

Nondestructive Evaluation: ASME Code Participation and Section XI Development in 2013

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Technical Update, July 2013

EPRI Project Managers

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PRODUCT DESCRIPTION

This work documents the participation of the Electric Power Research Institute (EPRI) Nondestructive Evaluation (NDE) Program staff at the ASME Sections XI and V Code committees for the benefit of those utilities that are unable to participate in the Code process. This report will now be published every other year instead of annually.

Background

Because some utilities are unable to participate in Code activities, this project provides a way for them to stay abreast of ASME Code activities, particularly with the Section XI Standards Committee (Nuclear In-Service Inspection). NDE Program staff members prepare Code revisions, inquiries, technical basis documents, and Code Cases for submittal to the Code's consensus process. Recent directives to the U. S. Nuclear Regulatory Commission (NRC) require the NRC staff to adopt national standards and consensus-developed programs whenever possible, which is an important incentive to participate in the Code meetings.

Objectives

- To provide technical support to Code activities that could affect utilities and to participate in the Code committee meetings

Approach

NDE Program members benefit from EPRI Code activity participation in various ways, including EPRI's impartial participation on 17 Section XI Code committees, consensus building with ASME Codes and Standards members, maintaining a continuity of issues, efficient dissemination of information, and providing research results necessary to develop and justify Code revisions. Most importantly, NDE Program members receive a direct benefit from the Code activities—these beneficial revisions and Code Cases can be incorporated into their in-service inspection programs. This report provides examples of some items that EPRI was actively involved with that will benefit utilities. Coordination is an important step in the process of revising the Code, and more than one person is responsible for or assists in the approval of Code items. Examples of EPRI research being used to directly justify and provide the basis for Code revisions and improvements include risk-informed in-service inspection and ultrasonic performance demonstration requirements.

Results and Findings

EPRI directly develops and provides supporting research for Code items. The items listed in this report are significant and will be beneficial for utilities. The total estimated savings from the risk-informed activities are estimated by the NRC to be US \$60–\$160 million during a 10-year interval. The dose savings for radiation workers range from 3000 to 7000 roentgen equivalent man (rem) (30 to 70 sievert) over the 10-year interval. Annual cost savings for the containment and insulated bolting items total \$781,000.

Applications, Value, and Use

EPRI has historically provided the technical basis for Code revisions, such as risk-informed inspections and ultrasonic performance demonstrations, which are important to utilities. In the future, the application of these technologies will also be applied to other components and processes, and other items at the code will require a technical basis that EPRI has the knowledge to provide. It will be beneficial to the EPRI membership to continue to support these activities.

It is important for EPRI to participate in and support Code activities. EPRI can provide research that is instrumental in providing the technical basis for revisions and Code. It is important that EPRI continues to cooperate with other organizations that participate in the Code to ensure that published requirements will allow nuclear power plants to operate safely. The NDE Program staff will continue to work with the Code to improve it, provide updates to utility members, and develop items that are technically sound for the utilities while they maintain their safe operation.

Keywords

American Society of Mechanical Engineers

ASME Code

In-service inspection

Nondestructive evaluation

Nondestructive examination

Section XI

ABSTRACT

Because some utilities are unable to participate in Code activities, this project provides a way for them to stay abreast of activities at ASME Code meetings. EPRI Nondestructive Evaluation (NDE) Program staff members participate in the meetings, particularly the Section XI Standards Committee (Nuclear In-Service Inspection) meetings. NDE Program staff members prepare Code revisions, inquiries, technical basis documents, and Code Cases for submittal to the Code's consensus process. Directives to the U.S. Nuclear Regulatory Commission require the regulator to adopt national standards and consensus-developed programs whenever possible, which is an important incentive to participate at Code meetings.

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INTRODUCTION

Because some utilities are unable to participate in Code activities, this project provides a way for them to stay abreast of ASME Code activities. Electric Power Research Institute (EPRI) Nondestructive Evaluation (NDE) Program staff members participate in the code activities, particularly for the Section XI Standards Committees (Nuclear In-Service Inspection). NDE Program staff members prepare Code revisions, inquiries, technical basis documents, and Code Cases for submittal to the Code's consensus process. In their standards committee activities, the NDE Program members participate, including voting, as individuals rather than as representatives of their employer or of any other organization in accordance with ASME policies. Recent directives to the U.S. Nuclear Regulatory Commission (NRC) require the NRC staff to adopt national standards and consensus-developed programs whenever possible, which is an important incentive to participate in Code activities.

NDE Program members benefit from EPRI Code participation in various ways, including impartial representation on 17 Section XI Code committees, consensus building with utility members, maintaining a continuity of issues, efficient dissemination of information, and providing research results necessary to develop and justify Code revisions. Most importantly, NDE Program members receive a direct benefit from the Code activities: these beneficial revisions and Code Cases can be incorporated into their in-service inspection programs. This report provides examples of some items that EPRI was actively involved with that will benefit utilities. Coordination is an important step in the process of revising the Code, and more than one person is responsible for or assists in the approval of Code items. Examples of EPRI research being used to directly justify and provide the basis for Code revisions and improvements include risk-informed in-service inspection (ISI) and ultrasonic performance demonstration requirements.

