



PROPOSED AGENDA SEMIANNUAL PDI NRC MEETING

June 27 - 28, 2000

- ▼ **GUIDLINE DOCUMENT**
- ▼ **INDIVIDUAL RFR**
- ▼ **SCHEDUAL OF IMPLEMENTATION**
- ▼ **PIPING SINGLE SIDE ACCESS (no report)**
- ▼ **RPV SINGLE SIDE ACCESS**
- ▼ **DISSIMILAR METAL WELDS**
- ▼ **OVERLAY**
- ▼ **SUMMARY OF ACTIONS**

**GUIDELINE
FOR
THE IMPLEMENTATION OF APPENDIX VIII
AND 10CFR 50.55a**

**Volume One
Programmatic Implementation
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5/22/2000**

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EXECUTIVE SUMMARY

Revisions to 10 CFR 50.55a published September 22, 1999 (Final Rule) mandate the implementation of the ASME Code, Section XI, Division 1, Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems". Appendix VIII requires qualification of the procedures, personnel, and equipment used to detect and size flaws in piping, bolting, and the reactor pressure vessel. Each organization (e.g. Owner or Vendor) will be required to have a written program to insure compliance with the requirements.

This Volume of the Guide identifies programmatic issues and describes the NRC Final Rule, the responsibilities of the owner, and the Performance Demonstration Initiative (PDI) Program. Recommendations are included to assist owners in developing their written program(s), with references to applicable Code Cases. Appendices provide detailed responses to frequently asked questions, detailed comparisons of the PDI Program requirements with those of the Final Rule, and sample requests for relief (RFR). Additional volumes will be published as needed. For example, Volume two will provide guidelines to assist owners in developing effective implementation programs for performing the examinations. It will also include lessons learned from earlier applications plus additional guidance in developing the owners program. Future Volumes will provide guidelines in areas that are currently in course of preparation. These include examination of corrosion resistant cladding and dissimilar metal welds.

US nuclear utilities formed the PDI in 1991 to address the pending requirements of Appendix VIII in an efficient, cost-effective, and technically sound manner. This included development of programs, qualifications of procedures, procurement of flawed practice and test specimens, and initial qualifications of personnel and equipment. All U.S. and three foreign nuclear utilities are members.

The Final Rule required implementation of Appendix VIII on an accelerated basis. Consequently, implementation for piping and bolting will be required after May 22, 2000 with RPV circumferential and longitudinal welds required after November 22, 2000. The remaining applications will become mandatory in 2 years for overlay repair welds and 3 years for RPV nozzles and dissimilar metal piping welds.

The owner will be required to initiate one or more RFR. The owner may be required to revise commitments associated with their written practice for certification of NDE personnel and their implementation of Regulatory Guide 1.1.50 or Generic Letter 88-01. The extent of these revisions will depend on such things as the examination plan and whether the plant is a pressurized or boiling water reactor. This document provides guidance in making those decisions. The following summarizes the required actions to establish an effective Appendix VIII Program.

A. Establish Licensee Commitments

Licensees are required to establish an Appendix VIII program that meets the requirements of the 95/96 Code as modified by the revision of 10 CFR 50.55a dated September 22, 1999. This program must include details of how they will implement Appendix VIII. Vendors that perform examinations at a licensee's facility must also establish a program. The majority of the US vendors and Utilities utilize the PDI program to meet the practical requirements of Appendix VIII, but the programmatic issues must be addressed in the licensee's/vendor's implementation documents.

B. Develop or Revise Implementation Documents

This guide describes different options for using Appendix VII. Utilities that have piping, bolting, and RPV shell examinations scheduled after May 22, 2000 must have a written practice that meets the requirements of the Final Rule or be granted relief. Training requirements must also be addressed. A listing of other referenced Code sections is included.

Licensees must also evaluate current commitments associated with RG 1.150 and GL 88-01 and revise as necessary.

C. Apply for Relief in the appropriate areas

As noted there are several areas that will require a RFR in order to successfully implement examinations in accordance with Appendix VIII and the accelerated schedule identified in the Final Rule. The licensee should review their examination plans well in advance of the outages and determine what areas will require relief. Additionally, commitments that may affect vendors programs must be transmitted to the vendors well in advance in order for them to make the appropriate changes.

PROGRAMMATIC CONSIDERATIONS

BACKGROUND

These Guidelines provide information that can be used to assist utilities in preparing for Implementation of 10 CFR 50.55a requirements for ultrasonic examination of piping, reactor pressure vessel (RPV), bolts and studs. The Final Rule requires implementation of the ASME Code, 1995 Edition, 1996 Addenda, Section XI, Division 1, Appendix VIII. US utilities formed the PDI in 1991 to address these issues and provide funding for the production of samples and the development of a cost effective, technically sound qualification program. Qualification demonstrations were initiated in 1994.

The original scope of the program included austenitic and ferritic piping, RPV circumferential and longitudinal welds, nozzle-to-shell welds, nozzle inner radius examinations, and bolts and studs. Activities on the two nozzle applications were halted, awaiting regulatory action. The nozzle examination activities were reactivated following issuance of the 10 CFR 50.55a Final Rule, September 22, 1999. PDI also initiated funding and development of the programs for dissimilar metal welds and overlay repaired welds.

Since the issuance of the Final Rule, PDI has been actively engaged in developing information that will assist member utilities in implementing the requirements of the 10 CFR 50.55a Final Rule and Appendix VIII. Responses to questions from the January 2000, PDI Workshop and frequently asked questions from utilities and vendors is included as Appendix A.

This document summarizes the requirements and describes actions that may be used by utilities in developing their programs to comply with these new requirements.

REQUIREMENTS

10CFR 50.55a, as amended by the Federal Register Notice 64 FR 51370 dated September 22, 1999, requires implementation of Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems". The effective date for the Final Rule is November 22, 1999.

Effective Code Year

The Final Rule requires licensees to implement Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems", to Section XI, Division 1, 1995 Edition with the 1996 Addenda with modifications as stated in 10 CFR 50.55a(b)(2)(xiv, xv and xvi).

Implementation Schedule

The Final Rule requires accelerated implementation of Appendix VIII. Licensees are required to implement the supplements to Appendix VIII according to the following schedule as defined in 10 CFR 50.55a(g)(6)(ii)(C):

SUPPLEMENT	QUALIFICATION REQUIREMENTS FOR:	IMPLEMENTATION DATE
1	Evaluating Electronic Characteristics of Ultrasonic systems	May 22, 2000
2	Wrought Austenitic Piping Welds	May 22, 2000
3	Ferritic Piping Welds	May 22, 2000
4	Clad/Basemetal Interface of Reactor Vessel	Nov. 22, 2000
5	Nozzle Inside Radius Section	Nov. 22, 2002
6	Reactor Vessel Welds other than Clad/Basemetal Interface	Nov. 22, 2000
7	Nozzle-to-Vessel Weld	Nov. 22, 2002
8	Bolts and Studs	May 22, 2000
9	Cast Austenitic Piping (In Course of Preparation)	N/A
10	Dissimilar Metal Welds	Nov. 22, 2002
11	Full Structural Overlaid Wrought Austenitic Piping Welds	Nov. 22, 2001
12	Coordinated Implementation of Selected Aspects of Supplements 2, 3, 10, and 11	Nov. 22, 2002
13	Coordinated Implementation of Selected Aspects of Supplements 4, 5, 6, and 7	Nov. 22, 2002

PDI PROGRAM

PDI is an organization comprised of all U.S. nuclear utilities that was formed to provide an efficient, cost-effective, and technically sound implementation of Appendix VIII performance demonstration requirements. The PDI is responsible for preparing the test protocol, documenting the budget and schedule, providing the NRC/Code interface, and providing technical, financial, and administrative oversight. The EPRI NDE Center is the Performance Demonstration Administrator (PDA) for the program. Under the guidance of the PDI and in compliance with the EPRI Quality Program and Procedure Manual, the PDA collects and disperses supplemental funding, provides technical and legal support, and administers the plan provided by the PDI. This includes specimen design, sample fabrication, qualification testing, and maintaining registries. The PDA also performs other support activities such as participation in NUPIC and EPRI internal QA audits, coordinating ANII(S) involvement in the PDI program, and maintaining generic procedures for manual ultrasonic examinations.

NRC Assessment

The NRC Staff performed an assessment of the PDI Program, Rev. 0, during the month of January 1995 and issued a report on March 6, 1996. The report listed 13 outstanding issues (1) that have been resolved to the satisfaction of the NRC (2). The resolutions to the NRC issues (changes and modifications) are contained in Rev. 1 Change 1 of the PDI Program Description document.

Program

The PDI Program is administered according to the "PDI Program Description" document (3) and is written to comply with the requirements of Code Case N-622. PDI works closely with the ASME Code to develop effective and practical requirements for the conduct of ultrasonic performance demonstrations. Code Case N-622 was developed to incorporate corrections to the Code and the practical experience of PDI in performing Appendix VIII piping, bolting and Reactor Pressure Vessel (RPV) demonstrations since 1994. The Final Rule references the ASME Code, Section XI, 95 Edition with the 96 Addenda (95/96 Code). A comparison of the 95/96 Code as modified by the Final Rule and Code Case N-622 established the basis for this Guideline. It is included for information purposes as Appendix B. The PDI Program meets or exceeds the requirements of the Final Rule, with the exception of five implementation issues, which remain unresolved. These issues are described below.

Implementation Issues

Piping Examinations from Inside Surface

Appendix VIII does not specifically address piping examinations performed from the inside surface during the RPV examination. PDI had intended that piping examinations performed from the inside surface would be implemented in tandem with the dissimilar metal weld examination qualifications. However, this is not reflected in the implementation schedule. No procedures, equipment, or personnel are currently qualified to perform examinations from the inside surface. PDI is addressing this problem by proposing recommendations for the revision of Appendix VIII.

Utilities scheduled to examine PWR category B-J similar-metal piping welds from the inside surface, after May 22, 2000 will be required to request relief from the implementation schedule requirements of 10 CFR 50.55a(g)(6)(ii)(C). A sample RFR and technical basis is included as Appendix C – Implementation Schedule for Welds Examined from the Inside Surface.

RPV Length Sizing Tolerance

Paragraph 2.4.1 in the summary of comments issued with the Final Rule, stated that the PDI requirements are directly contained in paragraph 10 CFR 50.55a(b)(2)(xv). However, the Final Rule inadvertently omits the length sizing qualification criteria of 0.75 inch Root Mean Square Error (RMSE), which was used to qualify all examiners. The 0.75-inch RMSE criterion is included in Code Case N-622. NRC has indicated that this was an oversight and that it will be corrected (4) in a future revision of the Final Rule.

All utilities planning to perform RPV examinations to the requirements of Appendix VIII must submit a RFR to allow the correct length sizing qualification criteria. NRC has previously granted relief for use of Code Case N-622 Appendix 4. This criterion was also the subject of review during the NRC Assessment of the PDI Program (1). A sample RFR is included as Appendix D – Alternative Supplement 4 Length Sizing Criteria.

Single Side Access

10 CFR 50.55a(b)(2)(xv)(A), 10 CFR 50.55a(b)(2)(xv) G, and 10 CFR 50.55a(b)(2)(xvi), define new requirements for coverage and qualification demonstration. These requirements affect both piping and RPV examinations.

The PDI Program is in agreement with the Final Rule regarding single side access for piping. The Final Rule requires that if access is available the weld shall be scanned in each of the four directions (parallel and perpendicular to the weld) where required. Coverage credit may be taken for single side exams on ferritic piping. However, for austenitic piping, a procedure must be qualified with flaws on the inaccessible side of the weld. The Final Rule requires that single side access examinations must demonstrate "equivalency to two sided examinations". Current technology is not capable of reliably detecting or sizing flaws on the inaccessible side of an austenitic weld, for configurations common to US nuclear applications. Instead of a full single side qualification, PDI offers a best effort approach, which demonstrates that the best available technology is applied. This best effort approach does not meet the requirements of the Final Rule. PDI Performance Demonstration Qualification Summary (PDQS) austenitic piping certificates list the limitation that single side examination is performed on a best efforts basis. This requires the inaccessible side of the weld to be listed as an area of no coverage. If a RFR is required, the technical basis may state that the best available techniques were used from the accessible side of the weld. A Sample RFR is included as Appendix E – Austenitic Welds Single Side Access.

