


United States Nuclear Regulatory Commission Official Hearing Exhibit	
In the Matter of:	Entergy Nuclear Operations, Inc. (Indian Point Nuclear Generating Units 2 and 3)
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IMPLEMENTATION REQUIREMENTS

The purpose of this section is to summarize the implementation requirements of these guidelines. These guidelines do not reduce, alter, or otherwise affect current ASME B&PV Code Section XI or plant-specific licensing inservice inspection requirements.

7.1 NEI 03-08 Implementation Protocol

These guidelines are a ‘work product’ of the EPRI MRP, an ‘Issue Program (IP)’ as defined in NEI 03-08 [1]. Addendum D to NEI 03-08, Implementation Protocol, defines the processes and expectations for implementing industry guidance issued under the Materials Initiative, and requires that IPs identify the specific implementation category for ‘requirements’ identified guideline-type work products.

The three implementation categories described in NEI 03-08 are as follows:

- Mandatory – to be implemented at all plants where applicable;
- Needed – to be implemented wherever possible, but alternative approaches are acceptable; and
- Good Practice – implementation is expected to provide significant operational and reliability benefits, but the extent of use is at the discretion of the individual utility.

Sections 7.2 through 7.6 list or summarize the requirements contained in this document. A failure to meet a Needed or a Mandatory requirement is a deviation from the guidelines and a written justification for the deviation must be prepared and approved as described in Addendum D to NEI 03-08 [1]. A copy of the deviation is sent to the MRP so that improvements to the guidelines can be developed.

7.2 Aging Management Program Requirement

Mandatory: *Each commercial U.S. PWR unit shall develop and document a PWR reactor internals aging management program (AMP) within thirty-six months following issuance of MRP-227-Rev. 0.*

Appendix A describes each of the attributes that comprise an acceptable AMP.

MRP-227-Rev. 0 is the first published version of these guidelines.

7.3 Reactor Internals Guidelines Implementation Requirement

Needed: *Each commercial U.S. PWR unit shall implement Tables 4-1 through 4-9 and Tables 5-1 through 5-3 for the applicable design within twenty-four months following issuance of MRP-227-A.*

Implementation of these guidelines is to take effect 24 months following issuance of MRP-227-A. MRP-227-A is the version that will have incorporated the changes proposed by the MRP in response to U.S. Nuclear Regulatory Commission (NRC) Requests for Additional Information, recommendations in the NRC Safety Evaluation and other necessary revisions identified since the previous publication of the report.

Earlier implementation may be required by plant-specific regulatory commitments (for example, license renewal approvals). Plants implementing these guidelines prior to the issuance of the “NRC-approved” version would thus implement the requirements in accordance with the current published version of these guidelines.

7.4 Examination Procedures Requirement

Needed: *Examinations specified in these guidelines shall be conducted in accordance with the Inspection Standard [3].*

7.5 Examination Results Requirement

Needed: *Examination results that do not meet the examination acceptance criteria defined in Section 5 of these guidelines shall be recorded and entered in the plant corrective action program and dispositioned.*

7.6 Aging Management Program Results Requirement

Good Practice: *Each commercial U.S. PWR unit should provide a summary report of all inspections and monitoring, items requiring evaluation, and new repairs to the MRP Program Manager within 120 days of the completion of an outage during which PWR internals are examined. The MRP template should be used for the report.*

This summary of the results will be compiled into an overall industry report which will track industry progress, aid in evaluation of significant issues, identification of fleet trends and determination of any needed revisions to these guidelines. The industry report will be updated biennially for the benefit of the fleet, the regulator, the PWROG and other industry stakeholders. This biennial report will serve to assist in review of operating experience, and required monitoring and trending for aging management programs established by the industry. In order to ensure completeness and consistency of reporting, the MRP will provide a template listing the requested information.