The following EPRI NDE staff members and their primary Code participation interests for the time period of June 2011 until June 2013 are as follows:

- John Lindberg: New plants; surface, visual, eddy current, and ultrasonic examinations; personnel certification; and in-service inspection
- Pat O'Regan: Risk-informed inspection and special processes
- Jack Spanner: Reactor vessel head penetration inspections, dissimilar metal weld inspection, UT in lieu of RT, Section V (NDE), in-service inspection, inquiries, high-density polyethylene (HDPE) pipe replacement for Class 3 systems, and steam generator tubing inspection
- Henry Stephens: Containment inspections and water-cooled systems
- Ronnie Swain: Section XI Appendix VIII performance demonstration activities and in-service inspection examinations, including examination of cast stainless steel components; austenitic, ferritic, and dissimilar metal piping welds; and Class 1 bolting
- Mike Orihuela: Ultrasonic testing (UT), UT in lieu of RT, primary piping, reactor vessel and bolting inspection, and performance demonstrations

The American Society of Mechanical Engineers (ASME) completed their realignment of the Code sections in 2009. The nuclear sections, III for nuclear construction and XI for in-service inspection have become individual standards committees, and the old standards committee, commonly referred to as the Main committee, no longer exists. Within Section XI, the subgroups and working groups remain the same. The new nuclear standards committees have their items reviewed by a new Technical Oversight Management Committee and approved by the Board on Nuclear Codes and Standards (BNCS). Other Code sections were also realigned. All the other sections will report to the Board on Pressure Technology Codes and Standards. This realignment was made to improve the efficiency of the Code, encourage international participation, and increase domestic participation.

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THE ASME SECTION XI DEVELOPMENT PROJECT

The NDE Program staff is actively involved in Section XI items related to NDE and risk-informed inspection (RII). Some of these items can result in a large cost savings for a power plant when they are implemented. The ASME Section XI Development Project identifies areas in Section XI that require revisions or enhancements, and addresses those areas by means of intent and requirement inquiries, relief requests, Code Cases, Code changes, and supporting technical justifications. It also supports codifying new items coming out of the Boiling Water Reactor Vessel Internals Project (BWRVIP), Steam Generator Management Program, Materials Action Plan Committee, Materials Reliability Program (MRP), and change initiative programs. The project also provides the coordination of Code-related NDE activities among issue program projects and in other areas identified by member utilities. For example, the project supports Code improvements for the examination of cast austenitic stainless steel and dissimilar metal welds and the examination of onlay, inlay, or overlay repair or mitigation activities.

Regulatory and Code processes are slow and not always conducive to the introduction of new ideas that can address strategic objectives. Many inspections required by Section XI or regulatory documents add considerable cost and dose burden without a commensurate safety or reliability benefit. When faced with the burden of implementing regulatory and Code requirements, utilities are underrepresented at the Code meetings and need dedicated resources to serve their interests. Meeting the burden of proof for the technical justification of alternative requirements or the elimination of exams can be onerous and not commercially viable. Code enhancement needs are identified through the BWRVIP, the MRP, the Performance Demonstration Initiative (PDI), and other nuclear utility-sponsored organizations and programs. Prior to incorporation into ASME Section XI, the new requirements must be reviewed and approved by several diverse groups and committees, and a coordinated effort is required to implement them quickly. Gary Lofthus is the primary sponsor for these activities.

Intent Technical Inquiries require an accompanying Code change and full approval through the Standards Committee, whereas Non-Intent Technical Inquiries are often used to resolve minor areas of confusion (for example, the applicability of Appendix VIII, Supplement 1) and only require the approval of the Section XI Technical Inquiry Committee before they are published and are immediately applicable.

The work performed under this project has led to the EPRI staff gaining considerable expertise in navigating the complex ASME Section XI Code process. It provides utilities with a ready source of Code-related information and develops code items beneficial to utilities. It allows technical achievements resulting from MRP, BWRVIP, and other programs to be rapidly assimilated into the Code.

One of the final steps in the technology transfer process is incorporating NDE enhancements into the in-service inspection requirements of ASME Section XI for approval in the Code of Federal Regulations (10CFR50.55a). This project exists to help ensure that this final step is accomplished.

Project Manager Records

Figure 2-1 was taken directly from the ASME Codes & Standards web page and identifies a portion of the Code actions associated with the ASME Section XI Development Project.

Hide	Record#	Subject	Created By	Most Recent Ballot#	Record Level	Actions Help
<input type="checkbox"/>	11-1365 Approved	Section XI, Appendix VIII, Supplement 14 - 2004 Edition through the 2010 Edition with the 2011 Adden...	Ryan Crane	11-2190	Board Approved	Update Post Response Delete
<input type="checkbox"/>	13-843	tbd	Ryan Crane	None	SC Proposal	Update Delete
<input type="checkbox"/>	12-830 Approved	Proposed Revision to Section XI, Appendix I, I-3200	Ryan Crane	12-2852	Board Approved	Update Post Response Delete
<input type="checkbox"/>	12-829 Approved	Appendix VIII, Article VIII-3000, paragraph VIII-3120(b) - Section XI, Division 1	Ryan Crane	13-4	Board Approved	Update Delete
<input type="checkbox"/>	12-686 Approved	Section XI - Code Case N-824, Alternate Requirements for Ultrasonic Examination of Cast Austenitic P...	Ryan Crane	12-2242	Board Approved	Update Post Response Delete
<input type="checkbox"/>	11-1918 Approved	Revise Code Case N-769-1; Roll Expansion of Class 1 In-Core Housing Bottom Head Penetrations in BWRs...	Ryan Crane	12-1569	Board Approved	Update Post Response Delete
<input type="checkbox"/>	11-1917 Approved	Revise Code Case N-730; Roll Expansion of Class 1 Control Rod Drive Bottom Head Penetrations in BWRs...	Ryan Crane	12-1569	Board Approved	Update Post Response Delete
<input type="checkbox"/>	11-1460 Approved	Section XI, Appendix I, Article I-3000, paragraph I-3200(c) - 2004 Edition with the 2005 Addenda thr...	Ryan Crane	12-698	Board Approved	Update Post Response Delete
<input type="checkbox"/>	11-1120 Approved	Section XI, Appendix VIII, Supplement 12 - 2001 Edition through the 2010 Edition with the 2011 Adden...	Ryan Crane	11-2190	Board Approved	Update Delete
<input type="checkbox"/>	10-1297 Approved	Appendix VIII, Supplement 11 - Qualification Requirements for Overlaid Piping Welds	Ryan Crane	12-698	Board Approved	Update Post Response Delete

