

Nondestructive Evaluation: NDE Reliability Update

A Guide for the Review and Implementation of Recent U.S. Nuclear Power Industry
NDE Reliability Guidelines and Reports

2016 TECHNICAL REPORT

Nondestructive Evaluation: NDE Reliability Update

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Recent U.S. Nuclear Power Industry NDE Reliability
Guidelines and Reports

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ABSTRACT

Although terminology and even codes and standards will vary around the world, nuclear power plant components—and the degradation mechanisms to which they are susceptible—are similar, from country to country, as are the equipment and techniques employed to examine them. Therefore, it is important that our global industry remain vigilant about sharing not only operating experience (OE) and issues, but also any responses, such as solutions or operational improvements that are being employed to improve or resolve those issues.

Starting in 2012, as a result of some troubling OE in the area of dissimilar metal (DM) piping and nozzle weld examinations, the U.S. nuclear industry nondestructive evaluation (NDE) experts focused a significant amount of energy and effort to improve the consistency and reliability of these examinations. This work culminated in the issuance of several Electric Power Research Institute (EPRI) NDE guidelines and reports. In addition, because of the severity of the issue and the desire on the part of the industry executives to swiftly find and implement solutions, almost all of the guidelines and reports produced by this effort were assigned U.S. industrywide implementation requirements.

Later, in 2015, based on the strength of these industry improvements—made specifically in the area of DM weld ultrasonic testing examination—the utility executives requested that EPRI develop an additional guidance document. The objective of this report was to take the principles developed for DM weld examinations and apply them, in a broader sense, to all NDE methods and techniques performed in the power plants. This resulted in an industry best practices report that was issued in early 2016.

Recently, EPRI members outside of the United States requested a report that summarizes all of the recent NDE reliability improvement guidance that has been developed for the U.S. fleet. Although there is no global mechanism for requiring the use of these documents worldwide, it may be beneficial for international utilities to review the principles and guidance provided in these reports and to assess how and to what extent they should be implemented in their power plants. This report is the result of that request.

Keywords

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Nondestructive Evaluation: NDE Reliability Update—A Guide for the Review and Implementation of Recent U.S. Nuclear Power Industry NDE Reliability Guidelines and Reports

PRIMARY AUDIENCE: International EPRI-Member Utilities

SECONDARY AUDIENCE: U.S. EPRI-Member Utilities

KEY RESEARCH QUESTION

How should nuclear power utilities not subject to the same codes and regulations as the United States consider implementation of recent EPRI NDE reliability guidelines and reports issued in response to U.S. industry NDE operating experience (OE) and lessons learned?

RESEARCH OVERVIEW

Although several NDE reliability guidelines and reports have recently been issued—which were specifically targeted for use at U.S. nuclear power plants—many of the principles and recommendations contained within these documents are universally applicable and should be reviewed and considered for implementation at any power plant worldwide that wishes to ensure that highly reliable NDE is being performed. Therefore, the goals of this report were to introduce each of these NDE reliability improvement guidelines and reports to the international community, to provide some context for why each of them was developed, and to summarize their content and potential value to any power plant seeking to benefit from the operating experiences and lessons learned from the U.S. fleet.

KEY FINDINGS

- Between 2012 and 2016, EPRI has published the following guidelines on NDE, based on U.S. operating experiences:
 - An extent-of-condition guideline to assist with assessing dissimilar metal welds by risk, associated with mitigation and ultrasonic examination history
 - A revised guideline for ultrasonic examination of dissimilar metal welds
 - Revised guidance on the use of site-specific NDE mockups and for conducting hands-on practice for ultrasonic examiners
 - An assessment on the effectiveness of an ultrasonic examination technique called *team scanning*
 - A guide to the best practices for planning, preparing for, and executing all NDE in a commercial nuclear power plant
- International power plants may use different designations for materials but many times will have the same susceptibility to degradation mechanisms such as stress corrosion cracking
- There is currently no mechanism for requiring all plants, worldwide, to conform to a single material initiative, such as NEI 03-08, *Guideline for the Management of Materials Issues*, which is used in the United States
- This report summarizes the purpose and contents of each of the recent NDE reliability guidelines and provides recommendations on how an international utility may implement them

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Nondestructive Evaluation: NDE Reliability Update—A Guide for the Review and Implementation of Recent U.S. Nuclear Power Industry NDE Reliability Guidelines and Reports. EPRI, Palo Alto, CA: 2016. 3002009080.

WHY THIS MATTERS

Recently, international EPRI members have been asking for a report that summarizes all of the recent NDE reliability improvement guidance that has been developed for the U.S. fleet. Although there are no existing mechanisms for mandating the use of these documents worldwide, it may be beneficial for international utilities to review the principles and guidance provided in these reports and to assess how and to what extent they should be implemented in their power plants.

HOW TO APPLY RESULTS

Although terminology and even codes and standards will vary around the world, nuclear power plant components and the degradation mechanisms to which they are susceptible are similar from country to country, as are the equipment and techniques employed to examine them. Therefore, it is important that our global industry remain vigilant about sharing not only OE and issues, but also any responses such as solutions or operational improvements that are being employed to improve or resolve those issues.

It is therefore recommended that international nuclear power utilities make this document available to the plant personnel responsible for the planning, preparation, and execution of NDE.