RPV qualifications performed to date have met all requirements of the ASME Code and the PDI Program at the time of qualification. Some of these qualifications list a single side capability. However, these demonstrations do not meet the new requirements for single side access qualifications that are listed in the Final Rule, 10 CFR 50.55a(b)(2)(xv)(G)(1), (2), and 10 CFR 50.55a(b)(2)(xvi)(A). Utilities and PDQS certificate holders which list single side qualifications will be notified of these differences. New certificates will be issued as amended single side procedures are demonstrated and qualified.

It is clear that RPV Supplement 4 and 6 procedures will require additional qualification for single side access. The extent of procedure and personnel requalification that must be performed to qualify vessel examination

for single side access remains unresolved at this time. A test block has been fabricated to demonstrate the required capabilities.

Utilities planning on performing RPV examinations using procedures qualified to Appendix VIII by PDI should not take credit for single side coverage unless the PDQS states that the procedure meets the intent of 10 CFR 50.55a(b)(2)(xv)(G) and CFR 50.55a(b)(2)(xvi)(A). No qualified procedures currently meet these requirements. A RFR similar to that contained in Appendix E may be used if required.

Referenced Code Sections

Utilities should be aware of and evaluate the impact of the following statement made by the NRC for resolution of comments to the Final Rule:

"The ASME has stated that provisions of the same vintage are to be used; i.e., provisions from the same edition and addenda. Appendix VIII, 1995 Edition with the 1996 Addenda, contains the following references: VIII-3110(c) references Appendix III, "Ultrasonic Examination of Piping Systems," as supplemented by Table I-2000-1, "Nozzle in Shell or Head (Examination Zones in Barrel Type Nozzles Joined by Full Penetration Corner Welds)." Appendix III references IWB-3500, "Acceptance Standards," IWA-2300, "Qualification of Nondestructive Examination Personnel," IWA-2120, "Qualification of Authorized Inspection Agencies, Inspectors, and Supervisors," and IWB-3514, "Standards for Examination Category B-F, Pressure Retaining Dissimilar Metal Welds in Vessel Nozzles, and Examination Category B-J, Pressure Retaining Welds in Piping." Supplements 5 and 6 reference Figure IWB-2500-7. Supplement 6 references IWA-3000, "Standards for Examination Evaluation". In addition, provisions from Subsection IWA for personnel requirements (e.g., CP-189) and third party inspection (ASME N626), as well as Section XI, Appendices IV and V, are referenced. The final rule would require that all related provisions be used."

The above topic was an item of discussion during the May 16, 2000 meeting of the Section XI Task Group on Appendix VIII. Specifically the need for a RFR if utilities wish to continue using the 1989 Appendix VII requirements (e.g. SNT-TC-1A) instead of implementing the 95/96 requirements (e.g. CP-189). The prevailing opinion was that when applicable, it is more appropriate to address pertinent Appendix VIII requirements using the current Code of Record (e.g. maintain the current written practice) than to use the later requirements. Since NRC comments are not part of the Final Rule and the Final Rule does not address Appendix VII a RFR was not considered necessary.

It is a utility decision whether to update or submit a request for relief. In support of those utilities submitting a RFR from implementing the 95/96 Appendix VII and CP-189, a sample RFR with basis is included as Appendix F – Continue Using ASNT SNT-TC-1A for Ultrasonic Examinations or alternatively Appendix G – Use CP-189 for Qualification of Nondestructive Examination Personnel.

Examination of Piping Welds with Corrosion Resistant Cladding (CRC)

CRC is austenitic weld material added to the inside surface in the area of the heat-affected zone. It was typically applied to piping systems to help mitigate IGSCC. To compensate for

radial shrinkage, cladding was occasionally applied to the outside surface. The presence of cladding adds additional challenges to the examination process.

Appendix VIII, Supplement 2 does not specifically address examination of piping containing CRC. This was an item of discussion during the May 16, 2000 meeting of the Section XI Task Group on Appendix VIII. The prevailing opinion was that CRC is not included in the scope of the PDI program for Supplement 2 and when Supplement 2 is inappropriate, the 95/96 Appendix I requires the supplemented use of Article 4 of Section V (I-2400), or the 1989 Appendix I requires the supplemented use of either Article 4 or 5 of Section V. Based on this premise, current options to address CRC include:

- 1 - Performing the examinations to Article 4 or 5 requirements;
- 2 - Performing the examinations to Article 4 or 5 requirements and supplementing them with good practices such as those identified in EPRI Report NP-4891-LD, "Examination of Corrosion Resistant Clad Weldments, Dated October, 1986, or;
- 3 - Obtaining a RFR to use the good practices instead of Article 4.

The subject report is no longer available but a copy will be made available upon request. It concludes in part that:

- 1 - Conventionally used S-wave examinations are ineffective;
- 2 - Refracted L-wave search units are required, and it may be necessary to use more than one per examination to ensure the optimum beam angle and frequency is used;
- 3 - Cracks penetrating the inside surface clad layer were readily detectable;
- 4 - L-wave search units with 60-degree beam angle are effective for crack detection. The 45-degree angle is also capable of detecting the cracks, but can produce false calls;
- 5 - Automated systems aided in the interpretation of examination due to complexities caused by the application of CRC and showed repeatable results on mockups, and;
- 6 - A survey of utilities revealed that a total of 312 weld joints have had CRC applied as an IGSCC countermeasure.

A sample RFR is included as Appendix H – Corrosion Resistant Cladding. PDI is presently working on developing a program to address CRC welds but it can not be completed according to the current implementation schedule.

UTILITY PROGRAM

Appendix VIII, Article VIII -1100 (b) requires that each organization (e.g. Owner or Vendor) shall have a written program to insure compliance with the requirements of the Appendix. Owners who participate in the PDI Program may list the appropriate revision of the PDI Program Description document as evidence of compliance with the qualification process. Vendors may provide their properly authenticated PDQS certificate as evidence of compliance in the qualification process. Compliance with Appendix VII is also required. In addition, the owners program should also include a listing of applicable code cases. A listing of applicable cases follows.

Code Cases:

It is recommended that the following Code Cases be included in the Owners Program.

N-622

“Ultrasonic Examination of RPV and Piping, Bolts, and Studs”: The only feature of CC N-622 that is required is the length sizing qualification criteria of Appendix 4. It is not currently recommended that Code Case N-622 is used in its entirety. A sample RFR is included as Appendix D – Alternative Supplement 4 Length Sizing Criteria.

When asked if Code Case (CC) N-622 is an acceptable alternative to the Final Rule, the NRC stated:

“N-622 has not been endorsed by the NRC in RG 1.147. Until CC N-622 is endorsed, licensees will have to request its use as an alternative to Code. The staff has reviewed portions of CC N-622, Chapters A-1000 through B-5000 and selected supplements. This review is contained in the safety evaluation to T. F. Plunkett, Florida Power and Light Company, dated September 29, 1999. The supplements not reviewed to date are 2, 3, 5B, and 8. There are also a number of editorial errors in CC N-622. Licensees requesting to use CC N-622 as an alternative per 10CFR 50.55a(a)(3)(i) will have to address the editorial errors, the clarifications in the letter dated September 23, 1999, and the differences between the Final Rule and the unreviewed portions and supplements”.

N-613

“Ultrasonic Examination of Full Penetration Nozzles in Vessels”: Relief should be requested for the use of N-613. This case redefines the nozzle to shell weld inspection volume and eliminates the need to perform circumferential scans on these welds. One utility has received permission to use this Code Case. A sample RFR is included as Appendix I – Code Case N-613

N-583

“Annual Training Alternative”: This Code case will allow individuals to receive 8 hours of hands on practice as an alternative to the 10 hours of annual training required by Appendix VII. This hands on practice is suitable to fulfill the 8 hours of practice required by the final rule, provided it is completed no earlier than 6 months prior to performing ultrasonic examinations at a licensee’s facility. Personnel who do not perform Appendix VIII activities could continue to receive the 10 hours of annual training required by Appendix VII. A sample RFR is included as Appendix J – Code Case N-583.

Effective Code Sections and Appendices

Piping

Appendix VIII, Supplements 2, 3, and 12 are applicable to all Class 1 and 2 austenitic and ferritic piping (This does not include ultrasonic thickness testing used in most flow accelerated corrosion programs). These Supplements are currently in use by several utilities. Adoption of these Supplements is optional before May 22, 2000. PDI qualifications also address IGSCC qualifications required by Generic Letter 88-01, (8).

Dissimilar Metal Welds

(In course of preparation)

RPV Circumferential and Longitudinal Welds

Appendix VIII, Supplements 4, 6, and 13 address qualification for the examination of RPV seam welds, excluding head to flange and shell to flange welds. Subparagraph I-2110(b) states “Ultrasonic examination of reactor vessel-to-flange welds, closure head-to-flange welds, and integral attachment welds shall be conducted in accordance with Article 4 of Section V, except that alternative examination beam angles may be used. These examinations shall be further supplemented by Table I-2000-1.”

Single side coverage would be reported according to the requirements of 10 CFR 50.55a(b)(2)(xv)(G). Coverage of the inner 15% of the weld from all four directions and the outer 85% in at least one direction parallel to the weld and one direction perpendicular to weld is considered single side coverage.

NOTE: Owners of BWR units will also want to request exclusion of circumferential welds. The Vessel and Internals Project (VIP) has addressed this exclusion (5) and relief has been granted to several utilities. NRC Generic Letter 98-05 contains additional guidance. It is available at <http://www.nrc.gov/NRC/GENACT/GC/GL/1998/g198005.html>.

Nozzle Inner Radius

Appendix VIII, Supplement 5 addresses qualification for the examination of the nozzle inner radius. The samples required for these qualifications are available. Implementation of the inner radius is required by November 22, 2002. Demonstrations are expected to begin in 2000 and 2001. Nozzle inner radius examinations are not included in the Scope of Regulatory Guide 1.150.

Owners of BWR units will need to address the requirements of NUREG 0619. The Demonstrations performed by the PDI Program will be sufficient to satisfy the demonstration requirements of NUREG 0619 (6) within the examination boundary specified by Section XI Figures IWB 2500 (a) and (b). Flaws located in the bore region (zones 2B and 3) may be examined using piping procedures. Before the implementation of Appendix VIII, Supplement 5B, the recommendations of the BWR Owners Group, GE-NE-A71-0594 (7) should be used for guidance. The NRC made the following statement in resolution of comments to the Final Rule.

"With regard to NUREG 0619, "BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking," November 1980, in a letter dated June 5, 1998, from Thomas Essig, Acting Chief, Generic Issues and Environmental Projects Branch, Division of Reactor Program Management, NRR, to Thomas J Raush, Chairman, Boiling Water Reactor Owner's Group (BWROG), the NRC accepted an alternative to the recommendations set forth in NUREG-0619. In summary, the NRC determined that the proposed BWROG alternative to the BWR feedwater nozzle inspections recommended in NUREG-0619 were acceptable provided that the provisions of Appendix VIII were used."

Nozzle to Shell Welds

Appendix VIII, Supplement 7 addresses qualification requirements for examination of the RPV Nozzle to shell welds. The samples required for these qualifications are available. Implementation is required by November 22, 2002. Demonstrations are expected to begin in 2000 and 2001. Code Case N-613 should be included in the Utility Program. Examinations performed to existing requirements will still need to address Regulatory Guide 1.150, where applicable.