Figure 2-1
Project manager's list from the ASME website

What follows is a brief introduction to the ASME Code development process and a description of the current projects, their associated Code committees, and their current status. For additional information, contact Ronnie Swain at 704.595.2514 or rswain@epri.com.

Code Development Process

The ASME Section XI Code development process consists of defining the required Code changes, developing the technical basis, documenting the changes and technical basis in accordance with standard Code formatting procedures, and presenting the resulting proposals to the applicable committees for approval. The following describes the steps involved in a typical Code action.

1. Proposals associated with technical NDE issues are typically initiated at the task group level, which for volumetric examination issues consists of Task Group – Appendix VIII (TG App VIII) or Task Group – Cast Austenitic Stainless Steel (TG CASS). The task groups function in an open forum. All attendees are invited to sit at the table while preliminary issues are readily exposed, discussed, and—to the extent practical—resolved.
2. The task groups report to the working group level, which for NDE issues is made up of the Working Group on Procedure Qualification and Volumetric Examination (WG PQ&VE), and the Working Group on Personnel Qualification and Surface, Visual, and Eddy Current Examination (WG PQSVET).

3. Projects approved through the working group level are subsequently presented to the Subgroup NDE (SG NDE) and the Boiler and Pressure Vessel (BPV) Standards Committee on Nuclear In-service Inspection (XI) for approval.
4. The final step is to go to the ASME Board for final approval and publishing.

The project manager for the ASME Section XI Development Project, Ronnie Swain, currently serves as Chairman for the TG App VIII and TG CASS committees and is a voting member of the WG PQ&VE and SG NDE committees. John Lindberg is chairman of the WG PQSVET, and Jack Spanner is chairman of the SG NDE.

There may be additional steps involved for items that involve both NDE and program issues. For example, the process for projects involving a change to a Section XI examination volume or surface figure are significantly more complex and time consuming because the SG NDE and SG Water-Cooled Systems (SG WCS) have joint ownership of the figures, and approval from each is required before it can be presented to the BPV Standards Committee on Nuclear In-Service Inspection (XI).

Project Activities Completed in 2012

Intent Inquiry for Section XI, Appendix I, Article I-3000, Paragraph I-3200(c) - 2004 Edition with the 2005 Addenda Through the 2010 Edition with the 2011 Addenda

The NRC Final Rule, published June 21, 2011, endorsed versions of ASME Section XI beyond the 2004 Edition. In reviewing the 2005 Addenda, it was discovered that a paragraph had been added to Appendix I, Article I-3000, pertaining to single-sided examination coverage of dissimilar metal welds, which was in direct conflict with the requirements contained in Appendix VIII, Supplement 10. The new paragraph required a qualification with all flaws on the opposite side of the weld, whereas Appendix VIII rules require at least 80% of flaws to be in the weld and butter material for any dissimilar metal weld qualification. Therefore, in November 2011, an intent inquiry was submitted to clarify that it was not the intent of the new I-3000 paragraph to contradict the existing Appendix VIII requirements. This interpretation was recently approved by the BPV Standards Committee on Nuclear In-Service Inspection in March 2012.

Revise Appendix III to Add a Cast Stainless Steel–Specific Supplement 2

Currently, Section XI requires ultrasonic (UT) examination of welds in piping to be performed according to the requirements of Appendix I and Appendix VIII. However, Supplement 9 of Appendix VIII, which is the supplement for qualification requirements for cast austenitic stainless steel (CASS), is currently being prepared. Since there are no provisions in Appendix VIII for qualification of UT techniques for CASS, Appendix VIII directs users to the requirements of Appendix III, as supplemented by Table I-2000-1 (Para. VIII-3100(c)). Unfortunately, Appendix III requirements currently consist of using amplitude-based examination techniques, which the nuclear industry no longer views as the most effective for flaw detection and characterization.

Therefore, in 2011, TG CASS took on the task of developing Code Case N-824, which was designed to add examination requirements specifically for CASS, reflecting the latest advancements in equipment and techniques that are known to provide better flaw detection in

this material. This Code Case was approved by the ASME Board in 2012. Consequently, in 2013, this project is proposing a Code change to incorporate the contents of the approved Code Case N-824 into the next revision of Section XI.

This project also recently introduced a rough draft version of the future Section XI, Appendix VIII Supplement 9, at TG CASS. The purpose of drafting this CASS qualification supplement was to help establish what unknowns still exist that must be addressed before such a supplement could be implemented. The current gaps in knowledge include:

- What is the appropriate flaw size distribution for an ultrasonic detection and sizing qualification test?
- What percentage of axially oriented flaws and circumferentially oriented flaws should be used?
- What is the appropriate flaw length and depth sizing acceptance criteria?

EPRI and other organizations are also working on development of flawed CASS samples that will be needed to conduct round-robin experiments in order to help establish the current state of the art for inspection of this material.

