April 9, 2005

Mr. Alex Marion, Senior Director
Engineering/Nuclear Operations Division
Nuclear Energy Institute
1776 I Street, NW Suite 400
Washington, DC 20006-3708

SUBJECT: MATERIALS DEGRADATION MATRIX

Dear Mr. Marion:

By letter dated November 3, 2004, the Nuclear Energy Institute (NEI) indicated that a significant milestone was recently achieved under the NEI 03-08 materials initiative with the development of a Materials Degradation Matrix (MDM). The purpose of the MDM is to address materials degradation in a top down fashion to ensure that all potential degradation that may affect materials used in primary systems are identified. The November 3, 2004, letter (ML043220011) provided Revision 0 of the MDM (ML043220014) for information and welcomed input from the Nuclear Regulatory Commission materials experts.

Materials experts from the Office of Nuclear Reactor Regulation and the Office of Nuclear Regulatory Research have reviewed the MDM and developed the attached comments. Overall, we find the MDM provides a suitable structure for the industry's top down approach to identifying potential degradation. We found no major omissions in the systems that you considered; however, we are providing some questions to consider on certain matrix cell determinations, and we have a number of comments that may assist in clarifying the document.

As we continue to work on the Proactive Materials Degradation Assessment Phenomenon Identification and Ranking Table and compare our results to the MDM, we will provide additional comments, as appropriate.

Sincerely,

/RA/

Michael E. Mayfield, Director
Division of Engineering
Office of Nuclear Reactor Regulation

Enclosure: As stated

cc: J. Riley, NEI

Mr. Alex Marion, Senior Director
Engineering/Nuclear Operations Division
Nuclear Energy Institute
1776 I Street, NW Suite 400
Washington, DC 20006-3708

SUBJECT: MATERIALS DEGRADATION MATRIX

Dear Mr. Marion:

By letter dated November 3, 2004, the Nuclear Energy Institute (NEI) indicated that a significant milestone was recently achieved under the NEI 03-08 materials initiative with the development of a Materials Degradation Matrix (DM). The purpose of the DM is to address materials degradation in a top down fashion to ensure that all potential degradation that may affect materials used in primary systems are identified. The November 3, 2004, letter (ML043220011) provided Revision 0 of the DM (ML043220014) for information and welcomed input from Nuclear Regulatory Commission materials experts.

Materials experts from the Office of Nuclear Reactor Regulation and the Office of Nuclear Regulatory Research have reviewed the DM and developed the attached comments. Overall, we find the DM provides a suitable structure for the industry's top down approach to identifying potential degradation. We found no major omissions in the systems that you considered; however, we are providing some questions to consider on certain matrix cell determinations, and we have a number of comments that may assist in clarifying the document.

As we continue to work on the Proactive Materials Degradation Assessment Phenomenon Identification and Ranking Table and compare our results to the MDM, we will provide additional comments, as appropriate.

Sincerely,

/RA/

Michael E. Mayfield, Director
Division of Engineering
Office of Nuclear Reactor Regulation

Enclosure: As stated

cc: J. Riley, NEI

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NRC Comments on Materials Degradation Matrix (MDM), Revision 0

1. Flow-accelerated corrosion is listed as a mechanism in the second level of the MDM. In the Mechanism Information Summaries, this degradation mechanism is described as erosion and erosion-corrosion. We suggest that this difference be rectified for consistency.

2. Link e010 applies to carbon and low-alloy steel (C&LAS) and C&LAS welds for pressurized water reactor (PWR) and boiling water reactor (BWR) reactor pressure vessels. This link notes a concern regarding a "flux effect" being addressed by the Materials Reliability Project Reactor Pressure Vessel Issue Task Group. We believe it would be appropriate to expand on the "flux effect" by discussing it in the appropriate section of the Mechanism Information Summaries.

3. It is not clear what additional Research and Development (R&D) work is being performed to address intergranular stress corrosion cracking degradation associated with 600MA tubes. We recommend that the report clarify the nature of this work.