Bolting

Appendix VIII, Supplement 8 requires a site-specific calibration stud or bolt. PDI offers personnel qualifications from the borehole and from the end surface of the bolt or stud. Member utilities may use these generic qualifications provided their application is within the scope of the qualified Generic Procedures. Qualified equipment, procedures, and personnel must be used for the examination. Supplement 8 replaces Appendix VI and its' use is mandatory after May 22, 2000.

Overlay

Appendix VIII Supplement 11 addresses overlay Welds. The required implementation date is November 22, 2001. Qualifications to the Three Party agreement Program will continue until samples and programs to meet the new Code requirements are available. It is anticipated that these qualifications can begin by January 2001.

OTHER REGULATORY ISSUES AND CONSIDERATIONS

Regulatory Guide 1.150

When implementing Supplements 4, 5, 6, and 7 for the RPV (excluding the reactor vessel-to-flange welds and closure head-to-flange welds) the ISI program should state that the Appendix VIII requirements are being implemented instead of Regulatory Guide 1.150 (4). Regulatory Guide 1.150 remains applicable for the reactor vessel-to-flange welds and closure head-to-flange welds.

The NRC made the following statement in the resolution of comments to the Final Rule:

"The NRC agrees that the prescriptive guidance given in Regulatory Guide 1.150, "Ultrasonic Testing of Reactor Vessel Welds During Preservice and Inservice Examinations," is not in total agreement with the PDI program which is a performance-based program. However, regulatory guides provide guidance and are not requirements. This rule requires implementation of the PDI program (or Appendix VIII as in the Code) and thus, supersedes any corresponding provisions in Regulatory Guide 1.150. It should be noted, however, that the regulatory guide provides instructive discussion on UT operability. The NRC staff will review RG 1.150 and determine whether any changes are necessary."

Generic Letter 88-01

The PDI Program includes provisions to address qualification of examiners for IGSCC susceptible piping, according to the requirements of Generic Letter 88-01. Several modifications have been made to the PDI program, at the request of NRC. NRC has reviewed the PDI Program and found it acceptable (2). The changes requested by NRC are addressed in the PDI Program and are included in Code Case N-622. It should be noted that a three-year personnel requalification requirement remains in place for IGSCC.

The NRC made the following statement in resolution of comments to the Final Rule:

"With regard to NUREG 0313, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping," Revision 2, January 1998, in a letter dated September 2, 1998, from Edmund J. Sullivan, Acting Chief, Materials and Chemical Engineering Branch, Division of Engineering, NRR, to Frank C. Leonard, Chairman, PDI, the NRC recognized the PDI program as an alternative to the IGSCC Coordination Plan, which therefore, satisfies the performance demonstrations in GL 88-01, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping," and NUREG-0313."

Other Considerations

Utilities should consider including the EPRI NDE Center in their approved vendor's list to provide training, testing, and examination services for qualification. The PDA functions under the EPRI Quality Assurance Program and receives periodic audits from both internal sources and external sources such as NUPIC.

Utilities should consider incorporating Generic Procedures into their examination program. PDI has developed and qualified Generic Procedures for Ferritic Piping (PDI-UT-1), Austenitic Piping (PDI-UT-2), Through Wall Sizing in Pipe Welds (PDI-UT-3), Studs and Bolts from the Bore (PDI-UT-4), Straight Beam of Studs and Bolts (PDI-UT-5), and Weld Overlaid Austenitic Piping Welds (PDI-UT-8).

Utilities should evaluate Authorized Inspector (ANII(S)) involvement before implementing their Appendix VIII Program. While several Authorized Inspection Agencies have been involved in the PDI Program and the qualification of the PDI Generic Procedures, this may not be true for vendor procedures.

Appendix K provides a sample Appendix VIII program and Appendix L provides the current status of PDI compliance with applicable portions of the Final Rule. Appendix L concludes with a listing of licensee action items.

REFERENCES

1. NRC Assessment of the PDI Program, March 6, 1996, Jack Strosnider, Chief Materials and Chemical Engineering Branch, to Bruce Sheffel, Charmin PDI, March 6, 1996.
2. IGSCC Performance Demonstration Administered by PDI as an Alternative for Generic Letter 88-01 Recommendations, Edmund J. Sullivan Jr. Acting Branch Chief to Frank Leonard, Chairman PDI, September 2, 1998.
3. "PDI Program Description," Rev (1) Change (1),
4. Regulatory Guide 1.150, "Ultrasonic Testing of Reactor Vessel Welds During Preservice and Inservice Examination", U.S. Nuclear Regulatory Commission, February 1983, Revision 1.
5. VIP-05 – Boiling Water Reactors Vessel and Internals Project
6. U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, "BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking": November 1980, NUREG-O619, Washington, D.C.: Office of Nuclear Reactor Regulation.
7. GE-NE-A71-0594 – "Alternate BWR Feedwater Nozzle Inspection Requirements".

APPENDICES

APPENDIX

- A. Frequently Asked Questions
- B. Comparison of the 1995 Edition, 1996 Addenda of the ASME Code Section XI Appendix VIII, as modified by the Final Rule and Code Case N-622
- C. Sample RFR - Welds Examined from the Inside Surface
- D. Sample RFR - Alternative Supplement 4 Length Sizing Criteria
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APPENDIX A
Responses to January 2000 PDI workshop questions and other
Frequently Asked Questions from vendors and utilities

General Implementation Questions/Concerns

1. *Will it be necessary to request relief to use Code Case N-622?*

Yes, however we do not recommend that you request relief to use the entire Code Case. It is more appropriate to work to the 95/96 Code as amended by the Final Rule and only request relief to use Appendix 4 of the Code Case. A sample RFR is included as Appendix D.

2. *Do PDQS documents, which list Code Case N-622, meet the requirements of the Final Rule?*

Yes, the PDI Program meets or exceeds the requirements of the Final Rule with the exception of the implementation issues listed in this report. A letter has been sent to the industry, Utilities, and vendors, describing the acceptability of current PDI qualifications.

3. *Will the NRC accept these proposed implementation approaches and will the current qualifications be acceptable?*

We believe they will. PDI has addressed the differences between the Final Rule and the PDI Program with NRC. NRC has indicated agreement with most of the recommendations made by PDI and they agreed to continue discussions on single sided examinations for the RPV. Owners should continue to report coverage as they have in the past.

4. *Does the current PDI Program address Corrosion resistant Cladding (CRC)?*

No, the original scope of the PDI Program did not include CRC. This is one of the 5 previously identified implementation issues. Owners that have CRC are joining to address this concern. The first step is to go to the NRC, inform them of the problem, and ask for an extension in this area. Similar to the problem with examination of piping welds from the inside surface, it will require a RFR (See Appendix H). The affected utilities are organizing to address this issue, including the development and sharing of samples.

5. *How many utilities depend on applying IWA-2240 and have NRC approval?*

No one at the PDI meeting responded, but it must be noted that after September 22, 1999, IWA-2240 is no longer needed to implement Appendix VIII qualified procedures. It may still be needed if a licensee decided to implement qualified techniques on components outside Appendix VIII, such as steam generator welds and pressurizers.

In their resolution of public comments, the NRC stated:

“Per 10 CFR 50.55a(g)(4), Section XI applies and, therefore, Subsection IWA-2240 also applies. IWA-2240, “Alternative Examinations”, states that, “Alternative examination methods, a combination of methods, or newly developed techniques may be substituted for the methods specified in this Division, provided the Inspector is satisfied that the results are demonstrated to be equivalent or superior to those of the specified method.” The NRC’s view is that, in order to use an alternative method; it would have to be satisfactorily demonstrated that the alternative examination method is equivalent or superior to the specified method. Thus, the performance demonstration would have to be as rigorous as the Appendix VIII performance demonstration.”

6. How are others in the industry applying IWA-2240 and/or relief requests for items not within the scope of Appendix VIII? What is the approach?

There have been several successful approaches. One is to request the use of alternative examination techniques in accordance with 10CFR.50. The other has been the use of IWA-2240. The acceptance of the approach seems to have been determined by the regional NRC inspectors, but most requests have been accepted thus far.

7. Do we have enough work force to meet personnel demands for Spring and Fall 2000? How do we address shortages, if any?

It is hard to tell whether sufficient people are available. Activity at EPRI has not picked up substantially since the issuance of the Final Rule. The vendors are the only people who really know if they have sufficient people to support their workload. There have been no shortages for the spring outages, but the fall of 2000 will be the real test. Vendors and contractors must be notified well in advance that they will be required

8. Is the PDI summer testing/qualification schedule full? Does it need to be?

The summer session is starting to fill. June is practically full, but there are still slots available in July and August. Vendors are the only ones that really know.

9. How does the ANII verify procedure revisions? At PDI? At utilities and how does the Final Rule affect this?

Presently, the ANII's on site are individually reviewing the procedures. In the past, ANII's were used to witness the qualification of the procedures during the PDI demonstrations. This is no longer the policy. Since Appendix VIII does not contain additional ANII responsibilities, current practices should remain unchanged.

Where a procedure is different from that which was qualified, the utility, vendor, and ANII will be required to assure that the essential variables are equal to those that were qualified. The PDA can assist in this effort at the request of the utility or vendor. It is not

a requirement that the PDA participate in the review. Software revisions for automated systems are subject to the same review process.

10. With the Final Rule, it is possible that PDI could obtain ANII witnessing on a generic basis. Currently, ANII witnessing is dealt with by each utility.

This is a PDI discussion, but based on the previous answer, it is less of an issue.

RPV Concerns

11. RPV single side exam—what is required by the Final Rule?

The Final Rule requires that the inner 15% of the vessel be scanned in two directions perpendicular to the weld and two directions parallel to the weld. This is no different from current requirements. If an area cannot be scanned to the extent required, this must be recorded and reported in accordance with existing requirements.

At this time, the remaining 85% should be scanned in the same manner as described above. Current PDI qualifications do not meet the requirements of 10CFR 50.55a(b)(2)(xv)(G)(2), which addresses single side access.

NRC has a concern that flaws with extreme orientation relative to the surface normal may go undetected. Examinations and destructive evaluation of components from canceled plants has revealed clustered flaws resulting from documented and undocumented repairs. EPRI and PDI are investigating this condition. Discussions with NRC will continue.

12. Where does the RPV closure head to flange weld fall—under Appendix I or Appendix VIII?

Appendix I. Appendix I requires that these welds be examined to the requirements of Section V, Article 4. Appendix VIII qualified sizing techniques may be applied to the flange according to the requirements of Appendix I. Detection examinations must be performed to the requirements of Section V, Article 4. Examinations procedures qualified to the requirements of Appendix VIII, may be applied using IWA-2240 or a request to use alternative examination criteria as provided by 10CFR 50.55a.

(B) Does 1.150 address these welds?

Licensees must commit to the level that they will follow the guide. Most licensees commit to following 1.150 for all RPV welds. In their response to comments to the Final Rule, the NRC stated the following.

“The NRC agrees that the prescriptive guidance given in Regulatory Guide 1.150, “Ultrasonic Testing of Reactor Vessel Welds During Preservice and Inservice Examinations,” is not in total agreement with the PDI program which is a performance-based program. However, regulatory guides provide guidance and are not

requirements. This rule requires implementation of the PDI program (or Appendix VIII as in the Code) and thus, supersedes any corresponding provisions in Regulatory Guide 1.150. It should be noted, however, that the regulatory guide provides instructive discussion on UT operability. The NRC staff will review RG 1.150 and determine whether any changes are necessary."

(C) Implication of using or not using 1.150?

NRC has stated that the licensees must identify their licensing commitments. There is no reason to apply RG 1.150 for welds that are examined with PDI qualified procedures after the implementation date, but RG 1.150 may still be required for welds being examined by Appendix 1 techniques (e.g., Flange to Shell and Head to Flange welds). The licensee must determine what procedures and techniques will be used on these welds.