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REFERENCES

1. Appendix D: Materials Guidelines: Implementation Protocol, in “*Guidelines for the Management of Materials Issues*,” NEI 03-08, Nuclear Energy Institute, Washington, DC, Latest Edition.
2. ASME Boiler & Pressure Vessel Code, Section XI, Division 1, “*Rules for Inservice Inspection of Nuclear Power Plant Components*,” American Society of Mechanical Engineers, New York, NY, 2001 Edition, Plus 2003 Addenda, or later.
3. *Materials Reliability Program: Inspection Standard for Reactor Internals (MRP-228)*. EPRI, Palo Alto, CA: 2009. 1016609.
4. 10 CFR 50.55a – Codes and Standards, Title 10 (Energy), Part 50 (Domestic Licensing of Production and Utilization Facilities) of the Code of Federal Regulations, U.S. Nuclear Regulatory Commission, Washington, DC, 2005.
5. *Materials Reliability Program: Framework and Strategies for Managing Aging Effects in Reactor Internals (MRP-134)*. EPRI, Palo Alto, CA: 2005. 1008203.
6. *Materials Reliability Program: Characterization of Decommissioned PWR Vessel Internals Material Samples – Material Certification, Fluence, and Temperature (MRP-128)*. EPRI, Palo Alto, CA: 2003. 1008202.
7. *Materials Reliability Program: PWR Internals Material Aging Degradation Mechanism Screening and Threshold Values (MRP-175)*. EPRI, Palo Alto, CA: 2005. 1012081.
8. *Materials Reliability Program: Screening, Categorization, and Ranking of B&W-Designed PWR Internals (MRP-189-Rev. 1)*. EPRI, Palo Alto, CA: 2009. 1018292.
9. *Materials Reliability Program: Failure Modes, Effects, and Criticality Analysis of B&W-Designed PWR Internals (MRP-190)*. EPRI, Palo Alto, CA: 2006. 1013233.
10. *Materials Reliability Program: Screening, Categorization and Ranking of Reactor Internals of Westinghouse and Combustion Engineering PWR Designs (MRP-191)*. EPRI, Palo Alto, CA: 2006. 1013234.
11. *Materials Reliability Program: Functionality Analysis for B&W Representative PWR Internals (MRP-229)*. EPRI, Palo Alto, CA: 2008. 1016598.
12. *Materials Reliability Program: Functionality Analysis for Westinghouse and Combustion Engineering Representative PWR Internals (MRP-230)*. EPRI, Palo Alto, CA: 2008. 1016597.
13. *Materials Reliability Program: Aging Management Strategies for B&W PWR Internals (MRP-231)*. EPRI, Palo Alto, CA: 2008. 1016592.
14. *Materials Reliability Program: Aging Management Strategies for Westinghouse and Combustion Engineering PWR Internals (MRP-232)*. EPRI, Palo Alto, CA: 2008. 1016593.

References

15. Letter to Reactor Internals Focus Group from MRP, Subject: *Minutes of the Expert Panel Meetings on Expansion Criteria for Reactor Internals I&E Guidelines*, MRP 2008-036 (via email), June 12, 2008.
16. *ASME Boiler & Pressure Vessel Code, Section V, Nondestructive Examination*, American Society of Mechanical Engineers, New York, NY, 2004 Edition, July 1, 2004.
17. *Nondestructive Evaluation: Evaluation of Remote Visual Examination Methods*. EPRI, Palo Alto, CA: 2006. 1013537.
18. Topical Report BAW-2248A, "Demonstration of the Management of Aging Effects for the Reactor Vessel Internals," March 2000.
19. *BWRVIP-100-A: BWR Vessel and Internals Project, Updated Assessment of the Fracture Toughness of Irradiated Stainless Steel for BWR Core Shrouds*. EPRI, Palo Alto, CA: 2006. 1013396.
20. *ASME Boiler & Pressure Vessel Code, Section XI, Division 1, Nonmandatory Appendices, Appendix C, "Evaluation of Flaws in Austenitic Piping,"* American Society of Mechanical Engineers, New York, NY, 2004 Edition, July 1, 2004.
21. *ASME Boiler & Pressure Vessel Code, Section III, Division 1, Nonmandatory Appendices, Appendix F, "Rules for Evaluation of Service Loadings With Level D Service Limits,"* American Society of Mechanical Engineers, New York, NY, 2004 Edition, July 1, 2004.
22. *Materials Reliability Program: Fracture Toughness Evaluation of Highly Irradiated PWR Stainless Steel Internal Components (MRP-210)*. EPRI, Palo Alto, CA: 2007. 1016106.
23. *BWR Vessel and Internals Project, Evaluation of Crack Growth in BWR Stainless Steel Reactor Pressure Vessel Internals (BWRVIP-14)*. EPRI TR-105873, EPRI, Palo Alto, CA: 1996.
24. *BWRVIP-99: BWR Vessels and Internals Project, Crack Growth Rates in Irradiated Stainless Steels in BWR Internal Components*. EPRI TR-1003018, EPRI, Palo Alto, CA: 2001.
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A