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PROGRAM: Nuclear NDE

IMPLEMENTATION CATEGORY: Reference

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1

BACKGROUND AND INTRODUCTION

North Anna Event

The North Anna Nuclear Generating Station has two Westinghouse pressurized water reactors that went online in 1978 and 1980, respectively.

In the spring of 2012, Unit 1 embarked on a campaign to preemptively install a mitigative weld overlay on a steam generator nozzle-to-piping dissimilar metal (DM) weld to protect it from stress corrosion cracking (SCC). At the location of the DM weld, this component was approximately 125 mm in thickness. The weld joined a large-diameter ferritic nozzle to a smaller diameter austenitic pipe via a tapered austenitic safe-end (see Figure 1-1). Therefore, the DM weld (DMW) itself had a tapered outside surface configuration. The weld and buttering material was Alloy 82/182. The plan was to perform pre-overlay ultrasonic testing (UT) of the weld to ensure that it was structurally sound, then machine away the tapered outside surface (removing approximately 25 mm of material from the outside surface) to make the weld area flat (see Figure 1-2). Finally, the team would install a structural weld overlay over the weld.

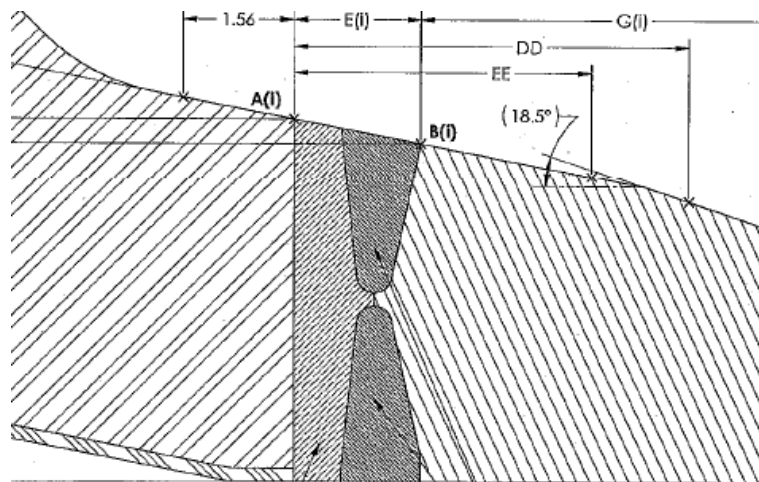


Figure 1-1
Depiction of the Original North Anna DM Weld Configuration

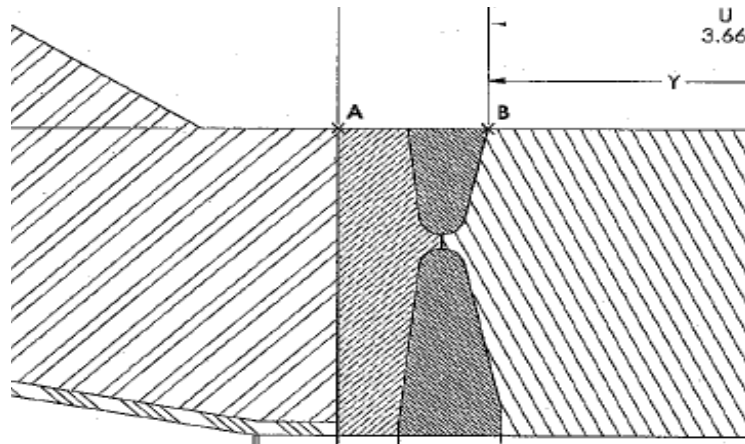


Figure 1-2
Depiction of the Modified North Anna DM Weld Configuration Prior to Installation of the Weld Overlay Repair

The pre-overlay examination was performed with non-encoded, conventional UT procedures, equipment, and personnel that were qualified to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section XI [1], Appendix VIII. The inventory of DMW qualification samples does not contain mockups of the North Anna configuration, so the search unit enhancements that were required for the unique tapered DMW configuration were qualified in a non-blind manner using a site-specific mockup that was fabricated by the utility. This examination reported no flaws. When the subsequent machining process was completed, to remove the taper and ready the surface for installation of the weld overlay, the weld area was visibly leaking water from two axial cracks that had been exposed by the machining process. Because only 25 mm had been removed during the machining step, these two cracks had to have been originally greater than 100 mm in through-wall depth. As a result of the discovery of two leaking cracks, a follow-up examination was performed using the same non-encoded, conventional UT procedure. However, this time the examination recorded a total of five axial flaws, each of which was greater than 75 mm in through-wall depth.

When this operating experience (OE) was shared with the U.S. nuclear industry, the utility executives reacted by calling for the formation of a focus group of industry subject matter experts to review the North Anna event and develop recommendations on ways to improve the UT examination process of DMWs. The NDE Improvement Focus Group (NIFG) was formed as a result of this mandate.