13. PDI applies to RPV seam welds and nozzle welds only. All others (non-RPV welds) fall under Appendix I?

Appendix I, Appendix VIII, and the Final Rule address shell to shell welds, nozzle to shell welds and the Nozzle inner radius area of the RPV. Appendix I specifically excludes head to flange and flange to shell welds. Appendix I requires that welds other than the RPV are to be examined according to the requirements of Section V Article 4.

14. Can we not justify our current demonstrations and qualifications (concerning the 45° flaw) based on fracture mechanics? Can we find these 45° flaws single sided?

This is being addressed by PDI and NDE Center Programs. Experiments are currently in progress to determine their detectability.

Piping Questions/Concerns

15. Can the PDI qualification for IGSCC be extended from 3 to 5 years? Why not?

No, based on the previous three-party agreement for IGSCC and poor current PDI requalification pass rates it will not be obtainable. Efforts will soon be underway to focus on performance enhancement concerning PDI (and IGSCC) qualification demonstrations.

16. Can a certifying agency give an individual a third Appendix VII examination (in 12 months) if he failed twice at PDI qualification? If he passes, can he be issued an Appendix VII qualification?

Yes, subparagraph VII-4360(c) states that "No individual shall be reexamined more than twice within any consecutive 12 month period". Since the individual has only taken 1 reexamination, this person could receive an Appendix VII qualification if they are successful on their third attempt.

17. Where and when do we record/report single side piping limitations? On NIS-1 or exam report?

The coverage achieved should be listed on the record of examination. When using ferritic piping procedures that are qualified for single sided access full coverage can be claimed for welds that have access only from one side provided the required coverage is achieved. For austenitic piping welds where only single side examination is available, full coverage should not be listed, unless it has been shown equivalent to dual side examinations according to the requirements of the Final Rule. Currently no austenitic procedure has been qualified to this requirement and only that portion of the weld that can be examined without the ultrasonic beam having to propagate through the austenitic weld material may be credited for 100% coverage. For coverage of the inaccessible side of the weld, PDI provides a limited demonstration, which can provide evidence that the best available techniques were applied. The PDQS will indicate whether or not the personnel, procedures, and equipment were demonstrated to these limited performance criteria. Coverage claimed on the inaccessible side of the weld should be accompanied by a note stating that, application of best available techniques were applied and provide a reference to the PDI Program and the PDQS.

18. Will there be a blanket/generic statement from PDI defining limited piping single side exam coverage?

PDI has made a generic statement about the coverage achieved during single side piping examinations. This letter is attached to every piping PDQS document issued. The letter basically restates that the qualification for single side austenitic welds is "best effort".

19. What about relief from NUREG 0313?

Relief is not required to use PDI qualified IGSCC procedures. Previous NRC correspondence has stated that PDI is an acceptable means of qualification to meet NUREG 0313 and GL 88-01. In their response to comments on the Final Rule, the NRC states the following.

"With regard to NUREG 0313, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping," Revision 2, January 1998, in a letter dated September 2, 1998, from Edmund J. Sullivan, Acting Chief, Materials and Chemical Engineering Branch, Division of Engineering, NRR, to

Frank C. Leonard, Chairman, PDI, the NRC recognized the PDI program as an alternative to the IGSCC Coordination Plan, which therefore, satisfies the performance demonstrations in GL 88-01, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping," and NUREG-0313."

20. Can we report limited exam coverage at the end of 10-year interval? Will this meet code? What if relief is not granted?

Typically a Summary Report is submitted each outage certifying that the statements made in the report are correct, the examinations meet the inspection plan as required by the Code, and corrective measures taken conform to the rules of the Code. This would normally include a RFR for those welds that had limited exam coverage. However, one utility listed exam coverage limitations at the end of the ten-year interval on the NIS-1 in a table.

21. Would like to have PDQS listing ("registry") and Table 1 on web for quick utility/subscriber access.

This task is in progress.

22. How do we compare equivalent procedures or assess Table 1 compliance for vendors on-site for spring 2000 exams? Which is most current Table 1 and do we need it?

The most current Table 1 is not required—assure your vendors are using equipment listed on the Table 1 that you do have.

23. If our utility does in-house comparison of equivalency, is that OK with ANII?

Yes, it should be. Refer back to question number 9.

24. PDQS says double sided. Can I do a single side exam?

No. No credit can be claimed for single sided exams, in this case. PDI does offer a demonstration on a best effort basis. However, these demonstrations do not meet the requirements of 10 CFR 50.55a(b)(2)(xvi)(A)

25. Does the current PDI program meet the Final Rule regarding single side access for austenitic piping regarding flaws on the opposite side of the weld?

No it does not. The Final Rule requires that single side examination be demonstrated to be equivalent to dual side access. This may never be possible for austenitic welds. See 10 CFR 50.55a(b)(2)(xvi)(A).

26. How do I know when I have the latest revision to Table 1?

We plan to put this information on the web site. Each key contact is notified when a new revision is issued. You may call the PDA to verify which is the latest revision.

27. What kinds of software controls are applied to generic procedures and Table 1?

The PDA controls and documents revisions to the Generic procedures. Distribution of the procedures is open. Responsibility for using the latest revision rests with the user.

28. What are the tolerances on the generic procedure qualifications (piping)? Would these cover 10, 12 and 14" NPS Schedule 10 pipes?

The diameter and thickness ranges covered by any procedures must be listed in the Scope of the procedure. This is the range, which has been qualified.

29. Based on the pipe geometry, when performing scans for axial flaws, must you use an angle listed in Table 1 if it does not meet the minimum angle requirements for the OD/ID ratio? Is Table 1 based on refracted angle or incident angle?

A letter was sent to all key contacts describing the appropriate approach to selecting the correct angle in this situation.

30. How are safe-end welds (PWR pump) covered? What about cast components?

Under Supplement 11 Dissimilar Metal Welds (See Implementation schedule). The examination of cast components is not presently addressed by Appendix VIII. Credit should not be taken for the cast side of a weld.

31. Risked based exams is code volume +0.5", how does or is this affected by current Appendix VIII approach?

No affect. An extension of the examination volume is acceptable as long as the techniques used to perform the examination are the same. PDI demonstrations extend beyond the counterbore area.

32. Is the exam volume an essential variable? What about when performing single side exams?

Not in itself, but it is part of the procedure scope and should be addressed. For single sided exams, the procedure(s) address what is to be done if coverage cannot be obtained with a particular search unit. It first requires an increase in angle. If coverage cannot be obtained with the higher angle, then an increase in V-path is acceptable, provided conditions such as counterbore and as-welded weld crowns do not adversely affect the bouncing of the beam. Single V-path examinations are preferred when possible.

33. What are the effects of qualifications regarding weld repairs on new welds or full volume repair welds? Is there a need for requalification? What about exam volume?

If weld repair is within the scope of the qualified procedure, then the qualifications are unaffected. One may need to revisit the scope of the procedure.

34. Does Appendix VIII supercede Appendix III?

Yes. Appendix I states that procedures qualified in accordance with Appendix VIII are acceptable and no other rules apply.

35. What about non-RPV welds and how is PDI addressing them?

Presently there are no Supplements in Appendix VIII that address non-RPV vessels, however some licensees are choosing to use techniques that have been demonstrated to be effective through RPV demonstrations on vessels such as steam generators and pressurizers. In order to use these techniques the licensees have used IWA-2240.

Bolting

36. How can I expand personnel and/or procedure qualification (for bolting)? Diameter or length?

The scope can be expanded by performing a demonstration to the ANII on your calibration standard, as long as the standard meets Appendix VIII requirements for notches.

Comment: Straight-beam technique from top or bottom is the most commonly used exam approach. If done from bore, bore size must cover radial metal path range at site. Qualification may require two demonstrations, one from bore and one from top or bottom.

37. If the length of the area of interest is within the PDI qualification (per PDQS), can the exam still be performed without further qualification even though the stud may be longer than the stud used for qualification?

Yes. The qualification is based on metal path.

Practice Guidelines

38. Can a utility meet the Final Rule for hands on practice within their own utility using their own Level III's and not have to go to PDI?

Yes, it can be done according to the policies and procedures of your utility. The PDI practice guideline is for portability.

39. Code Case N-583 - Do we need NRC approval for training?

Yes, you will need to request relief to use Code case N-583 until it is issued in Reg. Guide 1.147. Note the following response from NRC during resolution of comments to the Final Rule.

"The proposed requirements have been replaced in the final rule by Code Case N-583 as implemented by PDI. The PDI program will manage such features as training and maintaining the confidentiality of training specimens."

40. Is the 8-hour Final Rule 'training' requirement applicable for the upcoming Spring 2000 outages?

No, if before May 22, 2000: Yes, if on or after: for piping and bolting.

Dissimilar Metal Welds (DSM)

41. Are there any DSM in the current IGSCC sample population?

No.

42. Has IGSCC been included in DSM weld program? Why or why not? PDI should consider a DSM program with IGSCC.

There are no reliable IGSCC fabrication techniques in place to permit the mechanical verification of in-situ IGSCC. Based on flaws found in the field, we will attempt to simulate appropriate flaw responses.

43. What is the 'best effort' for DSM concerning IGSCC and other flaw mechanisms?

Research is needed and is underway to define these issues and develop a technical justification to assess measurable lengths and through-wall extents. Unique or special situation samples or mock-ups could be designed and fabricated through SRA funding.

44. Will the RPV nozzle to pipe qualification have cracks that are opened to the OD surface to satisfy the PT requirement for these welds?

That is the current plan.

Open Discussion

45. Define/explain what is flat-topped, as-welded, or flush?

Flat-topped permits scanning on the weld crown. Flush represents a condition where no exposed crown remains on the weld (radial shrinkage may be present for austenitic specimens). As-welded means As-welded, i.e. no grinding.

46. How do we assure compliance to Appendix VIII at the site? Computer programs available? Other means?

Qualified personnel should monitor the vendors. Use a spreadsheet with checklist and/or sign-offs. Check the vendor's probes and allow only approved search units. Use a database with personnel and equipment. Check vendor before they leave the calibration area. Issue technique sheet for each weld. Refer to the Part 2 of this report and the checklists in the Appendices.

47. Do you have a checklist for use by QA auditors during the exams?

Yes, we currently have available specific checklists used by PDA during qualification of Vendor procedures for automated examinations. Please contact the PDA and identify the applicable procedure. Other checklists are being developed for inclusion in Volume 2 of this Guideline. Should a need arise before this document is published, please contact the PDA.

APPENDIX B
Comparison of the 1995 Edition, 1996 Addenda of the ASME Code Section XI
Appendix VIII, as modified by the Final Rule and Code Case N-622

The following is provided for reference. It was used in part to establish the guideline and identifies several key differences between the Final Rule, CC N-622 and the PDI Program:

- (1) The PDI program and the Code Case include requirements accepted by the NRC as necessary for compliance with the qualification requirements of GL 88-01.
- (2) The Final Rule states that it modifies the 95/96 Code to be equivalent to the Code Case. However the Final Rule inadvertently omitted the Appendix VIII Supplement 4 length sizing accuracy which was used to qualify all of the qualified examiners and is included in Code Case N-622.
- (3) The Final Rule did not include the enhanced procedure qualification requirements, which were implemented based on requests by NRC and analysis of examination validity performed by PNNL.
- (4) It is clear that RPV Supplement 4 and 6 procedures will require additional qualification for single side access. The extent of personnel requalification to qualify vessel examination for single side access remains unresolved at this time.