In the link for 600MA tubes under intergranular stress corrosion cracking degradation there was no mention of mitigative measures. However, for 600sen the link e065 indicates that mitigative measures provide some improvement. We suggest clarification of what these mitigative measures are and whether they would provide a similar improvement for 600MA.

4. It is not clear what additional R&D work is being performed to address primary water stress corrosion cracking degradation associated with 600sen tubes. We recommend that the report clarify the nature of this work.

5. In section 5.2 of the Mechanism Information Summaries, page 23, C&LAS is listed as a steam generator (SG) tubing material. Since SG tubing in the U.S. is made of nickel-based alloys, this entry needs to be corrected.

6. Section 5.1 of the Mechanism Information Summaries notes that SG tubing is potentially affected by thermal aging induced fracture toughness reduction. This appears to be an incorrect entry.

7. On page 5 of the MDM - Second Level, it is not clear why "irradiation assisted" is listed as "applicability uncertain" for the PWR SG Shell SS welds and clad and Ni-base welds, which should not experience irradiation.

8. On page 8 of the MDM - Second Level, thermal aging is listed as an applicable mechanism for BWR pressure vessel wrought Ni alloys and Ni-based welds and clad and as an applicability uncertain mechanism for BWR internals made of wrought Ni alloys and Ni-based welds and clad. On page 4 and 5 of the MDM - Second Level, thermal aging is listed as "not applicable" for these materials in PWR pressure vessels and PWR internals. The reason for this difference is unclear since the temperatures in PWRs are generally higher than in BWRs.

ENCLOSURE

9. The Second Level footnotes explain the abbreviations for various degradation mechanisms. On pages 4 and 5 the abbreviation Th_n is used but not explained. Please explain this abbreviation and the difference between Th_n and Emb, for example, in terms of neutron energy.

This term, Th_n, is not used on corresponding pages 8 and 9 for BWRs. Should it be used there also?

10. We suggest that a discussion of experience with baffle former bolting be added to Chapter 4 on the Wrought Stainless Steel (SS) section of the Materials Information Summaries.

11. We recommend that a discussion of clad underbead cracking be added to Chapter 5 on the SS Welds and Clad section of the Materials Information Summaries. References for the discussion would include topical reports WCAP-15338, "A Review of Cladding Associated with Weld Deposited Cladding in Operating PWR Plants," and BAW-2274, Appendix C to BAW-2251, "Demonstration of the Management of Aging Effects for the Reactor Vessel."

12. This comment pertains to the links in the Second Level tables.

a. Link e020 pertains to rubbing marks/wear observed during inservice inspection (ISI) of vessel flange and core support lug areas. However, this link is provided in the Second Level MDM block under corrosion and wear for PWR SG shells and pressurizers for SS welds and clad. It is not clear why link e020 would apply to these components.

b. On page 7 of the MDM - Second Level, thermal aging is listed as applicability uncertain for SG tubing. Our knowledge would lead us to conclude that thermal aging is not applicable to SG tubing. Also, the links e067 and e079 for thermal aging in SG tubing do not appear to pertain to thermal aging.

c. On the second level tables there is a mixture of links and parenthetical notes in the first column, or component column.

For PWR Reactor Pressure Vessel link e001 says "includes stainless steel and nickel-base penetrations such as stub tubes, BMIs [bottom mounted instruments] and pressurizer penetrations."

For BWR Reactor Pressure Vessel there is a parenthetical note that says "includes stainless steel and Ni-base penetrations."

We recommend using links for all components where applicable instead of parenthetical notes, including examples like those in link e001; removing pressurizer penetrations from link e001 since these penetrations are not relevant to the PWR Reactor Pressure Vessel component; and addressing instrument penetrations for each component, where applicable, in the recommended links.

d. We recommend a comprehensive review of the links be performed for consistency with the cells in which they appear.

13. The last line of page 76 of section 8.6 of the Mechanism Information Summaries is cut off. We recommend correcting this omission.