Intent Inquiry for Code Case N-552 and Section XI, Appendix VIII, Supplement 5 - 2004 Edition Through the 2010 Edition with the 2011 Addenda

In 2011, a utility preparing to perform Appendix VIII-qualified volumetric examinations of their reactor vessel nozzles raised some questions regarding the scanning surfaces from which they were allowed to launch the ultrasonic beam and still obtain ASME Code examination coverage. Computer modeling of the nozzle configuration indicated a requirement to scan from certain external surfaces, which were not specifically demonstrated during the technique qualification. It was determined that the current wording in Code Case N-552 and Section XI, Appendix VIII Supplement 5 might lead to varying interpretations regarding which parameters are essential during nozzle examination procedure qualifications.

As a result of the issue described above, a three-part Code inquiry was developed to establish the intent of Code Case N-552 and Appendix VIII, Supplement 5 with regard to the importance of scan surface to the qualification of UT techniques for reactor vessel nozzle examinations and to clarify the essential parameters. This inquiry was approved by the ASME Board in 2012.

Revise Code Case N-730, Roll Expansion of Class 1 Control Rod Drive Bottom Head Penetrations in BWRs - Section XI, Division 1

An NDE-related shortcoming has been identified in Code Case N-730 by the Inspection Technical Advisory Committee of the BWRVIP. A revision is needed to allow users to manufacture control rod drive housing (CRDH) UT procedure demonstration mockups without violating the Code Case in the event that the number of flaws in the mockup exceeds the minimum. Currently, Code Case N-730 states that the UT procedure demonstration mockups shall contain at least 10 surface-breaking flaws. The Code Case goes on to specify that at least 4 and no more than 6 of the 10 required flaws must be connected to the outside surface. A similar statement specifies that there must be at least 3 and no more than 5 axial flaws contained within the mockups. This means that if a user designed a mockup with more than 10 flaws, it would still be necessary to limit the number of outside surface flaws to 6 and no more than 5 axial flaws.

Code Case N-730 should not prevent users from including additional flaws that fall outside the specified range when the minimum number of flaws has been exceeded in a mockup. Additionally, this revision clarified the requirement that no planar flaws can be accepted within Region II of a CRDH.

This project first attempted to address the issues with this Code Case in an intent interpretation in late 2011; however, the Code committees felt that a Code Case revision was more appropriate. As a result, this project proposed a Code change, which was Board approved in 2012.

Revise Code Case N-769-1, Roll Expansion of Class 1 In-Core Housing Bottom Head Penetrations in BWRs – Section XI, Division 1

A revision to Code Case N-769-1 is needed to allow users to manufacture in-core monitor housing (ICMH) UT procedure demonstration mockups out of alternative materials that match the installed components. The Code Case states that the UT procedure demonstration mockups shall be fabricated from a section of type 304 or similar stainless steel. Some ICMH housings are fabricated from Alloy 600 material. Although the acoustic properties of stainless steel and Alloy 600 material are very similar, the Code Case should not preclude users from using material that more closely matches the installed component. Additionally, this revision clarifies the requirement that no planar flaws can be accepted within Region II of ICMH.

Similar to the process with Code Case N-730, the project first attempted to address these issues in an intent interpretation, but the Code committees felt that a Code Case revision was more appropriate. As a result, this project proposed a Code change, which was Board approved in 2012.

Revise Appendix VIII, Article VIII-3000, Paragraph VIII-3120(b) - Section XI, Division 1

A few years ago, an inquiry was submitted to ASME pointing out that many of the Appendix VIII supplements do not contain provisions for the sizing of axially oriented flaws. The inquiry went on to ask what techniques should be used when estimating the length or depth of an axial flaw when using a technique qualified to one of these supplements. At that time, ASME responded that the same qualified procedures, personnel, equipment, and essential variables qualified for the sizing of circumferential flaws should be used for the sizing of axial flaws. This inquiry response was later incorporated as a Code change to Article VIII-3000, paragraph VIII-3120(b) of Appendix VIII.

While the committee's intent was good, it is often inappropriate to use exactly the same essential variables on axial flaws that would be employed on circumferential flaws. For example, the wedge contour used for examining in the axial direction is not useful in the circumferential scan direction. It is often also true that the examination angle must be changed when turning the transducer from the axial to the circumferential scan direction, due to the curvature of the component. Therefore, the current phrasing of the second sentence in paragraph VIII-3120(b) renders this paragraph impractical to use, in most cases, when examining piping or smaller-diameter vessels.

So, in 2012, a Code change was proposed by this project to modify paragraph VIII-3120(b) to remove the requirement to use the same essential variables qualified for circumferential flaw sizing. Additional wording was also added to the end of the paragraph to ensure that, when employing the sizing techniques qualified on circumferential flaws on axial flaws, modifications to the techniques would be limited to those that compensate for component geometry.

This Code change has been Board approved and will appear in the next printing of ASME Section XI.

Revise Appendix I, Paragraph I-3200 – Section XI, Division 1

Section XI Appendix I, paragraph I-3200 describes the required piping weld examination volume, including the qualification requirements to perform a single-sided examination. When describing the requirements for qualification of single-sided examination, paragraphs (b) and (c) state that when examination from both sides of the weld is not possible, procedures and personnel qualified for single-side examination in accordance with Appendix VIII, Supplement X, with all flaws on the opposite side of the weld, shall be used to examine the required volume.

Earlier in this section, an inquiry was discussed that successfully modified this paragraph. However, during that debate, the NRC raised a question as to how the near side and far side of a weld are defined. The members of SG NDE responded that the near side of the weld was defined as the side that the examiner's search unit was scanning on and that the centerline of the weld was the cutoff between the near and far sides. While this seemed correct to everyone in the discussion, the members also realized that Section XI had never officially defined this in writing. This project was then directed to originate a Code action to include a paragraph and figure to Section XI, Appendix I that defines "the opposite side of the weld."

