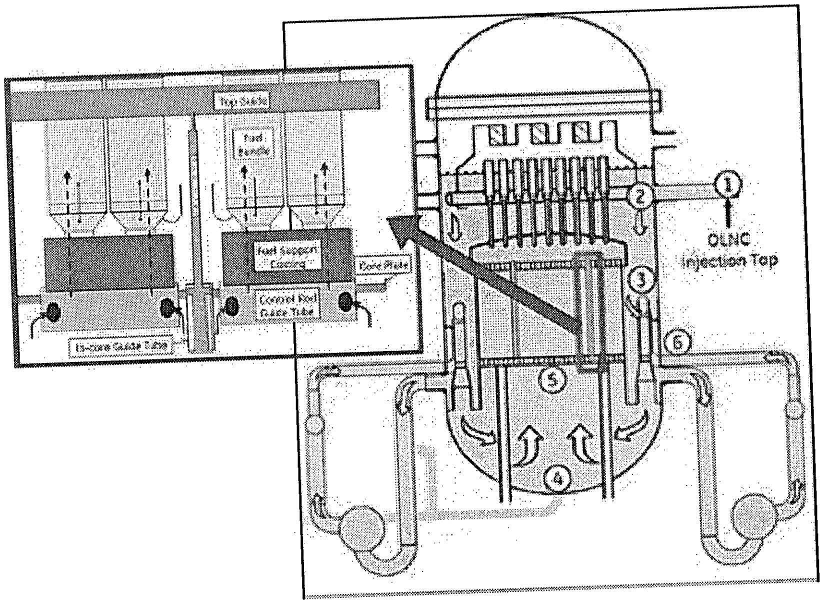

Figure 2. Schematic of Pt Flow to Dry Tubes During OLNC Application

The feedwater flow, which carries the highest concentration of Pt, is mixed with carryunder flow from the steam separator and dryer. The mixture proceeds from the upper vessel into the shroud annulus, where about two-thirds of it is driven into the bottom head through the jet pumps. The other one-third flows through the recirculation piping and into the bottom head as drive flow in the jet pumps. The bottom head water enters the fuel bundles through holes in the control rod guide tubes just below the core plate. Most of the water entering the fuel bundles flows up and between the fuel rods, but about 10% of it exits flow holes and gaps in the bundle lower tie plates and enters the bypass region between the bundles, which is where the dry tubes are located. Qualitatively, the Pt deposition on the dry tubes is expected to be comparable to that of the top guide and shroud inside surface, and low compared to that of all other reactor internal surfaces, which are "upstream" in the flow path. However, based on the low corrected results in Table 2, further in-vessel measurements by the BWRVIP are needed, and should be encouraged.

The GE Global Research Center (GRC) has done extensive work on the effectiveness of OLNC to mitigate stress corrosion cracking (SCC). Figure 3 shows GRC laboratory work where stainless steel specimens were prepared with varying amounts of OLNC-deposited Pt. The ECP of the specimens in high temperature water with excess hydrogen conditions (molar ratio (MR) of hydrogen to oxygen greater than two, in this case 2.5) was measured, resulting in the data points in the figure. The line shown is a judgment fit to the data points, so there is no extrapolation to deposition $<0.02\ \mu g/cm^2$. In addition, it should be noted that the results in the figure for $Pt<0.04\ \mu g/cm^2$ where the specimens are only partially catalytic are dependent on the oxygen content of the water.