The NDE Improvement Focus Group

This incident was viewed by the U.S. nuclear industry leadership as a “watershed” event, which called for a critical top-to-bottom review and overhaul of the processes used to ultrasonically examine DM welds. Therefore, the NIFG’s charter included a careful assessment of all associated tools and processes involved with the preparation and execution of these examinations, including training, qualification, maintenance of examiner proficiency, equipment selection, examination, oversight, reporting, and all available industry guidance. The work of the NIFG resulted in four Electric Power Research Institute (EPRI) documents being published:

- *Nondestructive Evaluation: NDE Improvement Focus Group Extent of Condition Actions in Response to North Anna Dissimilar Metal Weld Operating Experience* (3002000041) [2]. This report provided a process by which U.S. plants could categorize DM welds in terms of their risk of containing an undetected SCC flaw. The risk levels were determined by reviewing two key aspects: 1) whether the weld materials were considered susceptible to SCC (and had not been mitigated) and 2) whether the weld had ever been examined by ASME Section XI, Appendix VIII qualified, encoded UT procedures, personnel, and equipment.
- *Nondestructive Evaluation: Guideline for Conducting Examinations of Dissimilar Metal Welds, Revision 1* (3002000091) [3]. This report contains guidance on the planning, preparation, and execution of DM weld UT examinations. Although originally published in 2009, this report was thoroughly reviewed and revised by the NIFG to include the lessons learned from the North Anna OE. In addition, the NEI 03-08 implementation level of Revision 1 of this guideline was increased from *Good Practice* to *Needed*. (For additional information on NEI 03-08, see Section 4).
- *Nondestructive Evaluation: Performance Demonstration Initiative (PDI) Guidance for Improved Reliability in Ultrasonic Examinations* (3002000204) [4]. This report contains revised versions of two pre-existing Performance Demonstration Initiative (PDI) documents—*Site-Specific Mockup Requirements for Dissimilar Metal Welds, Revision C and Guideline for Hands-On Practice (PDI-GL-001), Revision B*—each of which was reviewed and revised by the NIFG, based on the North Anna OE and in an effort to improve the overall examination reliability associated with these products.
- *Nondestructive Evaluation: 2013 Team Scanning Assessment Conducted on Behalf of the NDE Integration Committee’s NDE Improvement Focus Group* (3002002048) [5]. A scanning technique commonly called team scanning was used during the North Anna event; however, this technique lacked any recognized guidance for implementation. Team scanning is performed in areas with limited access, where one examiner is positioned at the weld and is responsible for manipulating the search unit. A separate examiner is located 2 or 3 meters away and is responsible for controlling and observing the ultrasonic instrument. In response, the NIFG developed a new set of guidelines on the use of team scanning (Appendix B of *Guideline for Conducting Ultrasonic Examinations of Dissimilar Metal Welds, Revision 1* [3]). In an effort to test the reliability of team scanning, when employing these new guidelines, the NIFG conducted a blind testing experiment with three examiner teams using team scanning and following the new guidance. This report documents this experiment and the results and provides additional recommendations on the use of team scanning.

Purpose and Format of This Report

With these activities, the U.S. nuclear power industry has made and continues to make a determined effort to improve reliability, first for DM weld ultrasonic examinations and then for all types of commonly performed NDE in the plant. But it is recognized that, although the subject matter is universally applicable to the worldwide NDE community, many of these documents have been written with U.S. codes and regulatory requirements specifically in mind—and some aspects of these offerings may therefore not be directly applicable to a plant that falls outside the jurisdiction of the U.S. Nuclear Regulatory Commission (NRC). Therefore, the purpose of this report is to explain these documents and other guidelines to the international community by describing how each one is recommended to be used and in what order they should be applied.

2

ADDITIONAL INFORMATION ON DISSIMILAR METAL WELD MATERIALS

In this report, as well as those issued by the NIFG, SCC susceptible high-nickel alloy materials used in DM welds are generally identified as Alloy 600 (for base material) and Alloy 82 or Alloy 182 (for weld filler materials) because these are the most commonly cited materials in the United States. However, it has been noted—especially for some international plants—that SCC susceptible high-nickel alloy materials are not always identified this way. But just because the materials may be identified differently does not necessarily mean that the welds in question are not susceptible to SCC. For instance, some AREVA-designed plants have been noted to identify M4102 NC15Fe as the equivalent to Alloy 600 and, in some cases, may simply list the weld filler materials as NiCrFe instead of Alloy 82 or Alloy 182.

Utilities should also be aware of a predecessor weld filler material to Alloy 82 and 182. Some older boiling water reactor (BWR) DM welds in the United States contain Inconel BP-85 filler material. In their in-service inspection programs and for flaw evaluations, Inconel BP-85 is conservatively treated the same as Alloys 82 and 182 because its resistance to SCC is not documented.

Finally, it has also been noted that some Water-Water Energetic Reactor (commonly called *VVER*) DM welds have experienced SCC issues (see Figure 2-1); the weld filler material was identified as EA400/10T (shielded metal arc welding [SMAW]) with an Sv04CH19N11M3 (tungsten inert gas [TIG]) root pass. In addition, the weld buttering filler material was identified as Sv04CH19N11M3 (TIG) on both sides of the butt-weld joint, with an additional layer of material identified as Sv10CH16N25AM6 buttering along the ferritic steel forging side of the weld.