The resulting Code change was proposed in May 2012, which inserted a new paragraph (d) into Appendix I, I-3200 that stated, "Near side (same side) and far side (opposite side) of the weld are in relationship to the weld centerline and search unit location as depicted in Figure I-3200-1." A figure was also added to I-3200. This Code change was Board approved in late 2012 and will appear in the next printing of ASME Section XI.

Current Project Activities in 2013

A new EPRI project that has recently been proposed on qualifying a procedure for single-side access of austenitic stainless steel has raised the question of exactly how single-side access qualifications should be performed. This is not clearly addressed in Section XI Appendix VIII, at this time. Therefore, this project has proposed a Code action that would add a new Section 4.0 to Appendix VIII, Supplement 2 that defines the flaw distribution requirements for a single-side austenitic qualification and also how a coordinated implementation between single- and dual-side qualifications should be performed. This action is currently being discussed in TG App VIII.

As stated earlier in this Section, the project has also introduced a "straw man" draft version of Appendix VIII, Supplement 9, which contains qualification requirements for CASS. This draft was introduced in order to help TG CASS determine all the open items that must be understood before such a qualification supplement can be developed and implemented.

Other items under consideration for this project to work on in the near future are:

- Revision of Appendix VIII to address corrosion-resistant cladding (CRC) (inlays and onlays)
- Appendix VIII addition to define performance demonstration administrator (PDA) role and responsibilities
- Development of requirements for Section XI NDE technical justifications
- Appendix VIII revision to address new technology essential variables (for example, phased array)
- Appendix VIII addition to define the use and requirements for site-specific mockups
- Revision to Appendix VIII, Supplement 14 through-wall sizing acceptance criteria

Project Summary

In 2012 and 2013, the project has continued to be instrumental in the coordination of Code-related activities among the nuclear community's issue programs, such as BWRVIP, MRP, and PDI. It also accomplished several important revisions or enhancements to ASME Section XI on behalf of EPRI's nuclear utility members.

This project also continues to support utility- or vendor-specific Code inquiries, as well as responding to Code questions for EPRI members throughout the year. The work performed under this project has led to EPRI's gaining considerable expertise in navigating the complex ASME Section XI Code process. It provides utilities and their vendors with a ready source of Code-related information and keeps utilities abreast of Code items that might affect them.

Finally, in response to the NRC endorsement of the 2007 Edition with Addenda through 2008 of ASME Section XI, in the June 2011 revision to 10CFR50.55a, this project worked closely with the PDI committee to determine the impact of Code changes between the 2001 Edition and the 2007 Edition with 2008 Addenda of Section XI, Appendix VIII. This determination was in terms of the impact that the changes will have on the industry's Appendix VIII UT performance demonstration programs as well as the vendors and utilities that are implementing programs for Appendix VIII examinations. This work will continue in 2013 and 2014, with a focus on ensuring that the industry remains in full compliance with current and future Appendix VIII requirements.

3

IMPORTANT APPROVED CODE ITEMS AND U.S. NRC RULEMAKING

This section describes important revisions and Code Cases that have been ASME Board approved from May 2011 through May 2013 in which the NDE Program staff actively participated. These revisions and Code cases are those that the NDE staff submitted or provided the technical justification for or ones that are important to NDE or repair/replacement activities.

The Section XI committee is now itself a Boiler and Pressure Vessel (BPV) Standards Committee. As such, it now conducts business using the ASME committee procedures that are applicable to Standards Committees. Under the Standards Committee procedures, new Section XI Code actions are no longer voice-voted for approval during Code week. Instead, essentially all Code actions that come before the Section XI Standards Committee must be letter balloted.

Approved Code Items Related to NDE and Repair/Replacement

The following items have been approved by the ASME In-Service Inspection Standards Committee. Items in **bold** were supported extensively by the EPRI staff, and some of them are described in Chapter 2 with more detail. All items listed below are important for utility staff to be aware of if they are responsible for in-service inspection, NDE, or repair/replacement activities.

- Revisions to IWA-3320, IWB-2420, and IWC-2420 to incorporate the provisions of Code Case N-526, which deletes the requirement for successive examinations when subsurface flaws in vessels meet the modified surface proximity rule for discriminating surface from subsurface indications (Record No. 09-1163).
- **Revisions to Figures IWB-2500-1, 2, 3, 4, 5, and 6 that incorporate Code Case N-613-1. Code Case N-613-1 reduced the examination volume for nozzle-to-vessel welds from effectively 1/2t to 1/2 inch (12.7 mm). This action applies the same examination volume reduction to the remaining Class 1 vessel welds for in-service examination (Record No. 10-751).**
- A new Section XI Code Case, N-806, Evaluation of Metal Loss in Class 2 and 3 Metallic Piping Buried in a Back-Filled Trench, that addresses evaluation of degraded buried pipe (Record No. 10-915).
- **An Intent Interpretation and revisions to Code Case N-552 and Section XI, Appendix VIII, Supplement 5 to clarify that examination surfaces other than the vessel plate, outer blend radius, and nozzle boss may be used during procedure qualifications (Record No. 11-1852).**