AGING MANAGEMENT PROGRAM ATTRIBUTES

A.1 Program Description

An aging management program based upon inspection and evaluation in conformance with the Materials Reliability Program (MRP) Inspection & Evaluation (I&E) guidelines (hereafter referred to as “the I&E guidelines”) for PWR internals is intended to ensure the long-term integrity and safe operation of these components. In the following paragraphs, each of the ten attributes that comprise an acceptable aging management program are described, as given in NUREG-1801 [A1]. Some early license renewal plants have committed to an earlier version of the Generic Aging Lessons Learned (GALL) report (Revision 0) that describes the attributes for PWR internals specifically. Revision 1 of the GALL report [A1] does not specifically provide an AMP for PWR internals.

The attributes for an AMP are summarized in Table A-1 and meet the intent of either version of the GALL for PWR internals. The extent to which the requirements and information contained in the I&E guidelines constitute satisfaction of a particular attribute is then discussed. In some cases, such as Attribute 1 (Scope of the Program), Attribute 3 (Parameters Monitored/Inspected) and Attribute 4 (Detection of Aging Effects), the I&E guidelines provide complete satisfaction of the GALL requirements. In other cases, supplementary information must be assembled by the utility to satisfy all of the remaining GALL aging management program requirements. The supplementary information requirements are identified in this appendix. Additional information on some of the attributes is provided in the text of the I&E guidelines.

A.2 Evaluation and Technical Basis

1. Scope of Program

The I&E guidelines for PWR internals provide generic requirements that help utilities assure functional integrity of safety-related PWR internals. The scope of the I&E guidelines covers internals in all commercial operating U.S. PWR nuclear power plants. The scope does not include consumable items such as fuel assemblies, reactivity control assemblies, and nuclear instrumentation. The scope also does not include welded attachments to the reactor vessel.

The I&E guidelines include:

- summary descriptions of PWR internals and functions;
- summary of the categorization and aging management strategy development of potentially susceptible locations, based on the safety and economic consequences of aging degradation;
- guidance for methods, extent, and frequency of one-time, periodic, and conditional examinations and other aging management methodologies;
- acceptance criteria for the one-time, periodic, and conditional examinations and other aging management methodologies;
- methods for evaluation of aging effects detected by the aging management methodologies that exceed the examination acceptance criteria; and
- requirements for implementation of the I&E guidelines.

The PWR internals are separated into four groups: Primary components; Expansion components; Existing Programs components; and No Additional Measures components. Definitions of these groups are included in Section 3.

Details of the generic requirements for the PWR internals aging management program are provided in the I&E guidelines only for the Primary and Expansion groups. Existing Programs to be continued throughout the license renewal term are covered briefly.

2. **Preventive Actions:** The I&E guidelines do not specify any preventive actions other than their applicability limitations to base-loaded plants. However, the guidelines do rely on PWR water chemistry control to manage SCC and reduce the impact of IASCC. Therefore, an important adjunct to the aging management methodologies described by the I&E guidelines is PWR water chemistry control. The water chemistry program for PWRs relies on monitoring and control of reactor water chemistry as presented in Chapter XI.M2, "Water Chemistry," of NUREG-1801, Volume 2 [A1].
3. **Parameters Monitored/Inspected:** The program monitors the effects of eight aging degradation mechanisms on the intended function of PWR internals through one-time, periodic, and conditional examinations, and other aging management methodologies, as needed, in accordance with the ASME Code, Section XI [A2], which provides established criteria, and the Preventive Maintenance Management Program (PMMP) approved I&E guidelines for PWR internals. The eight aging degradation mechanisms, and their associated effects, are described in Section 3.

The program contains elements that monitor and inspect for the parameters that govern the progress of each of these effects. Section 4 of the I&E guidelines for PWR internals describes the methodologies that provide the monitoring and inspection of these effects.