IMPLEMENTATION SCHEDULE

10 CFR 50.55a	Code Case N-622
10 CFR 50.55a(g)(6)(ii)(C) Implementation of Appendix VIII to Section XI. (1) The Supplements to Appendix VIII of Section XI, Division 1, 1995 Edition with the 1996 Addenda of the ASME Boiler and Pressure Vessel Code must be implemented in accordance with the following schedule: Supplements 1, 2, 3, and 8—May 22, 2000; Supplements 4 and 6—November 22, 2000; Supplement 11—November 22, 2001; and Supplements 5, 7, 10, 12, and 13—November 22, 2002.	Not addressed

PERSONNEL QUALIFICATION

10 CFR 50.55a(b)(2)(xiv) personnel qualification	Code Case N-622
(xiv) Appendix VIII personnel qualification. All personnel qualified for performing ultrasonic examinations in accordance with Appendix VIII shall receive 8 hours of annual hands-on training on specimens that contain cracks. This training must be completed no earlier than 6 months prior to performing ultrasonic examinations at a	Personnel qualification as specified by the 10CFR rule is not currently included in Section XI Appendix VIII. Appendix VII of Sec XI VII-4240 Addresses Annual Training (10 hours).

licensee's facility.	
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EXAMINATION COVERAGE

10 CFR 50.55a(b)(2)(xv) Appendix VIII specimen set and qualification requirements.	Code Case N-622
The following provisions may be used to modify implementation of Appendix VIII of Section XI, 1995 Edition with the 1996 Addenda. Licensees choosing to apply these provisions shall apply all of the provisions except for those in § 50.55a(b)(2)(xv)(F) which are optional.	Not Addressed

Piping

§ 50.55a(b)(2)(xv)(A) and § 50.55a(b)(2)(xvi)(B) When applying Supplements 2 and 3 to Appendix VIII, the following examination coverage criteria requirements must be used:	Code Case N-622 A-1100 PIPING
(1) Piping must be examined in two axial directions and when examination in the circumferential direction is required, the circumferential examination must be performed in two directions, provided access is available.	(a) The required piping examination volume shall be examined in two axial directions. When examination in the circumferential direction is required, the circumferential examination shall be performed in two directions.
(2) Where examination from both sides is not possible, full coverage credit may be claimed from a single side for ferritic welds. Where examination from both sides is not possible on austenitic welds, full coverage credit from a single side may be claimed only after completing a successful single sided Appendix VIII demonstration using flaws on the opposite side of the weld.	(b) Alternatively, when examinations of ferritic welds from both sides is not possible, full coverage credit may be claimed from a single side using a procedure qualified for single-side examination in accordance with Appendix III. When examination of austenitic welds from both sides is not possible, full coverage credit may be claimed from a single side using a procedure qualified for single-side examination in accordance with Appendix II, with all flaws on the opposite side of the weld.
50.55a(b)(2)(xvi) <i>Appendix VIII single side ferritic vessel and piping and stainless steel piping examination.</i>	
50.55a(b)(2)(xvi)(B) Examinations performed from one side of a ferritic or stainless steel pipe weld must be conducted with equipment, procedures, and personnel that have demonstrated proficiency with single side examinations. To demonstrate equivalency to two sided examinations, the demonstration must be performed to the requirements of Appendix VIII as modified by this paragraph and § 50.55a(b)(2)(xv)(A).	

Vessel

50.55a(b)(2)(xv)	Code Case N-622 A-1200 REACTOR PRESSURE VESSEL SHELL WELDS
(G) When applying Supplement 4 to Appendix VIII, Supplement 6 to Appendix VIII, or combined Supplement 4 and Supplement 6 qualification, the following additional provisions must be used, and examination coverage must include:	
(1) The clad to base metal interface, including a minimum of 15 percent T (measured from the clad to base metal interface), shall be examined from four orthogonal directions using procedures and personnel qualified in accordance with Supplement 4 to Appendix VIII.	(a) The clad-to-base-metal interface region, including at least 15% T (measured from clad-to-base-metal interface), shall be examined from four directions, using a procedure qualified in accordance with Appendix IV. Examination directions shall include scans parallel and perpendicular to the weld.
(2) If the clad-to-base-metal-interface procedure demonstrates detectability of flaws with a tilt angle relative to the weld centerline of at least 45 degrees, the remainder of the examination volume is considered fully examined if coverage is obtained in one parallel and one perpendicular direction. This must be accomplished using a procedure and personnel qualified for single-side examination in accordance with Supplement 6. Subsequent examinations of this volume may be performed using examination techniques qualified for a tilt angle of at least 10 degrees.	(b) If the clad-to-base-metal-interface procedure demonstrates detectability of flaws with a tilt angle relative to the weld centerline of at least 45 deg., the remainder of the examination volume is considered fully examined if coverage is obtained in one parallel and one perpendicular direction. This <i>shall</i> be accomplished using a procedure and personnel qualified for single-side examination in accordance with Appendix VI. Subsequent examinations may be performed using examination techniques qualified for a tilt angle of at least 10 deg.
(3) The examination volume not addressed by § 50.55a(b)(2)(xv)(G)(1) is considered fully examined if coverage is obtained in one parallel and one perpendicular direction, using a procedure and personnel qualified for single sided examination when the provisions of §50.55a(b)(2)(xv)(G)(2) are met.	If the <i>Appendix VI</i> procedure demonstrates detectability of flaws with a tilt angle relative to the weld centerline of at least 45 deg., the remainder of the examination volume is considered fully examined if coverage is obtained in one parallel and one perpendicular direction. This shall be accomplished using a procedure and personnel qualified for single-side examination in accordance with Appendix VI. Subsequent examinations may be performed using examination techniques qualified for a tilt angle of at least 10 deg
(4) Where applications are limited by design to single side access, credit may be taken for the full volume provided the examination volume is covered from a single direction perpendicular to the weld and the weld volume is examined from at least one direction parallel to the weld.	

Nozzle-To-Shell

<p>50.55a(b)(2)(xv) (K) When performing nozzle-to-vessel weld examinations, the following provisions must be used when the requirements contained in Supplement 7 to Appendix VIII are applied for nozzle-to-vessel welds in conjunction with Supplement 4 to Appendix VIII, Supplement 6 to Appendix VIII, or combined Supplement 4 and Supplement 6 qualification.</p>	<p style="text-align: center;">Code Case N-622 A-1300 REACTOR PRESSURE VESSEL NOZZLE-TO-SHELL WELDS</p>
<p><i>Note K(1) is addressed in Supplement 7</i></p>	<p><i>See Code Case Appendix 7</i></p>
<p>(K)(2) For examination of reactor pressure vessel nozzle-to-vessel welds conducted from the inside of the vessel,</p>	<p>(a) Examinations Conducted from the Inside</p>
<p>(i) The clad to base metal interface and the adjacent examination volume to a minimum depth of 15 percent T (measured from the clad to base metal interface) must be examined from four orthogonal directions using a procedure and personnel qualified in accordance with Supplement 4 to Appendix VIII as modified by §§ 50.55a(b)(2)(xv)(B) and 50.55a(b)(2)(xv)(C)</p>	<p>(1) The clad-to-base-metal interface and the adjacent examination volume to a depth of at least 15% T (measured from the clad-to-base-metal interface) shall be examined from four orthogonal directions, using a procedure qualified in accordance with Appendix IV.</p>
<p>(ii) When the examination volume defined in § 50.55a(b)(2)(xv)(K)(2)(i) cannot be effectively examined in all four directions, the examination must be augmented by examination from the nozzle bore using a procedure and personnel qualified in accordance with §50.55a(b)(2)(xv)(K)(1).</p>	<p>(2) When the examination volume defined in (1) cannot be effectively examined in all four directions, the examination shall be augmented by examination from the nozzle bore, using a procedure qualified in accordance with Appendix VII.</p>
<p>(iii) The remainder of the examination volume not covered by § 50.55a(b)(2)(xv) (K)(2)(ii) or a combination of § 50.55a(b)(2) (xv) (K)(2)(i) and § 50.55a(b)(2)(xv) (K)(2)(ii), must be examined from the nozzle bore using a procedure and personnel qualified in accordance with §50.55a(b)(2)(xv)(K)(1),</p>	<p>(3) The remainder of the examination volume not covered by (1) or by a combination of (1) and (2) shall be examined in at least one radial direction from: (a) the nozzle bore using a procedure qualified in accordance with Appendix VII, or</p>
<p>or from the vessel shell using a procedure and personnel qualified for single sided examination in accordance with Supplement 6 to Appendix VIII, as modified by §§ 50.55a(b)(2)(xv)(D), 50.55a(b)(2)(xv)(E), 50.55a(b)(2)(xv)(F), and 50.55a(b)(2)(xv)(G).</p>	<p>(b) the vessel shell using a procedure qualified for single-sided examination in accordance with Appendix VI.</p>
<p>(K)(3) For examination of reactor pressure vessel nozzle-to-shell welds conducted from the outside of the vessel,</p>	<p>(b) Examinations Conducted from the Outside</p>
<p>(i) The clad to base metal interface and the</p>	<p>(1) The clad-to-base-metal interface and the</p>

<p>adjacent metal to a depth of 15 percent T, (measured from the clad to base metal interface) must be examined from one radial and two opposing circumferential directions using a procedure and personnel qualified in accordance with Supplement 4 to Appendix VIII, as modified by §§ 50.55a(b)(2)(xv)(B) and 50.55a(b)(2)(xv)(C), for examinations performed in the radial direction, and Supplement 5 to Appendix VIII, as modified by § 50.55a(b)(2)(xv)(J), for examinations performed in the circumferential direction.</p> <p>50.55a(b)(2)(xv)(K)(3)</p>	<p>adjacent examination volume to a depth of at least 15% T (measured from the clad-to-base-metal interface) shall be examined from one radial and two opposing circumferential directions using a procedure qualified in accordance with Appendix VI, for examination performed in the radial direction, and Appendix V-B, for examination performed in the circumferential directions.</p>
<p>(ii) The examination volume not addressed by § 50.55a(b)(2)(xv)(K)(3)(i) must be examined in a minimum of one radial direction using a procedure and personnel qualified for single sided examination in accordance with Supplement 6 to Appendix VIII, as modified by §§ 50.55a(b)(2)(xv)(D), 50.55a(b)(2)(xv)(E), 50.55a(b)(2)(xv)(F), and 50.55a(b)(2)(xv)(G).</p>	<p>(2) The remainder of the examination volume not covered by (1) shall be examined in at least one radial direction using a procedure qualified for a single-side examination in accordance with Appendix VI.</p>
<p>NOTE 50.55A(B)(2)(H), (I) AND (J) DO NOT MODIFY SECTION XI APPENDIX I REQUIREMENTS, THEY MODIFY SECTION XI APPENDIX VIII SUPPLEMENT 5 "NOZZLE INNER-RADIUS QUALIFICATION REQUIREMENTS", SEE CODE CASE APPENDIX V.</p>	

Bolts and Studs

	<p style="text-align: center;">Code Case N-622 A-1400 BOLTS AND STUDS</p> <p><i>ULTRASONIC EXAMINATION OF BOLTS AND STUDS SHALL BE PERFORMED USING PROCEDURE AND PERSONNEL QUALIFIED IN ACCORDANCE WITH CHAPTER B, APPENDIX VIII. THE VOLUME SPECIFIED IN IWB-2500 AND IWC-2500 SHALL BE EXAMINED.</i></p>
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SCOPE

<p style="text-align: center;">1995/1996A APPENDIX VIII V-1100 General</p>	<p style="text-align: center;">Code Case N-622 B-1100GENERAL</p>
<p>Same</p>	<p>(a) This Chapter provides requirements for performance demonstration for ultrasonic examination procedures and personnel used to detect and size flaws.</p>
<p>Same</p>	<p>(b) Each organization (e.g., Owner or vendor) shall have a written program that ensures compliance with this Case. Each organization that performs ultrasonic examinations shall qualify its procedures and personnel in</p>

	accordance with this Case. The organization may contract implementation of the program.
Same	(c) Performance demonstration requirements apply to personnel who detect, record, or interpret indications or size flaws in welds or components.
Same	(d) The performance demonstration requirement specified in this Case do not apply to personnel whose involvement is limited to mounting a scanning device, marking pipe, or other situations where knowledge of ultrasonics is not important.
(e) Any procedure qualified in accordance with this Appendix is acceptable.	Not addressed
(f) Instrument characterization described in supplement 1 is optional. When Supplement 1 is selected, both the original and substituted equipment shall be characterized.	Not addressed
Same	(e) Operators of fully-automated data collection systems need not be qualified to the requirements of this Case, provided that (1) the data analyst is qualified to the requirements of this Case, and is responsible for system calibration and verifying systems sensitivity; (2) the analyst is responsible for establishment of examination sensitivity; and (3) the system meets the definition of automated system, below.
Same	(f) Systems used for acquisition (collection) of ultrasonic data are classified as automated, semi-automated, or manual, as define below.
Same	(1) Automated system - A system that is fully software-controlled by input parameters or specification from an operator and that digitally acquires and records the complete real-time output for each transducer during the collection process. All system calibrations, examination, and scanning parameters used during collection are verifiable during off-line analysis. All required real-time information (e.g., A-scan waveforms, C-scan or B-scans images) can be processed off line for analysis. No adjustments to the ultrasonic parameters can be made without knowledge and