- **A revision to Code Case N-730, Roll Expansion of Class 1 Control Rod Drive Bottom Head Penetrations in BWRs, that allows users to manufacture CRDH UT procedure demonstration mockups without violating the Code Case in the event that the number of flaws in the mockup exceeds the minimum. The revision corrects current N-730 wording that limits the number of flaws in a mockup. It was never intended that N-730 would prevent users from including additional flaws that fall outside the specified range when the minimum number of flaws has been exceeded in a mockup (Record No. 11-1917).**
- **A revision to Code Case N-769-1, Roll Expansion of Class 1 In-Core Housing Bottom Head Penetrations in BWRs, that allows users to manufacture ICMH UT procedure demonstration mockups out of alternative materials that match the installed components. The Case stated that the UT procedure demonstration mockups shall be fabricated from a section of type 304 or similar stainless steel. The revision allows the mockups to be fabricated from Alloy 600 material, the alloy used for some of the installed ICMHs (Record No. 11-1918).**
- An Intent Interpretation and revision to Code Case N-729-2, Alternative Examination Requirements for PWR Reactor Vessel Upper Heads with Nozzles Having Pressure-Retaining Partial-Penetration Welds, clarifies what a relevant condition is. Specifically, the wording in paragraph -3141(c) of the Case, which provides what relevant conditions need evaluation as a result of reactor coolant leakage on the upper reactor head based on observable areas of corrosion, boric acid deposits, and discoloration, was clarified (Record No. 11-1956).
- A revision to IWA-4142(a)(2) that updates the NQA-1 reference therein from the 1989 Edition to the 1994 Edition. This corrected an issue where IWA-4142(a)(2) referenced a different edition than the one listed in Table IWA-1600, which was updated to the 1994 Edition back in the 2009 Addenda (Record No. 12-33).
- A revision to IWA-5000 that removes Table IWA-5210-1 and all associated references from the code. The table no longer served a meaningful purpose. The table was once used as a cross reference for various code paragraphs when the pressure test consisted of functional, in-service, and hydrostatic testing. The current code requires only a leakage test so the cross-reference table is no longer needed (Record No. 12-132).
- A revision that relocates the paragraph on tolerances from the foreword to new paragraph IWA-1800 (Record No. 12-458).
- Deletion of IWA-5212(e) and revisions to IWC-5221 and IWD-5221 that clarify the leakage test pressure for systems that have multiple functions (Record No. 12-828).
- An Intent Interpretation and Code change to clarify that circumferential welds in a vessel head in the knuckle of an elliptical or torispherical head in Class 2 vessels are subject to in-service volumetric examination under Section XI, Division 1, Examination Category C-A (Record No. 10-950).
- A revision that standardizes the IWX-2500-1 tables for all Class 1, 2, and 3 welded attachments, makes them consistent, moves examination requirements from the examination figures to the tables, and removes conflicting Class 3 vessel requirements (Record No. 10-1338).

- A revision that adds a “boiler plate statement” to the “scope” paragraph at the beginning of Non-Mandatory Appendix S to prescribe how it is intended to be used (Record No. 11-1899).
- **A new Code Case, N-824, Alternate Requirements for Ultrasonic Examination of Cast Austenitic Piping Welds from the Outer Diameter (OD) Surface. The Case provides alternatives to Appendix VIII-3110(c), which directed the use of Appendix III for piping welds whose Supplement is in the course of preparation. The alternatives are considered to be improvements over just performing UT in accordance with Appendix III (Record No. 12-686).**
- An Intent Inquiry and Code revision to Section XI IWA-3300(b) to clarify the flaw combination rule (Record No. 12-1014).
- A revision to Appendix G to include nozzle discontinuity solutions (Record No. 08-1642).
- **A new Code Case, N-829, that provides rules for ambient temperature gas tungsten arc welding (GTAW) temperbead repair of cladding in ASME Class 1, 2, and 3 components (Record No. 10-1843).**
- Code changes that reformat the notes in the Class 1, 2 and 3 IWX-2500 tables affecting welded attachments to correctly incorporate Code Case N-509 and N-700 (Record No. 11-1126).
- A revision to Subparagraph IWA-4131.2 to include the requirements of Article IWA-3000 for design and any other applicable articles in IWA-4000 for small items to be used for repair/replacement activities. This action was considered to be a clarification of the Subgroup Repair\Replacement Activities’ original intent for these items (Record No. 12-733).
- Due to a lack of acceptance standards for austenitic steel Category C-A and C-B components (that is, pressure-retaining welds in vessels and vessel nozzles), IWC-3510 and IWC-3511 were revised to direct the use of Table IWC-3514-1 and Table IWB-3514-2 (austenitic steel piping acceptance standards) for austenitic Category C-A and C-B components respectively (Record No. 12-795).
- **A revision to Appendix VIII paragraph VIII-3120(b) to provide practical requirements for ultrasonic sizing of axial flaws with techniques qualified on circumferential flaws (Record No. 12-829).**
- **A revision to Appendix I, article I-3200, Piping, that provides a new subparagraph and a figure, Figure I-3200-1, that define what is meant by the terms *near side* (same side) and *far side* (opposite side) of the weld (Record No. 12-830).**
- A revision to Code Case N-694-1 (that is, N-694-2), Evaluation Procedure and Acceptance Criteria for PWR Reactor Vessel Head Penetration Nozzles, to provide additional flaw evaluation guidance to ensure consistent application of the required evaluation methodology and acceptance criteria (Record No. 12-842).
- **Revisions to IWA-4621 and IWA-4651 that clarify that peening for enhancing the surface properties of completed temper bead welds is not prohibited and also eliminate peening as a qualification variable in IWA-4652 (Record No. 12-1239).**
- Revisions to Non-Mandatory Appendices A, C, E, G, H, K, L, and O to add a “boiler plate statement” to the “scope” paragraph of each of the appendices to describe how they are intended to be used (Record No. 12-1602).