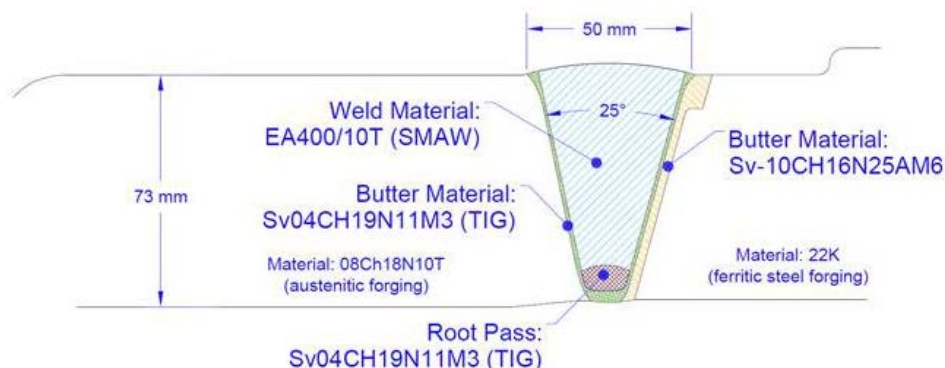


Figure 2-1
Example SCC Susceptible VVER DM Weld Configuration

3

ACCESSING THE REPORTS REFERENCED IN THIS DOCUMENT ON EPRI.COM

All of the EPRI products discussed in this report are available for download via EPRI.com and the EPRI NDE Cockpit (see Figure 3-1). To download a document, simply go to EPRI.com or the NDE Cockpit, then type either the product title or the product identification (ID) number in the upper right-hand search window and hit enter. The document, in Adobe PDF format, should be returned as an option to download. Each of these reports is available to the general public so that they can be downloaded by inspection vendor organizations and examiners.

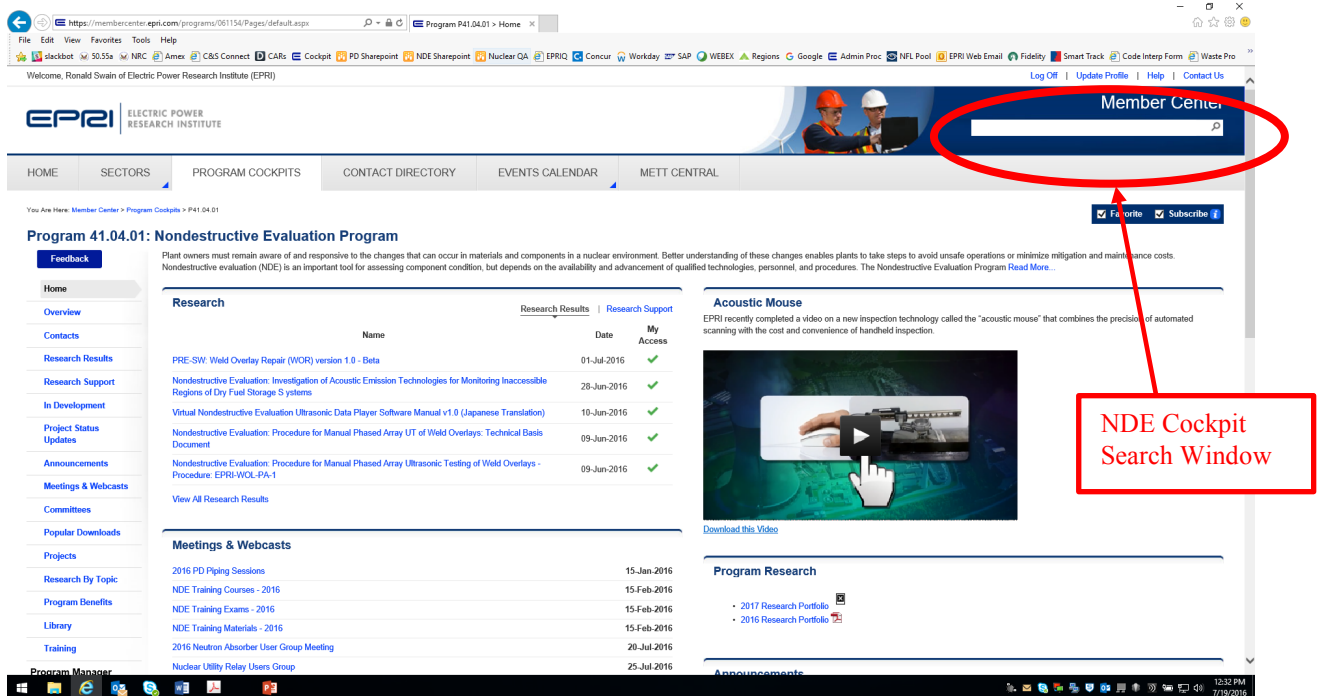


Figure 3-1
Location of Search Window in the EPRI NDE Cockpit

4

DISCUSSION OF NEI 03-08

For organizations outside the United States, it may be worthwhile to take some time to describe NEI 03-08, *Guideline for the Management of Materials Issues, Revision 2* [6], including why it exists and how it affects U.S. utilities. This insight may help international utilities consider how they may choose to apply NEI 03-08 guidance within their own plants.