4. **Detection of Aging Effects:** The aging management methodologies described in Section 4 of the I&E guidelines for PWR internals are based on either existing inservice examinations required by the ASME Code, Section XI [A2], or on well-documented and well-demonstrated examination methods with which the industry has considerable experience. For example, the industry has considerable experience with the volumetric examination by

ultrasonic testing (UT) of PWR internals bolts, pins, and fasteners, such as baffle-former bolting in B&W and Westinghouse units. The extent of this experience and the capability of the UT methods used has been documented in the Inspection Standard [A3] that supports the implementation of the I&E guidelines for PWR internals. This document will be used by utilities to support the Technical Justifications that are needed for examination method demonstrations, in accordance with the requirements of the ASME Code, Section V, Article 14 [A4]. Based upon this supporting documentation, the methods, coverage, and schedule of the inspection and test techniques prescribed by the ASME Code, Section XI, and the PMMP approved I&E guidelines for PWR internals are intended to maintain structural integrity and ensure that the detection and correction of aging effects before the loss of intended function of PWR internals.

5. **Monitoring and Trending:** One-time, periodic, and conditional examinations and other aging management methodologies, scheduled in accordance with the ASME Code, Section XI [A2], which provides established criteria, and the I&E guidelines for PWR internals, provide timely detection of aging effects. In addition to the Primary components, Expansion components have been defined should the scope of examination and re-examination need to be expanded beyond the Primary group, should significant effects be detected.
6. **Acceptance Criteria:** Section 5 of the I&E guidelines for the PWR internals provides the examination acceptance criteria for the Primary and Expansion components. In addition, the criteria for expanding the examinations from the Primary components to include the Expansion components are provided. The examination acceptance criteria include: (i) specific, descriptive relevant conditions for the visual (VT-3) examinations; (ii) requirements for recording and dispositioning surface breaking indications that are detected and sized for length by the visual (VT-1/EVT-1) examinations; and (iii) requirements for system-level assessment of bolted or pinned assemblies with unacceptable volumetric (UT) examination indications that exceed specified limits. Any detected condition that does not satisfy these examination acceptance criteria must be dispositioned. Example methodologies that can be used to analytically disposition unacceptable conditions are discussed or referenced in Section 6 of the I&E guidelines. However, other demonstrated and verified alternatives to the Section 6 methodologies may be used.
7. **Corrective Actions:** Corrective actions following the detection of unacceptable conditions are fundamentally provided for in each plant's corrective action program (CAP). Additional guidance for disposition of unacceptable conditions for PWR internals may be found in the ASME Code, Section XI; in the PMMP-approved I&E guidelines for PWR internals; and in reports referenced therein or demonstrated through an appropriate technical justification. Section 6 of the I&E guidelines provides information on methodology that can be used for the evaluation of detected conditions that exceed the examination acceptance criteria of Section 5. In addition, the alternative of component repair and replacement procedures for PWR internals is subject to the requirements of the ASME Code Section XI. The implementation of the I&E guidelines for PWR internals, plus the implementation of any ASME Code requirements, is intended to provide an acceptable level of aging management of the safety-related components addressed in accordance with the corrective actions of 10 CFR Part 50, Appendix B [A5] or its equivalent, as applicable.