Same	<p>concurrency of the analyst.</p> <p>(2) Semi-automated system or manual system. A system that is not fully software-controlled, i.e., that requires an operator to make ultrasonic parameter adjustments during the collection process, that will affect the off-line analysis. The following are some characteristics of semi-automated or manual systems:</p> <p>(a) complete real-time output for each transducer is not recorded;</p> <p>(b) all system calibrations, and examination, and scanning parameters cannot be verified during off-line analysis;</p> <p>(c) the examination cannot be reconstructed from the recorded data;</p> <p>(d) adjustments to the ultrasonic parameters can be made without knowledge and concurrency of the analyst.</p>
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GENERAL EXAMINATION SYSTEM REQUIREMENTS

VIII-2000	B-2000
VIII-2100 PROCEDURE REQUIREMENTS	B-2100 PROCEDURE REQUIREMENTS
Same	(a) The examination procedure shall contain a statement of scope that specifically defines the limits of procedure applicability (e.g., materials, thickness, diameter, and product form).
Inserted NEW item and renumbered	(b) The procedure shall provide specific instructions with sufficient detail to assure that the Owner can determine that the qualified procedure is followed during field applications.
SAME AS VIII-2000(b)	(c) The examination procedure shall specify a single value or a range of values for the variables listed in B-2100(e).
SAME AS VIII-2000 (c)	(d) Any calibration method may be used provided it is described and complies with B-2100 (e)(5).
SAME AS VIII-2000 (d)	<p>(e) The examination procedure shall specify the following essential variables:</p> <p>(1) instrument or system, including manufacturer and model or series of pulser, receiver, and amplifier, including:</p> <p>(a) instrument settings for center frequency, pulse width, and filtering or smoothing;</p> <p>(b) operation, e.g., voltage, spike, square wave, tone burst;</p> <p>(2) search units, including:</p> <p>(a) center frequency and either bandwidth</p>

	<p>or waveform duration as defined in B-4000;</p> <p>(b) mode of propagation and nominal inspection angles;</p> <p>(c) number, size, shape, and configuration of active elements and wedges or shoes;</p>
Same	<p>(3) search unit cable, including:</p> <p>(a) type;</p> <p>(b) maximum length;</p> <p>(c) maximum number of connectors;</p>
Same	<p>(4) detection and sizing techniques, including:</p> <p>(a) scan pattern and beam directions;</p> <p>(b) maximum scan speed;</p>
(c) minimum and maximum pulse repetition rate;	(c) minimum and maximum pulse repetition rate (BOLTING ONLY);
(d) minimum sampling rate (automatic recording systems);	(D) MINIMUM SPATIAL SAMPLE SPACING IN SCAN AND INDEX DIRECTIONS, I.E., SAMPLE SURFACE DISTANCE BETWEEN POINTS WHERE AN A-SCAN IS RECORDED (AUTOMATED SYSTEMS);
Same	(e) extent of scanning and action to be taken for access restrictions;
Same as VIII-2000(d)(5)-(10)	<p>(5) methods of calibration for detection and sizing (e.g., actions required to insure that the sensitivity and accuracy of the signal amplitude and time outputs of the examination system, whether displayed, recorded, or automatically processed, are repeated from examination to examination);</p> <p>(6) inspection and calibration data to be recorded;</p> <p>(7) method of data recording;</p> <p>(8) recording equipment (e.g., strip chart, analog tape, digitizing) when used;</p> <p>(9) methodology and criteria for discrimination of indications (e.g., geometric versus flaw indications and for length and depth sizing of flaws);</p> <p>(10) surface preparation requirements;</p>
New Item	(11) ANY OTHER IDENTIFIABLE FACTOR THAT COULD SUBSTANTIALLY INFLUENCE THE EFFECTIVENESS OF THE EXAMINATION.

PERSONNEL REQUIREMENTS

VII-2200	B-2200 PERSONNEL REQUIREMENTS
Same	Personnel shall meet the requirements of Section

	XI Appendix VII and shall be qualified in accordance with B-3000
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QUALIFICATION TEST REQUIREMENTS

	B -3000
	B-3100 QUALIFICATION TEST REQUIREMENTS
	B -3110 DETECTION
Same	(a) Qualification test specimens shall meet the requirements of the appropriate Appendix listed in Table B-3110-1
Same	(b) The examination procedure and personnel are qualified for detecting flaws upon successful completion of the performance demonstration specified in the appropriate Appendix listed in Table B-3110-1.
Same	(c) For piping welds whose requirements are in course of preparation the requirements of Appendix III of Section XI, as supplemented by Table I-2000-1, shall be met.

Sizing

VIII-SIZING	B-3120 SIZING
Same	(a) Qualification test specimens shall meet the requirements of the appropriate Appendix listed in Table B-3110-1.
Same	(b) The examination procedure and personnel are qualified for sizing flaws upon successful completion of the performance demonstration specified in the appropriate Appendix listed in Table B-3110-1.
Same	(c) For piping welds whose requirements are in course of preparation, the requirements of Section XI of Appendix III, as supplemented by Table I-2000-1, shall be met.
Same	(d) RMS error shall be calculated as follows: $RMS = \left[\frac{\sum_{i=1}^n (m_i - t_i)^2}{n} \right]^{1/2}$ <p>where m_j = measured flaw size t_j = true flaw size n = number of flaws measured</p>

**TABLE B-3110-1
COMPONENT QUALIFICATION APPENDIX'S**

Component Type	Applicable Appendix
Piping Welds	
Wrought Austenitic	II
Ferritic	III
Cast Austenitic	[Note (1)]
Dissimilar Metal	Appendix VIII, Supplement 10
Overlay	Appendix VIII, Supplement 11
Coordinated Implementation	Appendix VIII, Supplement 12
Vessels	
Clad-to-Base-Metal Interface Region	IV
Nozzle Inside Radius Section	V-A or V-B
Reactor Vessel Welds Other Than Clad-to-Base-Metal Interface	VI
Nozzle-to-Vessel Weld	VII
Coordinated Implementation	XIII
Bolts and Studs	VIII

NOTES

1. In the course of preparation

ESSENTIAL VARIABLE RANGES

VIII-3130 ESSENTIAL VARIABLE RANGES	B-3130 ESSENTIAL VARIABLE RANGES
Same	<p>(a) Any two procedures with the same essential variable [B-2100 (e)] are considered equivalent. Pulsers, search units, and receivers that vary within the tolerance specified in B-4100 are considered equivalent. When the pulser, search units, and receivers vary beyond the tolerances of B-4100, or when the examination procedure allows more than one value or range for an essential variable, the qualification test shall be repeated at the minimum and maximum value, as applicable from B-4100 (e.g., at the lowest and highest allowed settings or frequencies) for each essential variable with all other variables remaining at nominal values. Changing the essential variable may be accomplished during successive personnel performance demonstrations. Each examiner need not demonstrate qualification over the entire range of every essential variable.</p>
(b) When the procedure does not specify a range for essential variables and establishes criteria for selecting values, the criteria shall be demonstrated	(b) When the procedure does not specify a range for essential variables and establishes criteria for selecting values, the criteria shall be

	demonstrated DURING THE PROCEDURE QUALIFICATION.
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REQUALIFICATION

VIII-2200 REQUALIFICATION	B-3140 REQUALIFICATION
Same	When a change in an examination procedure causes an essential variable to exceed a qualified range, the examination procedure shall be requalified for the revised range.

PROCEDURE MODIFICATION

VIII-4100 PROCEDURE MODIFICATION	B-4100 PROCEDURE MODIFICATION
V-4110 PULSERS, RECEIVERS, AND SEARCH UNITS	B-4110 PULSERS, RECEIVERS, AND SEARCH UNITS
The qualified procedure may be modified to substitute or replace pulsers, receivers, or search units without requalification when the following conditions are met.	COMPONENTS OF THE SAME MAKE, MODEL NUMBER AND PHYSICAL DESCRIPTION ARE SUBSTITUTABLE WITHOUT FURTHER CONSIDERATION. The qualified procedure may be modified to substitute or replace pulsers, receivers, or search units without requalification when the following conditions are met.
Same	(a) Instruments with reject, damping, or pulse tuning controls, have discrete settings specified in the procedure. (b) Pulsers and receivers shall be evaluated using ASTM E 1324, Guide for Measuring Some Electronic Characteristics of Ultrasonic Instruments, with the following exceptions:
Same	(1) The lower (F_L) and upper (F_U) limits for receivers shall be determined between frequencies that are 6 dB below the peak frequency.
Same	(2) The receiver center frequency (F_C) shall be determined by: $F_C = \frac{F_L + F_U}{2}$ (3) The receiver bandwidth (BW) shall be determined by: $BW = \frac{F_U - F_L}{F_C} \times 100$ (c) Search units shall be evaluated using ASTM E 1065, Evaluation of the Characteristics of Ultrasonic Search Units. (d) Examination systems shall be evaluated using

	<p>Appendix I.</p> <p>(e) Replacements of the instrument or the pulser section of the instrument system shall be with the following tolerances of the original equipment as measured into a 50 ohm, non-inductive, non-capacitive, resistive load:</p>
Same	<p>(1) pulse amplitude, $\pm 10\%$;</p> <p>(2) pulse rise time, $\pm 10\%$;</p> <p>(3) pulse duration, $\pm 10\%$.</p>
Same	<p>(f) Replacements of the instrument or the receiver section of the instrument system shall be within the following tolerances of the original equipment:</p> <p>(1) lower and upper frequency limits at the -6 dB point, ± 0.2 MHz;</p> <p>(2) center frequency for instrument receivers with bandwidths less than 30%, $\pm 5\%$;</p> <p>(3) center frequency for instrument receivers with bandwidths equal to or greater than 30%, $\pm 10\%$.</p>
Same	<p>(g) Replacement search units of the same manufacturer's model, size, and nominal frequency may be used without requalification.</p> <p>(h) Replacement search units not of the same manufacturer's model, that are of the same nominal size and frequency, shall be within the following tolerances of the original search units:</p> <p>(1) propagation mode is the same;</p> <p>(2) measured angle, ± 3 deg.;</p> <p>(3) center frequency for search units with bandwidths less than 30%, $\pm 5\%$;</p> <p>(4) center frequency for search units with bandwidths equal to or greater than 30%, $\pm 10\%$;</p> <p>(5) waveform duration, $\pm 1/2$ cycle or 20%, whichever is greater (measured at -20 dB), or bandwidth, $\pm 10\%$;</p>
	<p>(i) As an alternative to (e) through (h) above, equipment replacement, including interconnecting cabling, is acceptable if the examination system is within the following tolerances of the original system, as measured according to the requirements of Appendix I:</p> <p>(1) system center frequency $\pm 5\%$, for examination systems with bandwidths less than 30%;</p> <p>(2) system center frequency $\pm 10\%$, for examination systems with bandwidths equal to or greater</p>

	than 30%;
(3) system bandwidth, $\pm 10\%$	(3) system bandwidth, -10% and no upper limit.