The Nuclear Energy Institute (NEI) is an organization established to promote the beneficial uses of nuclear technology before the U.S. government bodies at both the federal and state levels. Additional information on NEI is available at its website: www.nei.org/About-NEI. Because this organization regularly promotes the safety and reliability of nuclear power, the U.S. utilities decided to document their Materials Initiative in an NEI document, as a demonstration of their united commitment to understanding and finding solutions for any emergent material degradation issues. In addition, initiatives launched from the auspices of NEI require an 80% affirmative vote by the Nuclear Strategic Issues Advisory Committee (NSIAC), which is made up of the chief nuclear officers of each U.S. utility; as such, the initiatives are strictly adhered to by the U.S. utilities and carry a great deal of weight with the NRC.

Therefore, in January 2004, the industry issued a new Materials Initiative: NEI 03-08, *Guideline for the Management of Materials Issues* [6]. This document defines the scope and objectives of the Initiative, establishes itself as the governing policy, recognizes several Issue Programs within its scope (for example, the Boiling Water Reactor Vessel Internals Program [BWRVIP], the Materials Reliability Program [MRP], the Steam Generator Management Program [SGMP], and the Nondestructive Evaluation [NDE] Program), and defines the roles and responsibilities of each of these Issue Programs as well as those of the utilities.

The objective of the NEI 03-08 Initiative is to ensure the safe, reliable, and efficient operation of U.S. nuclear power plants in the management of materials issues. Its purpose is to provide a uniform and consistent management process, a method of prioritization of materials issues, and integrated and coordinated approaches to materials issues. It commits **all** U.S. utilities to providing resources to the Initiative, including funding, executive leadership, and technical personnel. Importantly, it also commits each U.S. utility to adhere to and implement any applicable “Mandatory” and “Needed” guidance documents produced by its Issue Programs.

When an Issue Program develops guidance based on industry material events or issues, it must make a determination as to the appropriate implementation level to assign to that guidance. There are three choices:

- **Mandatory:** To be implemented at all plants, where applicable.
- **Needed:** To be implemented whenever possible, but alternative approaches are acceptable.
- **Good Practice:** Implementation is expected to provide significant operational and reliability benefits, but the extent of use is at the discretion of the individual plant or utility.

The process of arriving at the implementation level is achieved through consensus. Typically this first requires a group of subject matter experts to offer a recommendation. The recommendation is then shared with the industry Issue Program technical committees. Following their agreement, the recommendation is then passed along to an executive committee for endorsement.

Following the issuance of guidance containing NEI 03-08 expectations, utilities are expected to implement the requirements within a defined timeframe. In practice, Mandatory or Needed guidance is required unless a formal deviation disposition is processed (similar to an ASME Code Relief Request). The only difference for a deviation from Mandatory guidance versus one for Needed guidance is that deviating from Mandatory guidance requires an independent third-party review and approval. Issue Program guidelines typically include an “Implementation” paragraph, in the front sections of the document, which outlines the NEI 03-08 implementation requirements of the report. An example from *Nondestructive Evaluation Improvement Focus Group Extent of Condition Actions in Response to North Anna Dissimilar Metal Weld Operating Experience, Revision 1* [2] is highlighted in Figure 4-1.

1
OBJECTIVE

This report provides instructions and necessary follow-up actions required for licensees to complete an evaluation of extent of condition (EOC) for dissimilar metal (DM) welds nondestructively examined in accordance with the *ASME Boiler and Pressure Vessel Code*, Section XI, Appendix VIII, Supplement 10.

The requirements for addressing EOC of DM welds at each facility are being issued under the Nuclear Energy Institute (NEI) *Guideline for the Management of Materials Issues*, NEI 03-08 [5], as “needed,” by endorsement of the Executive Committees of the PWR Materials Management Program and the BWR Vessel and Internals Project. The “needed” requirements are the following:

- Complete the prerequisites and screening actions defined in Section 3.
- Perform the corrective actions defined in Section 4.
- Complete the template provided in Appendix A and return it to the Electric Power Research Institute (EPRI) Nondestructive Evaluation (NDE) Action Plan Committee.

Figure 4-1
Example of NEI 03-08 Implementation Requirements

5

DETAILED DESCRIPTIONS OF NDE IMPROVEMENT FOCUS GROUP PRODUCTS

Nondestructive Evaluation Improvement Focus Group Extent of Condition Actions in Response to North Anna Dissimilar Metal Weld Operating Experience, Revision 1 [2]

The first guideline issued by the NIFG was aimed at gathering the U.S. industry's extent of condition related to the North Anna DM weld cracking event. At the time this document was issued, it carried NEI 03-08 "Needed" implementation level actions—both for the risk categorization of all DM welds in a plant's in-service inspection (ISI) program and for the reporting of these categorizations and the resulting examination plans to the NDE Integration Committee for review. The reason for this was that the industry had made a commitment to the U.S. regulator to determine how many DM welds potentially existed in the U.S. fleet that could contain unidentified cracking.

This document contains a set of instructions to enable a plant to categorize its DM welds by risk. The risk categories are based on the UT techniques that have historically been used to inspect the weld as well as its susceptibility to SCC based on its material makeup, operating temperatures, and whether it was considered *mitigated*. For a weld to be considered *mitigated*, it either has to have been overlaid with non-susceptible weld material, such as Alloy 52, or it has to have undergone a recognized stress improvement process, such as the mechanical stress improvement process (MSIP).