- **An Intent Code Interpretation (Applicability – 1998 Edition through 2013), Code revision to IWA-2323, Level III Personnel, and a new Appendix VII paragraph, VII-4343, Written Examination Administration, that clarifies the “administration” of Level III written test questions (Record No. 12-1905).**
- A Code change to that adds a new figure, Figure IWB-2500-8(e), that provides examination requirements for double groove welded joints in piping, nozzle to safe-end, and nozzle to component welds (Record No. 12-1979).
- A periodic update of Table IWA-1600-1, Referenced Standards and Specifications (Record No. 12-1981).
- A revision to Code Case N-766 (N-766-4), Nickel Alloy Reactor Coolant Inlay and Onlay for Mitigation of PWR Full Penetration Circumferential Nickel Alloy Dissimilar Metal Welds in Class 1 Items, which was made to resolve NRC comments and also address industry requested changes (Record No. 11-835).
- A revision to Code Case N-770 (N-770-3), Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated With UNS N06082 or UNS W86182 Weld Filler Material With or Without Application of Listed Mitigation Activities, Section XI, Division 1, that was made to address cold leg inspections (Record No. 12-267).
- A revision to Code Case N-789 (N-789-1), Reinforcing Pads for Raw Water Systems, to reflect clarifications and requirements resulting in NRC acceptance of the first relief request for this CC, which was an Exelon Relief Request for 10 plants that was approved in May 2012 (Record No. 12-1621).
- **A Code change to revise flaw size requirements for qualification of eddy current surface examination procedures. The Code change revises Appendix IV, Supplement 2, 1.0 (d) (2) to add the option for qualification of an eddy current procedure with flaws 1/16 in. (1.59 mm) or less in length (Record No. 12-2015).**
- A Code change revising the IWB-3514 and IWC-3514 acceptance standards to clarify the requirements for flaws in stress corrosion cracking– (SCC-) susceptible materials. The revisions provide additional guidance to use analytical evaluation when the acceptance standards of IWB-3514 and IWC-3514 are not applicable due to the material being susceptible to SCC (Record No. 12-1411).

NRC Publishes 10CFR50.55a, Industry Codes and Standards; Amended Requirement

On June 21, 2011, the NRC published a revised final rule for referencing Codes and Standards. The amendment to Part 10 of the Code of Federal Regulations, Section 50.55a (10CFR50.55a) incorporates by reference the 2007 ASME Boiler and Pressure Vessel Code, Section III, Division 1, and Section XI, Division 1, 2007 Edition, with 2008a Addenda. The rule also implements by reference (with conditions on their use) ASME Boiler and Pressure Vessel Code Case N-722-1, “Additional Examinations for PWR Pressure-Retaining Welds in Class 1 Components Fabricated with Alloy 600/82/182 Materials, Section XI, Division 1,” and ASME Boiler and Pressure Vessel Code Case N-770-1, “Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated with UNS N06082 or UNS W86182 Weld Filler Material with or Without Application of Listed Mitigation

Activities, Section XI, Division 1.’’ The rule became effective on July 21, 2011. This revised final rule contains more requirements, and this section provides only a short synopsis. The entire document is available at the NRC website at:

<http://www.regulations.gov/#!documentDetail;D=NRC-2008-0554-0026> (Reference 1).

ASME Code Case Rulemaking/Regulatory Guides

The NRC periodically reviews and approves nuclear Code Cases developed by Section III and XI. On October 5, 2010, the following were approved:

- Regulatory Guide (RG) 1.84, Revision 35, “Design, Fabrication, and Materials Code Case Acceptability, ASME Section III” (Agency-Wide Documents Access and Management Systems [ADAMS] accession No. ML101800532).
- RG 1.147, Revision 16, “In-Service Inspection Code Case Acceptability, ASME Section XI, Division 1” (ML101800536).
- RG 1.192, Revision 0, “Operation and Maintenance Code Case Acceptability, ASME OM Code” (ML030730430). The associated rulemaking can be found at 75 FR 61530.

There is a fourth guide not associated with the rulemaking, RG 1.193, Revision 3, “ASME Code Cases Not Approved for Use,” that was issued for informational purposes (ML100560131). The guides address Code Cases from Supplement 2 to the 2004 Edition through Supplement 0 to the 2007 Edition.

On October 5, 2010, the final rule that incorporated Regulatory Guide 1.84, Revision 35, and Regulatory Guide 1.147, Revision 16, by reference into 10 CFR 50.55a was also issued (75 FR 61321).

Draft Revision 36 to RG 1.84, draft Revision 17 to RG 1.147, draft Revision 1 to RG 1.192, and draft Revision 4 to RG 1.193 were published for public comment in June 2013 in conjunction with the proposed Code Case rulemaking. The draft guides address Supplements 1–10 to the 2007 Edition. The risk-informed Code Cases in draft RG 1.192 have been clarified to make them consistent with current generic NRC risk-informed guidance. The NRC staff has completed its review of Supplements 1–11 to the 2007 Edition and Supplement 0–10 to the 2010 Edition. Draft Revision 37 of RG 1.84, draft Revision 18 of RG 1.147, draft Revision 2 of RG 1.192, and draft Revision 5 of RG 1.193 have been initiated. The drafts will address the Code Cases published by the ASME in Supplement 11 to the 2007 Edition through Supplement 10 to the 2010 Edition. It is expected that these drafts will be published in the Federal Register for comment within a few months after Revision 36 of RG 1.84, Revision 17 of RG 1.147, Revision 1 of RG 1.192, and Revision 4 of RG 1.193 are published.