SEARCH UNIT CHARACTERIZATION

VIII-4120 SEARCH UNIT CHARACTERIZATION	B-4120 SEARCH UNIT CHARACTERIZATION
Same	Characterization measurements of the search unit shall be made using either a sinusoidal tone burst technique or shock excitation. When using shock excitation, the characterization pulser and UT instrument pulser shall be the same within the limits of B 4110(e).

COMPUTERIZED SYSTEM ALGORITHMS

B-4200 COMPUTERIZED SYSTEM ALGORITHMS	B-4200 COMPUTERIZED SYSTEM ALGORITHMS
Same	When the performance demonstration uses prerecorded data, algorithms for automated decisions may be altered when the altered algorithms are demonstrated to be equivalent to those qualified. When the performance demonstration results meet the acceptance requirements of B-3000, the algorithm shall be considered qualified.

CALIBRATION METHODS

B-4300 CALIBRATION METHODS	B-4300 CALIBRATION METHODS
Same	Alternative calibration methods may be demonstrated equivalent to those described in the qualified procedure without requalification. This demonstration of equivalence shall be conducted for each beam angle and mode of propagation to which it applies, as follows.
Same	(a) Calibrate the examination system in accordance with the alternative methods. (b) Compare the sensitivity of the alternative calibration method to that of the qualified calibration method.
Same	(c) The alternative calibration method is acceptable when the system sensitivity is no more than 2 dB below that obtained by the qualified method.

B-5000 RECORD OF QUALIFICATION B-5100 GENERAL

Same	The organization's performance demonstration program shall specify the documentation that shall be maintained as qualification records.
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Documentation shall include identification of personnel, NDE procedures, equipment and specimens used during qualification, and results of the performance demonstration.

APPENDIX I

EVALUATING ELECTRONIC CHARACTERISTICS OF ULTRASONIC SYSTEMS

There are no changes in this Supplement by either the Code Case or the regulation

1.0 SYSTEM FREQUENCY CHARACTERISTICS

1.1 The frequency response, also known as the frequency spectrum, shall be determined by measuring the amplitude of the pulse echo response from a target as a function of frequency. This response shall be used as a basis for establishing the center frequency and bandwidth of the ultrasonic system.

CAUTION: The required output signal test point from the ultrasonic instrument may require access to ultrasonic circuitry inside the instrument chassis. The use of high impedance test probes may also be required if the signal of interest is not buffered.

1.2 Connect the ultrasonic instrument including the search unit and, if applicable, the wedge, as shown in Fig. I-1A. The output signal from the ultrasonic instrument that is used in data analysis for flaw detection or flaw sizing (i.e., the output signal after amplification, filtering, and video detection) shall be input to a device that is capable of measuring the frequency spectrum (e.g., a spectrum analyzer or a digitizing circuit with a software package that determines the frequency response of waveforms). If a digitizing circuit is used, the rate of digitizing shall be at least five times the nominal (labeled) frequency of the search unit.

(a) If the receiver or transmitter provides variable signal filtering or frequency control, the signal controls shall be set as specified in the examination procedure. Check all connections in the test setup to ensure that it is safe to turn on the ultrasonic system.

(1) Flat or non-focused search units shall be adjusted so that the distance (Z_0) from the face of the search unit to the target is 2 in. (see Fig. I-1B). A smooth, flat block with minimum dimensions 2 in. x 2 in. x 1 in. thick is the target. Using a manipulator, adjust the search unit angle with respect to the block until the return echo is maximized indicating that the sound field is perpendicular to the block. Adjust the receiver section gain controls until the ultrasonic signal amplitude from the block is 80% of full scale without saturating the ultrasonic signal. Plot the frequency spectrum of the ultrasonic signal as shown in Fig. I-2A.

(2) Determination of the frequency response for focused search units shall follow the same procedure for flat search units, except that the distance Z_0 shall be adjusted to maximize echo from the target.

1.3 System Frequency Response Results

(a) Lower Frequency Limit (F_L)—The lower frequency limit (MHz) at a specific frequency control setting is the lowest frequency on the frequency response curve that is 6 dB below the maximum amplitude as shown in Fig. I-2A.

(b) Upper Frequency Limit (F_U)—The upper frequency limit (MHz) at a specific frequency control setting is the highest frequency on the frequency response curve that is 6 dB below the maximum amplitude as shown in Fig. I-2A.

(c) Center Frequency (F_c)—The center frequency (MHz) at a specific frequency control setting shall be calculated in accordance with B-4110, (b)(2).
(d) Bandwidth (BW)- The bandwidth (%) at a specific frequency control setting shall be calculated in accordance with B-4110, (b)(3).
(e) The system frequency response results, (a) through (d) above, shall be obtained for the remaining receiver and transmitter control module setting combinations used in the performance demonstration. These values shall be recorded.

FIGURES NOT INCLUDED IN THIS TEXT ARE INCLUDED IN CODE CASE N-622, THESE INCLUDE; FIG: I-1A SYSTEM CONFIGURATION, FIGURE. I-1B TEST CONFIGURATION AND FIGURE I-2A FREQUENCY RESPONSE CURVE

APPENDIX II

QUALIFICATION REQUIREMENTS FOR WROUGHT AUSTENITIC PIPING WELDS

1.0 SPECIMEN REQUIREMENTS

Same	Qualification test specimens shall meet the requirements listed herein, unless a set of specimens is designed to accommodate specific limitations stated in the scope of the examination procedure (e.g., pipe size, access limitations). The same specimens may be used to demonstrate both detection and sizing qualification.
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1.1 General

Same	(a) Specimens shall have sufficient volume to minimize spurious reflections that may interfere with the interpretation process.
Same	(b) The specimen set shall consist of at least four specimens having different nominal pipe diameters and thickness. The set shall include pipe specimens not thicker than 0.1 in. more than the minimum thickness, nor thinner than 0.5 in. less than the maximum thickness for which the examination procedure is applicable. It shall include the minimum, \pm NPS 1/2, and maximum pipe diameters and thickness for which the examination procedure is applicable. If the procedure is applicable to pipe diameters of 24 in. or larger, the specimen set must include at least one specimen 24 in. or larger in diameter but need not include the maximum diameter.
Same	(c) The specimen set shall include examples of the following fabrication condition: <ul style="list-style-type: none"> (1) unground weld reinforcement (crowns); (2) wide crowns, such that the total crown width is 1 1/2 to 2 times the nominal pipe wall

	<p>thickness;</p> <p>(3) geometric conditions that normally require discrimination from flaws (e.g., counterbore, weld root conditions such as excessive ID reinforcement);</p> <p>(4) typical limited-scanning surface conditions (e.g., diametrical shrink, single-side access due to safe ends or fittings).</p>
Same	<p>(d) All flaws in the specimen set shall be cracks.</p> <p>(1) Mechanical fatigue cracks and either IGSCC or thermal fatigue cracks shall be used. No more than 25% of the flaws shall be mechanical fatigue cracks.</p> <p>(2) At least 50% of the cracks shall be coincident with fabricated conditions described in (c) above.</p>
Same	<p>1.2 Detection Specimens</p> <p>(a) Specimens shall be divided into grading units. Each grading unit shall include at least 3 in. of weld length. If a grading unit is designed to be unflawed, at least 1 in. of unflawed material shall exist on either side of the grading unit. The segment of weld length used in one grading unit shall not be used in another grading unit. Grading units need not be uniformly spaced around the pipe specimen.</p>
Same	<p>(b) Detection sets for personnel qualification shall be selected from Table S2-1. The number of unflawed grading units shall be at least twice the number of flawed grading units.</p>
NEW	<p>(c) FOR THE INITIAL PROCEDURE QUALIFICATION, DETECTION SETS SHALL INCLUDE THE EQUIVALENT OF THREE PERSONNEL QUALIFICATION SETS.</p> <p>EXTENSION OF QUALIFICATIONS TO QUALIFY NEW VALUES OF ESSENTIAL VARIABLES REQUIRES AT LEAST ONE PERSONNEL QUALIFICATION SET.</p>
New	<p>(d) WHEN THE PROCEDURE IS INTENDED TO DETECT IGSCC, AT LEAST FOUR FIELD-REMOVED, IGSCC-FLAWED GRADING UNITS SHALL BE INCLUDED IN THE DETECTION TEST SET.</p>
Same as old 1.2 (c)	<p>(e) Flawed grading units shall meet the following criteria for flaw depth, orientation, and type.</p>
Same as 1.2 (c) (1)	<p>(1) A minimum of 1/3 of the flaws, rounded to the next higher whole number, shall have depths between 5% and 30% of the nominal pipe wall thickness. At least 1/3 of the</p>

	flaws, rounded to the next higher whole number, shall have depths greater than 30% of the nominal pipe wall thickness.
Same as 1.2 (c) (2)	(2) At least one and a maximum of 10% of the flaws, rounded to the next higher whole number, shall be oriented axially. The remainder of the flaws shall be oriented circumferentially.
1.2(c)(3) SERVICE-INDUCED FLAWS SHALL BE INCLUDED	SEE 1.2(D) ABOVE FOR SPECIFIC IGSCC REQUIREMENT.

1.3 Sizing Specimens

Same	(a) The minimum number of flaws shall be ten.								
Same	(b) Flaws in length sizing sample sets shall meet the requirements of paragraph. 1.2(e)(1), when given in conjunction with a detection test. When the length sizing test is administrated independently, the flaw depth requirements do not apply.								
Same	(c) Flaws in the depth sizing sample set shall be distributed as follows:								
Same	<table border="1"> <thead> <tr> <th>Flaw Depth (% Wall Thickness)</th> <th>Minimum Percentage of Flaws</th> </tr> </thead> <tbody> <tr> <td>5-30%</td> <td>20%</td> </tr> <tr> <td>31-60%</td> <td>20%</td> </tr> <tr> <td>61-100%</td> <td>20%</td> </tr> </tbody> </table>	Flaw Depth (% Wall Thickness)	Minimum Percentage of Flaws	5-30%	20%	31-60%	20%	61-100%	20%
Flaw Depth (% Wall Thickness)	Minimum Percentage of Flaws								
5-30%	20%								
31-60%	20%								
61-100%	20%								

The remaining flaws shall be in any of the above categories.

2.0 CONDUCT OF PERFORMANCE DEMONSTRATIONS

(1)	Flaw location and specimen identification shall be obscured to maintain a "blind test". Divulgence of particular specimen results or candidate viewing of unmasked specimens after the performance demonstration is prohibited.
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2.1 Detection Test

Same old 2.1	(a) Flawed and unflawed grading units shall be randomly mixed.
NEW	(B) DETECTION TESTS SHALL INCLUDE LENGTH SIZING.

2.2 Length and Depth Sizing Tests

NEW	(A) EACH REPORTED FLAW IN THE DETECTION TEST SHALL BE LENGTH SIZED.
NEW	(B) WHEN ONLY LENGTH SIZING IS BEING TESTED, THE REGIONS OF EACH SPECIMEN CONTAINING A FLAW

	TO BE SIZED SHALL BE IDENTIFIED TO THE CANDIDATE. THE CANDIDATE SHALL DETERMINE THE LENGTH OF THE FLAW IN EACH REGION.
(b) For the depth sizing test 80% of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate. For the remaining flaws, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.	(c) For the depth sizing test, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.

3.1 Detection Acceptance Criteria

3.1 old	(a) Personnel demonstrations shall meet the requirements of Table II-1 for both detection and false calls.
New	(B) PROCEDURE QUALIFICATIONS SHALL DEMONSTRATE DETECTABILITY OF EACH FLAW, WITHIN THE SCOPE OF THE PROCEDURE. SUCCESSFUL PERSONNEL DEMONSTRATIONS MAY BE COMBINED TO SATISFY THE REQUIREMENTS FOR PROCEDURE QUALIFICATIONS.
NEW	(c) IF THE PROCEDURE IS INTENDED TO DETECT IGSCC, FAILURE TO DETECT MORE THAN ONE OF THE IGSCC FLAWS IS UNACCEPTABLE FOR PERSONNEL QUALIFICATIONS.