Utilities may benefit from implementing the DM weld risk categorization process outlined in this report (see Figure 5-1) to determine what population of welds may exist at their power plants that are at greater risk of containing unidentified SCC. Utilities may also benefit from implementing an accelerated examination plan for those welds similar to the one outlined in this guideline.

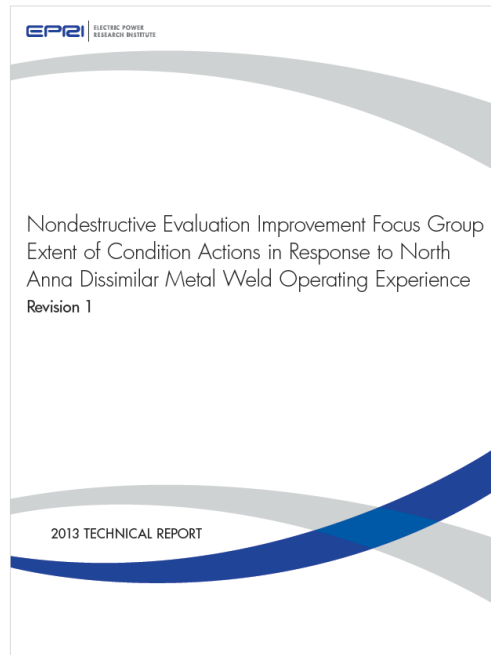


Figure 5-1
Cover of Product ID 3002000041

Nondestructive Evaluation: Guideline for Conducting Ultrasonic Examinations of Dissimilar Metal Welds, Revision 1 [3]

The original version of this report, published in 2009, was issued to provide industry best practices on the examination of DM welds. At that time, it was published in response to several instances of U.S. industry OE that indicated that planning, preparation, and execution of DM weld examinations needed to be improved. After significant SCC flaws were missed at North Anna in 2012, the NIFG decided to review and revise this report, adding tools and information on several specific topics and making the use of this guideline a “Needed” requirement of the U.S. fleet.

The body of Revision 1 contains discussions on the potential human factors that can degrade the reliability of a DM weld examination, such as the physical environment in which the examinations are performed (heat, noise, and so on), as well as mental stress caused by issues such as perceived time pressure. It then provides industry best practices on how to minimize or alleviate these factors. The report also explores pre-outage preparations such as performing good walkdowns of each component, determining whether an encoded technique can be used and is warranted, and selecting and properly preparing your ISI vendor—along with training and qualification considerations that can help the examination team to be more knowledgeable and prepared. It then delineates the key aspects of the actual execution stage of these examinations that can help ensure reliability, including conducting high-quality pre- and post-job briefings, providing meaningful utility oversight during DM weld examination campaigns, and conducting proper examination documentation and data reviews.

Finally, the report contains several appendices covering specific topics that have been shown by industry OE to deserve additional detail and focused guidance. These include a decision tool for selecting between encoded and non-encoded examination technologies, in-depth guidance for the use of team scanning (when necessary), and tools and processes that can help a utility in performing meaningful examination oversight.

This document was issued under NEI 03-08 implementation rules and therefore carries specific requirements for implementation by U.S. utilities. However, any nuclear plant having DM welds constructed of Alloy 600 materials or other materials known to be susceptible to SCC—or for whom the reliability of ultrasonic examinations is important—may benefit by implementing the information and principles provided in this report (Figure 5-2).

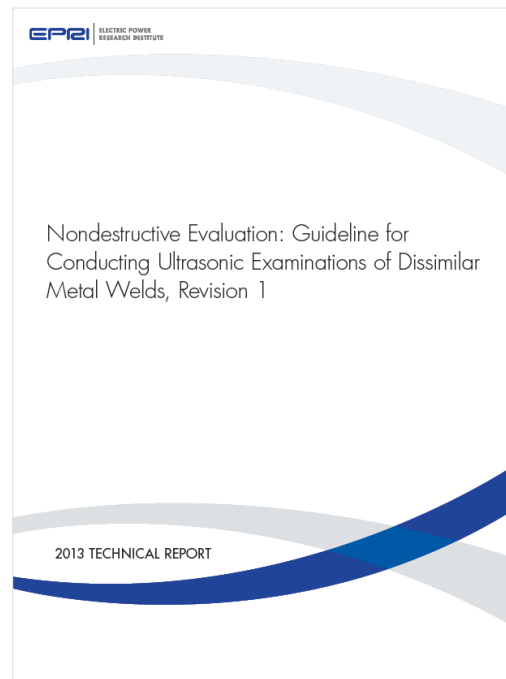


Figure 5-2
Cover of Product ID 3002000091

Nondestructive Evaluation: Performance Demonstration Initiative (PDI) Guidance for Improved Reliability in Ultrasonic Examinations [4]

The Performance Demonstration Initiative (PDI) is an organization first established by U.S. nuclear utilities to provide an efficient, cost-effective, and technically comprehensive implementation of ASME Section XI, Appendix VIII performance demonstration requirements. Today, the PDI Program is part of the EPRi NDE Program, and many utilities that are EPRi members use all or part of the PDI Program. This report was published to provide revisions to two existing PDI documents that were each intended to improve an important aspect of performing reliable ultrasonic examinations.