8. **Confirmation Process:** Site quality assurance procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B [A5] or their equivalent, as applicable. It is expected that the implementation of the I&E guidelines for PWR internals will provide an acceptable level of quality for inspection, flaw evaluation, and other elements of aging management of the PWR internals that are addressed in accordance with the 10 CFR Part 50, Appendix B [A5] or their equivalent (as applicable), confirmation process, and administrative controls.
9. **Administrative Controls:** The administrative controls for such programs, including their implementing procedures and review and approval processes are under existing site 10 CFR 50 Appendix B [A5] Quality Assurance Programs or their equivalent, as applicable. Such a program is thus expected to be established with a sufficient level of documentation and administrative controls to ensure effective long term implementation.
10. **Operating Experience:** Relatively few incidents of PWR internals aging degradation have been reported in operating U.S. commercial PWR plants. However, a considerable amount of PWR internals aging degradation has been observed in European PWRs, with emphasis on cracking of baffle-former bolting. For this reason, the U.S. PWR owners and operators began a program a decade ago to inspect the baffle-former bolting in order to determine whether similar problems might be expected in U.S. plants. A benefit of this decision was the experience gained with the UT examination techniques used in the inspections. In addition, the industry began substantial laboratory testing projects in order to gather the materials data necessary to support future inspections and evaluations. Several other items with existing or suspected material degradation concerns that have been identified for PWR components are wear in thimble tubes and potentially in control guide cards and observed cracking in some high-strength bolting and in control rod guide tube alignment (split) pins. The latter are conditions that have been corrected primarily through bolt replacement with less susceptible material and improved control of pre-load. The PWR Internals Programs established per the I&E guidelines will be new programs. Accordingly, there is no direct programmatic history. The program is based upon industry operating experience, research data, and vendor evaluations. Development of the program relied upon the consensus review and inputs of the MRP Reactor Internals Core and Focus Groups, which include representatives from utilities, research scientists, and vendors. This program will continue to evolve as additional experience is gained. Reactor internals failures, both domestically and internationally have been considered in the development of the I&E guidelines.

**Table A-1
Key elements of PWR internals aging management plan document**

	NRC Evaluation Attribute	PWR Internals Aging Management Plan Elements
1	Scope of Program	The scope of the program covers the internals for all currently operating commercial U.S. PWRs.
2	Preventive Actions	Preventive actions include implementation of the PWR primary coolant chemistry program.
3	Parameters Monitored/Inspected	PWR internals in the Primary and Expansion groups may include additional AMP elements, such as UT or VT-1/EVT-1 examinations; PWR internals in the Existing Programs group rely on the requirements of the ASME Code Section XI examinations, as well as other applicable items; PWR internals for which the effects of all aging degradation effects are below screening criteria or tolerated with no loss of function, require no additional aging management elements; Section 4 of the guidelines defines the parameters to be monitored and/or inspected.
4	Detection of Aging Effects	The Inspection Standard [A3] provides evidence of the capability of additional AMP elements, such as UT or VT-1/EVT-1 examinations; existing AMP elements, such as the ASME Code Section XI VT-3 examinations, are based on codified examination standards.
5	Monitoring and Trending	Monitoring may be used to define the scope or schedule for some one-time or conditional examinations or inspections. Trending of inspection results, especially for early plant inspections, will be used to determine any needed modifications to the I&E guidelines; Section 7 of the I&E guidelines describes the monitoring and trending requirements.
6	Acceptance Criteria	Section 5 of the guidelines provides the examination acceptance criteria for the AMP elements described in Section 4, Tables 4-1 through 4-6; references to applicable supporting document, such as applicable ASME Code Section XI acceptance or industry-supplied criteria, are provided for the evaluation of AMP element application results.
7	Corrective Actions	Procedures for disposition of inspection findings that exceed examination acceptance criteria are provided in Section 6 of the guidelines, as implemented by individual plant corrective action programs.
8	Confirmation Process	Reference to site quality assurance procedures and associated regulations are provided.
9	Administrative Controls	Reference to mandatory element of a site-specific PWR internals program and need for compliance with 10CFR50 Appendix B.
10	Operating Experience	Industry PWR internals operating experience is described.

A.3 References

- A1. Generic Aging Lessons Learned (GALL) Report, Volume 2, "Tabulation of Results," (NUREG-1801, Volume 2), Revision 1, U.S. Nuclear Regulatory Commission, Washington, DC: September 2005.
- A2. ASME Section XI, *Rules for Inservice Inspection of Nuclear Power Plant Components*, ASME Boiler and Pressure Vessel Code, 2001 Edition, including the 2002 and 2003 Addenda, American Society of Mechanical Engineers, New York, NY.
- A3. *Materials Reliability Program: Inspection Standard for Reactor Internals (MRP-228)*. EPRI, Palo Alto, CA: 2009. 1016609.
- A4. *ASME Boiler & Pressure Vessel Code, Section V, Nondestructive Examination*, American Society of Mechanical Engineers, New York, NY, 2004 Edition, July 1, 2004.
- A5. 10 CFR Part 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants*, Office of the Federal Register, National Archives and Records Administration, 2005.

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