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FUTURE GOALS FOR SECTION XI AND NDE ITEMS

Each Subgroup and Working Group that reports to the BPV Standards Committee prioritizes its actions under an operational plan. Each Subgroup Chair maintains that plan and provides feedback to the Executive Committee. The Chair of the BPV Standards Committee then presents his selection of the “top ten” priorities to the Executive Committee every two years for approval. The “top ten” is developed based on the feedback from the Subgroup Chairs, industry issues, and other stakeholders. It is expected that each Subgroup will support the “top ten” by managing the Subgroup and Working Group activities.

Table 4-1 shows the “top ten” priorities that will be used from January 2013 to December 2014 for current Section XI items. **Note:** The shaded items have been Board approved.

Table 4-1
Section XI priority items for 2013–2014

Record #	Group	Description	Importance and (Industry)
09-1145	TGHSNAI (Alloy 600)	Code Case N-770-2 changes to incorporate optimized weld overlay and difficult-to-inspect large-diameter cold leg temperature locations.	This action allowed the capability to deal with large-diameter cold leg locations with permanent obstructions. (Utilities & Regulators)
06-500	WGWSRP	Code Case N-754 to address optimized dissimilar metal weld overlay used for mitigation and repair.	The action extended the use of overlays to applications in large-diameter, heavy-wall piping. (PWR Utilities & Regulators)
11-4	WGFE	Develop fatigue crack growth reference curves for austenitic steels in water environments.	This action will expand the reference curves in Section XI to include crack growth rates for de-aerated PWR environments. (Utilities)
09-822	WGWSRP	Revise Code Case N-740-2 to address the previous NRC negatives as well as what has been done on MRP-169 with the NRC for N-740-2.	This action is to address NRC negatives on the previous version and change the allowed surface area to 1000 sq. inches (0.645 sq. m). (Utilities & Regulators)
11-232	WGPT	Rules for disposition of leakage identified outside Section XI.	This is to clarify the role of Section XI when leakage is discovered from an activity that is not Section XI driven. (Regulators)
11-822	TGBCI&T	Development of rules for addressing buried piping.	This action is to develop rules for addressing buried piping to address the operating experience with buried piping leaks. (Utilities & Regulators)

Table 4-1 (continued)
Section XI priority items for 2013–2014

Record #	Group	Description	Importance and (Industry)
08-1595	WGFE	Improvements to stress intensity factor solutions in Appendix A for buried flaws.	This action will change the calculation methods for determination of the stress intensity factor (K) for surface and subsurface flaws. This will update the methods to allow for nonlinear stress variation. An improvement to the accuracy of the methods and a reduction of the conservatisms inherent in the original linearization method for subsurface flaws will be realized. (Utilities & Regulators)
07-1328	SWGRIM	Revise Division 2 of Section XI to incorporate new reactor designs.	This action is a complete rewrite of Division 2 that will address all known designs of reactors, focusing first on the small modular reactor types. This action will introduce a new method of managing risk called the Reliability and Integrity Management (RIM) System. (SMR Vendors and Regulators)
05-1328	WGFE	Code Case N-749 - Flaw Evaluation Acceptance Criteria for Ferritic Components based on elastic plastic fracture methods.	This action allowed the alternative flaw acceptance criteria based on elastic-plastic mechanics analysis methods. (Utilities & Regulator)
11-835	WGWSRP	Revise Code Case N-766 for inlay to resolve NRC comments.	This action is to add a requirement for the implementation of inlay and onlay for mitigation of PWSCC on PWR full penetration circumferential nickel alloy DM welds. (Utilities & Regulators)
10-1845	WGWSRP	New Code Case to develop rules for partial examination and weld repair of dissimilar metal welds.	This action will provide the rules for performing a partial weld repair of DM welds. This will reduce the exposure to personnel and the amount of material being added for repairs. (Utilities & Regulators).
12-2244 11-1348	TG for Alt NDE for RRA	UT in lieu of RT (Code Case N-831 for carbon steel piping and N-713).	This action will revise the existing Code Case to address concerns with using UT in lieu of RT for examinations. The issue with performing RT at an operating nuclear power plant is the potential radiation exposure to personnel and the requirement to rope off areas where workers cannot go. (Utilities & Regulators).

Table 4-1 (continued)
Section XI priority items for 2013–2014

Record #	Group	Description	Importance and (Industry)
11-666	TGHSNAI	Revision to N-770-2 to include surface stress improvement.	This action adds surface mitigation techniques to the Code Case. This would add more options to mitigate the results of PWSCC. (Utilities & Regulators).
11-1103	SC XI	N-808 "HDPE for Section XI."	This action will provide the specific rules different than Code Case N-755 for the use of high-density polyethylene (HDPE) in repair/replacement activities at operating nuclear power plants. (Utilities & Regulators).

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SUMMARY

Some Code items are administrative or clarifying in nature. The items listed in this report are fairly significant and will be beneficial for utilities. The total estimated savings from the risk-informed activities are estimated by the NRC to be \$60–\$160 million during a 10-year interval. The dose savings for radiation workers range from 3000 to 7000 rem ((30 to 70 sievert) over the 10-year interval. Annual cost savings for the containment and insulated bolting items total \$781,000. The replacement of Class 3 systems with polyethylene pipe has the potential to save \$3.2 million when the cleaning of 8000 ft (2443 m) of ferritic pipe is avoided. The NDE Program staff will continue to work with the Code to improve it, represent the utility interests, and develop items that are technically sound and beneficial to the utilities while they maintain their safe operation.

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REFERENCES

1. June 21, 2011 Amended 10CFR50.55.a Rule
<http://www.regulations.gov/#!documentDetail;D=NRC-2008-0554-0026>.

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