It is recognized that, during the construction of a power plant, piping systems and components will often require slight modification to enable them to fit together and function properly. Because of this, even plants starting out with the same component manufacturer and design may end up with unique weld configurations, such as shortened safe-ends or tapered surfaces, which can create complex challenges for ultrasonic examination of those welds. The purpose of *Site-Specific Mockup Requirements for Dissimilar Metal Welds* is to provide guidance for the optimization of ASME Section XI, Appendix VIII qualified examination techniques to allow compensation for unique site-specific configurations that are not represented in the PDI demonstration mockup inventory. The latest revision of this report (Revision C) is an extensive modification of the original document based on direct lessons learned from the U.S. industry experiences, including the North Anna event in 2012. It is intended to improve the reliability of site-specific examination preparations by making the rules surrounding this process much more rigorous. For example, this revision now requires an extensive technical basis document to accompany any site-specific mockup and even requires computer modeling to be used to support any examination modifications used, particularly if these modified techniques are to be validated using only a non-blind demonstration process.

The second document included in this report was written in recognition that it is essential that ultrasonic weld examiners maintain proficiency in their ability to reliably detect and characterize flaws. The *Guideline for Hands-On Practice (PDI-GL-001)* provides a process for qualified examiners to maintain this examination proficiency through regular practice using qualified procedures on practice specimens or pre-recorded data that contain cracks. This guideline was specifically written to satisfy the 8-hour hands-on practice training requirements specified in both the NRC Code of Federal Regulations (10CFR50.55a) [7], paragraph (b)(2)(xiv) and the ASME Boiler and Pressure Vessel Code, Section XI [1], Appendix VII, paragraph VII-4240. Revision B of this document is the result of an extensive review by the NIFG and provides more stringent implementation requirements than in the original version. For example, personnel holding qualifications in multiple ASME Section XI [1], Appendix VIII supplements (for example, austenitic and DM piping weld examination) are required to practice on at least two of the Appendix VIII supplements for which they hold qualifications. In addition, the examiner is required to exercise the entire examination process, including equipment selection, calibration, scanning, data interpretation, data recording, and documentation of the examination.

For utilities that are not bound by the NEI 03-08 process, the principles contained in the two PDI documents included in this guideline will be useful for helping to ensure that highly reliable UT examinations are being performed in the plant. Regardless of which codes and standards apply, it is important that the individuals performing UT examinations are practicing on realistic mockups, on a regular basis, and thereby maintaining a high level of proficiency in the procedures for which they are currently qualified. In addition, when a plant has identified one or more complex weld configurations requiring volumetric examination and a site-specific mockup is needed to determine the best technical approach to performing that examination, the site-specific mockup processes spelled out in this report provide a sound scientific approach to determining the best examination method and essential parameters to be used. See Figure 5-3.

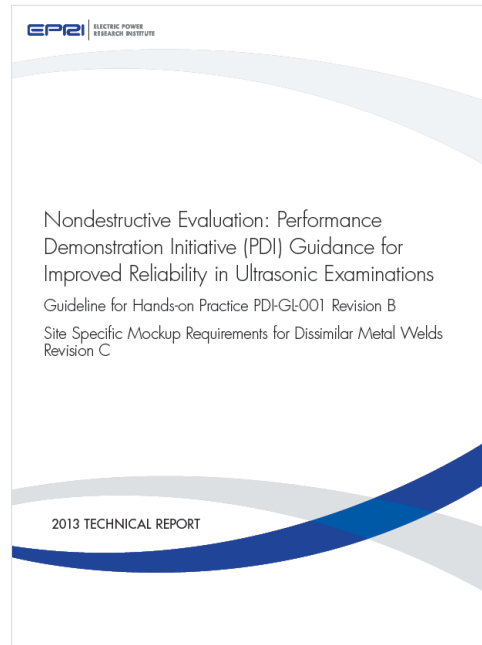


Figure 5-3
Cover of Product ID 3002000204

Nondestructive Evaluation: 2013 Team Scanning Assessment Conducted on Behalf of the NDE Integration Committee's NDE Improvement Focus Group [5]

Team scanning is the process by which one technician scans or physically manipulates the UT transducer during an examination while a separate qualified examiner performs real-time interpretation of the displayed UT signals. Because this technique was identified as a possible contributing cause in the *Dominion Root Cause Evaluation – RCE001078* [8] (Note: Dominion owns and operates the North Anna nuclear power station), it was included in the scope of items reviewed by the NIFG. As a result, Appendix B of the *Guideline for Conducting Examinations of Dissimilar Metal Welds, Revision 1* [3] specifically provides guidance on the use of team scanning.

In addition to developing a set of NEI 03-08 “Needed” rules for conducting team scanning, the NIFG commissioned EPRI to design and conduct an experiment to assess the effectiveness of team scanning when performed in accordance with the NIFG guidance. This report describes the experiment that was performed, the results obtained from the experiment, and several additional recommendations for consideration by utilities that find themselves in a position to use the technique.