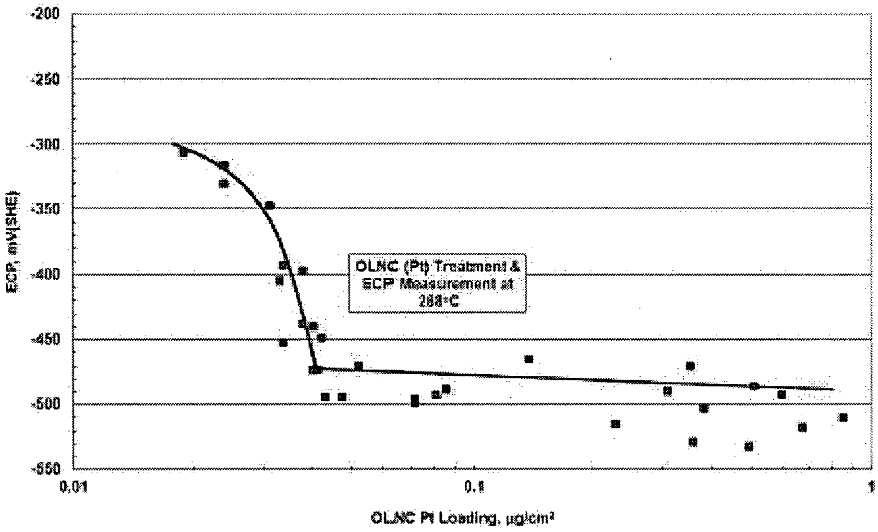

Figure 3. GRC Test Results of ECP Response of Stainless Steel vs. OLNC Pt Deposition

Mitigation of SCC is a continuum as a function of ECP, but the industry uses -230 mV(SHE) as the maximum limit for effective mitigation. The ECP is <-230 mV(SHE) even at Pt deposition levels in Figure 3 as low as 0.02 µg/cm². Similar results have been seen at two plants that have measured the catalytic ECP of the MMS ECP manifold by adding 50-100 ppb dissolved oxygen (DO) to the MMS supply water to assure a MR of 3-5. At one plant, the MMS coupon deposition was 0.01 µg/cm² and the ECP during the OLNC application was -300 mV(SHE). At the other plant, the MMS coupon deposition was 0.03 µg/cm² and the ECP during the OLNC application was -330 mV(SHE).

Summary

The Grand Gulf dry tube Pt deposition evaluation is summarized in the following points:

- Due to the MMS being inoperable, Grand Gulf decided to perform scrape sampling of dry tubes as in-vessel artifacts, an alternative allowed by BWRVIP guidance for noble metal mitigation monitoring.
- The dry tube scrape filters yielded Pt deposition results of <0.003-0.012 µg/cm². However, benchmark tube results demonstrated that the filter collection efficiency was 19.6%. The corrected Pt deposition results for the dry tubes were <0.015-0.06 µg/cm². These results are consistent with MMS coupon deposition results from other OLNC plants.
- Given the reactor water flow path from the OLNC injection point in the feedwater to the dry tubes, it is expected that the top guide and shroud inside surface would have comparable deposition and all other reactor internals and piping would have higher Pt deposition than the dry tube results.
- Based on the study of ECP and Pt deposition performed by GRC, surfaces with ≥0.04 µg/cm² would be fully catalytic, with ECP of -480 mV(SHE). ECP and MMS coupon data from one plant that measured ECP during DO addition suggest that catalytic ECP may be <-230 mV(SHE) for Pt deposition ≥0.01 µg/cm². However, the oxygen concentration in the water, in this case 50-100 ppb, affects the ECP result.

The low Pt deposition results on the dry tubes make a blanket judgment of reactor internals mitigation difficult. The detected levels are expected to be enough for catalytic mitigation, but one dry tube had

less than detectable results for all three scrapes. On the plus side, the dry tubes (and shroud ID and top guide) are at the end of the circulatory flow path relative to the feedwater spargers where Pt and H_2 enter the reactor, so O_2 and ECP may be significantly reduced in the core bypass and outer core bypass regions due to reactor water contacting the large catalytic surface area of housings and guide tubes below the core plate. In the relatively low flow regions like the bypass regions, Pt deposition is expected to increase as operating time and the number of OLNC applications increase.

GEH has recommended to the BWRVIP that more in-vessel Pt measurements be made. Entergy should encourage the BWRVIP to make such measurements a higher priority. Specific to Grand Gulf, GEH is developing an injector quill designed to reduce the amount of Pt that deposits in the feedwater piping near the injection taps, thereby increasing Pt available to deposit on reactor internal surfaces. Grand Gulf has had injection tap blockage issues, which the injector quills are also designed to prevent. Addition of injector quills during the next refueling outage should be considered, and can be discussed in the near future when convenient.

If you have any questions, please do not hesitate to contact me.

Regards,

T.A. Caine

Tom Caine
Manager, Chemistry & Materials