Utilities reviewing this report may not be readily aware of whether team scanning is being used for examinations at their plants. This was the case with many of the U.S. utilities surveyed by the NIFG. Therefore, it may be worthwhile to explore this question with your NDE staff and inspection vendors. If it is determined that team scanning is sometimes used in your facilities, it would be worthwhile to consider employing the guidance that the NIFG has developed as well as reviewing this team scanning assessment report for additional recommendations to ensure that the examinations are performed in a reliable manner. See Figure 5-4.

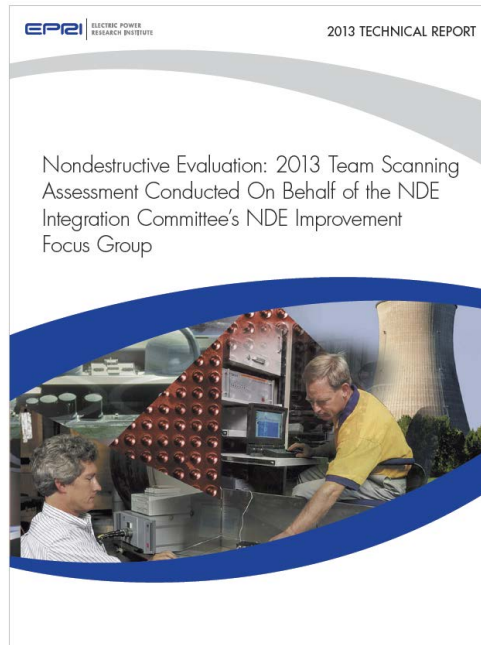


Figure 5-4
Cover of Product ID 3002002048

Nondestructive Evaluation: Industry Best Practices for Performing Reliable NDE [9]

Based on the reliability improvements for UT of DM welds realized because of the NIFG products discussed in this report, the EPRI Nuclear Power Council's NDE Action Plan Committee (APC #4) requested that additional NDE guidance be developed to assist plant NDE personnel with planning and executing all NDE with the same high standards of reliability. So, in 2015, another industry focus group of experienced utility and vendor Level III and ISI personnel was assembled to help write a high-level guide, containing the key aspects and best industry practices for planning and performing NDE. In April 2016, EPRI published the resulting report (3002007329, shown in Figure 5-5). It is formatted as a reference guide to allow quick reference to various aspects of the examination process. As such, it provides high-level points, intended to guide the user through key aspects of proper planning and execution of efficient, reliable, and meaningful NDE. When it touches on topics in which a greater level of detail may be helpful to the end user, this product also provides references to other EPRI or industry documents where the appropriate level of detail may be found.

Although some of the discussion and terminology used in this report—and even the codes and standards referenced—may not be directly applicable to power plants outside the United States, the principles and techniques that it discusses should be universally applicable to the performance of reliable and consistent NDE in nuclear power plants. As such, personnel responsible for conducting examinations at any nuclear power plant worldwide should consider downloading this report and keeping it handy as a reference guide to assist them with the preparation, planning, and execution of NDE.

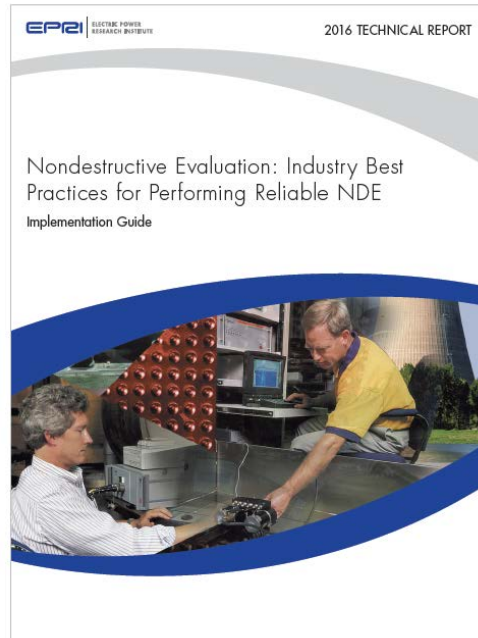


Figure 5-5
Cover of Product ID 3002007329

6

SUMMARY

Although there are many variations in codes and regulations applicable to NDE of nuclear power plant components, as well as the way they may be applied, the performance of consistent and reliable NDE is vitally important—regardless of the geographical location of the plant. Therefore, sharing information about NDE-related events, lessons learned, and solutions throughout the global NDE community can help improve the reliability and consistency of examinations everywhere.

The United States has experienced issues of varying severity related to NDE reliability in recent years. And although the industry has always responded appropriately and taken actions to correct the deficiencies, when five relatively large SCCs failed to be detected during ultrasonic examination of a DMW at the Unit 1 North Anna Power Station in 2012, the U.S. industry became resolved to carefully examine all aspects of this examination process and make improvements. This “watershed” event led to the formation of the NDE Improvement Focus Group and the development of several guidelines and reports aimed at improving the overall reliability and consistency of NDE.

Although these guidelines and reports are specifically targeted for use at U.S. nuclear power plants, the principles and recommendations contained within these documents are universally applicable and should be reviewed and considered for implementation at any power plant that wishes to ensure that highly reliable NDE is being performed. Therefore, the objectives of the current report are to introduce the global NDE community to several recent NDE reliability improvement guidelines and reports, to provide some context for why each of them was developed, and to summarize their content and potential value to any power plant seeking to benefit from these significant NDE-related operating experiences and lessons learned.

7

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