3.2 Sizing Acceptance Criteria

Same	(a) The RMS error of the flaw lengths estimated by ultrasonics, as compared with the true lengths, shall not exceed 0.75 in.
Same	(b) The RMS error of the flaw depths estimated by ultrasonics, as compared with the true depths, shall not exceed 0.125 in.

TABLE II-1
PERFORMANCE DEMONSTRATION DETECTION TEST
ACCEPTANCE CRITERIA

Detection Test Acceptance Criteria		False Call Test Acceptance Criteria	
No. of Flawed Grading Units	Minimum Detection Criteria	No. of Unflawed Grading Units	Maximum Number of False Calls
5	5	10	0
6	6	12	1

7	6	14	1
8	7	16	2
9	7	18	2
10	8	20	3
11	9	22	3
12	9	24	3
13	10	26	4
14	10	28	5
15	11	30	5
16	12	32	6
17	12	34	6
18	13	36	7
19	13	38	7
20	14	40	8

**APPENDIX III
QUALIFICATION REQUIREMENTS FOR FERRITIC PIPING WELDS**

Qualification of examination procedures, and personnel for ferritic pipe examination shall be accomplished by satisfying the requirements of Appendix II, except that the sample material shall be ferritic and <u>75% OF</u> the sample set defects shall be mechanically or thermally induced fatigue cracks. In addition, the set shall include pipe specimens not thicker than 0.1 in. more than the minimum thickness, nor thinner than 1.0 in. less than the maximum thickness for which the examination procedure is applicable.	Qualification of examination procedures, and personnel for ferritic pipe examination shall be accomplished by satisfying the requirements of Appendix II, except that the sample material shall be ferritic and the sample set defects shall be mechanically or thermally induced fatigue cracks. In addition, the set shall include pipe specimens not thicker than 0.1 in. more than the minimum thickness, nor thinner than 1.0 in. less than the maximum thickness for which the examination procedure is applicable.
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**APPENDIX IV
QUALIFICATION REQUIREMENTS FOR THE CLAD TO BASE-METAL INTERFACE OF
REACTOR VESSEL**

1.0 SPECIMEN REQUIREMENTS

Same	Qualification test specimens shall meet the requirements listed herein unless a set of specimens is designed to accommodate specific limitations stated in the scope of the examination procedure. The same specimens may be used to demonstrate both detection and sizing qualifications.
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1.1 Detection Specimens

<p>1.1 Detection Specimens. Detection specimens, which may be full-scale mock-ups, shall conform to the following requirements.</p>	<p>1.1 Detection Specimens</p>
<p>Same except for highlighted sentence.</p>	<p>(a) Specimens shall have sufficient volume to minimize spurious reflections. Specimens need not contain a butt weld. Specimen length and width shall be at least 12 in. There shall be at least 10 sq. ft of clad surface in the specimen set.</p>
<p>Same</p>	<p>(b) Specimen thickness: (1) When the examination procedure requires the examination to be performed from the vessel ID (clad surface), the specimen minimum thickness shall be 3 in. or the maximum thickness of the vessel (whichever is less).</p>
<p>Same</p>	<p>(2) When the examination procedure requires the examination to be performed from the vessel OD surface, the specimen shall be at least 90% of the maximum thickness to be examined.</p>
<p>Same</p>	<p>(c) The performance demonstration shall be on the same type cladding as that to be-examined, with the following exceptions: (1) Demonstration on shielded metal arc welding (SMAW) single-wire cladding is transferable to multiple wire or strip-clad processes. (2) Demonstration of multiple-wire or strip-clad is considered equivalent but is not transferable to SMAW type clad.</p>
<p>Same</p>	<p>(d) The surface condition of the test specimens shall be representative of the general condition of the vessel scanning surface.</p>
<p>10CFR 50.55a (b)(2)(xv)(C)(3) (i), (ii), and (iii) ... same as N-622 (3) In lieu of the flaw type requirements of Subparagraph 1.1(e)(1), a minimum of 70 percent of the flaws in the detection and sizing tests shall be cracks. Notches, if used, must be limited by the following: <i>(i) Notches must be limited to the case where examinations are performed from the clad surface.</i> <i>(ii) Notches must be semielliptical with a tip width of</i></p>	<p>(e) The detection test matrix shall include flaws with the following description. (1) Flaw type. At least 70% of the flaws shall be cracks. Notches are limited to when the examination is performed from the clad surface, i.e., no corner-trap applications. Machined notches shall meet the following requirements: (a) Notches shall have a maximum width of 0.010 in. at the tip. The width at the</p>

<p><i>less than or equal to 0.010 inches.</i> (iii) Notches must be perpendicular to the surface within 002 degrees.</p>	<p>clad-to-base-metal interface shall not exceed 0.020 in. (b) Notches shall conform to the following: (1) Notch depth shall not exceed 0.25 in. (2) Notches shall be semi-elliptical.</p>
<p>10CFR 50.55a (b)(2)(xv)(C)(4) In lieu of the detection matrix requirements in paragraphs 1.1(e)(2) and 1.1(e)(3) personnel demonstration test sets must contain a representative distribution of flaw orientations, sizes and locations.)</p>	<p>(2) For procedure qualification, at least 40% of the flaws shall be oriented parallel to the clad direction, ± 10 deg., and at least 40% shall be oriented perpendicular to the clad direction, ± 10 deg. For personnel qualification, at least 20% in either direction is sufficient.</p>
<p>Same as above</p>	<p>(3) The flaw sizes shall be uniformly distributed in through-wall depths among the following ranges: (a) 0.075-0.200 in. (b) 0.201-0.350 in. (c) 0.351-0.550 in. (d) 0.551-0.750 in.</p>
<p>Same</p>	<p>(4) No flaw shall have an aspect ratio (depth/length) less than 0.1.</p>
<p>10CFR 50.55a (b)(2)(xiv)(B)(2) same as N-6222 (2) Paragraph 1.1(c), Detection test matrix—Flaws smaller than the 50percent of allowable flaw size, as defined in IWB-3500, need not be included as detection flaws. For procedures applied from the inside surface, use the minimum thickness specified in the scope of the procedure to calculate a/t. For procedures applied from the outside surface, the actual thickness of the test specimen is to be used to calculate a/t.</p>	<p>(5) Flaws smaller than 50% of the allowable flaw size, as defined in IWB-3500, need not be included as detection flaws. For procedures applied from the inside surface, the minimum thickness specified in the scope of the procedure shall be used to calculate a/t. For procedures applied from the outside surface, the thickness of the test specimen shall be used to calculate a/t.</p>
<p>(f)The number of flaws in a personnel detection demonstration shall be selected from Table IV-1.</p>	<p>(f) The number of flaws in a personnel detection demonstration shall be selected from Table IV-1.</p>
<p>The rules of IWA-3000 shall be used for determining whether closely spaced flaws should be treated as separate flaws.</p>	<p>See (h) below</p>
<p>New</p>	<p>(g) For initial qualification detection sets for procedure qualification shall include the equivalent of three personnel qualification sets. Extension of qualifications to qualify new value of essential variables requires at least one personnel qualification set.</p>
<p>See (f) above</p>	<p>(h) The requirements of IWA-3000 shall be used to determine whether closely-spaced flaws are to</p>

	be treated as separate flaws.
New	(i) flaw location and specimen identification shall be obscured to maintain a "blind test."

1.2 Sizing Specimens

	(a) Personnel qualification demonstrations shall contain at least 10 flaws, at least 70% of which shall be cracks.
	(b) Procedure qualifications shall include the equivalent of three personnel qualification sets.
	(c) Sizing specimens shall conform to the requirements of 1.1(b), 1.1(c), 1.1(d), and para.1.1(e).

CONDUCT OF PERFORMANCE DEMONSTRATIONS

2.1 Detection Test

Section XI Appendix VIII Supplement 4 2.1(a) All examinations shall be completed prior to grading and presenting the results to the candidate.	(a) Flaw locations shall be obscured to maintain a "blind test." Divulging particular specimen results or candidate viewing of unmasked specimens is prohibited.
10CFR 50.55a (b)(2)(xv)(C)(2) In lieu of the location acceptance criteria requirements of Subparagraph 2.1(b), a flaw will be considered detected when reported within 1.0 inch or 10 percent of the metal path to the flaw, whichever is greater, of its true location in the X and Y directions.... same as N-622	(b) If a flaw is reported within the greater of 1.0 in. or 10% of the metal path length to the flaw, from its true location (x, y, and z) it shall be considered detected. All other reported flaws shall be considered false calls.

2.2 Length and Depth Sizing Test

	(a) Each reported flaw in the detection test shall be length sized.
	(b) When only length sizing is being tested, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the length of the flaw in each region.
	(c) For the depth sizing test, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.

3.1 Detection Acceptance Criteria

New	(a) Procedure qualifications shall demonstrate detectability of each flaw within the scope of the
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	procedure.
10CFR 50.55a (b)(2)(xv)(B) The following provisions must be used in addition to the requirements of Supplement 4 to Appendix VIII: (1) Paragraph 3.1, Detection acceptance criteria—Personnel are qualified for detection if the results of the performance demonstration satisfy the detection requirements of ASME Section XI, Appendix VIII, Table VIII-S4-1 and no flaw greater than 0.25 inch through wall dimension is missed.	(b) Personnel are qualified if the results of the performance demonstration satisfy the acceptance criteria of Table IV-1 and no flaw greater than 0.25 in. depth is missed.
Same	(c) For procedure and personnel demonstrations, the number of false calls shall not exceed A/10, rounded to the next whole number, where A is the total scan area of specimens in the test measured in square feet.

3.2 Sizing Acceptance Criteria

(b) flaw lengths estimated by Ultrasonics shall be the true length - ¼ in., + 1.0 in.;	Not addressed in the 10CFR for Supplement 4. It is addressed for Supplement 6.	(a) The RMS error of the flaw lengths estimated by ultrasonics, as compared with the true lengths, shall not exceed 0.75 in.
50.55a (b)(2)(xv)(C)(1) ... same as N-622 (1) A depth sizing requirement of 0.15 inch RMS shall be used in lieu of the requirements in Subparagraphs 3.2(a) and 3.2(b).		(b) The RMS error of the flaw depths estimated by ultrasonics, as compared with the true depths, shall not exceed 0.15 in. <i>(The Final Rule should have referenced Subparagraphs 3.2(a) through 3.2(c).)</i>

TABLE IV-1 PERFORMANCE DEMONSTRATION DETECTION TEST ACCEPTANCE CRITERIA	
Number of Flaws	Minimum Detection Criteria
7	7
8	8
9	9
10	10
11	11
12	11
13	12
14	13
15	14
16	14
17	15
18	16
19	17
20	18

APPENDIX V (A)
QUALIFICATION REQUIREMENTS FOR NOZZLE INSIDE RADIUS SECTION EXAMINATIONS
FROM THE INSIDE SURFACE

Examination procedures and personnel are qualified for nozzle inside radius section examination from the inside surface, when the following requirements are met. Personnel qualified for detection or depth sizing in accordance with the requirements of Appendix IV, are qualified in accordance with this Appendix, with no additional demonstration, provided the procedure used by the personnel to qualify in accordance with Appendix IV, other than changes required to adapt to the nozzle geometry, is also qualified in accordance with this Appendix.

1.0 SPECIMEN REQUIREMENTS

- (a) For PWR vessels, both the inlet and outlet configurations shall be included in the demonstration.
- (b) Flaws shall meet the requirements of Appendix IV, except that they shall be oriented as shown in IWB-2500-7. The entire size distribution need not be contained in every specimen, provided one or more examples of the smallest category are included.
- (c) The minimum nozzle diameter contained in the scope of the procedure shall be included.
- (d) Qualification on clad nozzle mockups may be used for qualification for examination of unclad nozzles. Qualifications on unclad nozzle mockups shall not be used for qualification for examination of clad nozzles.

1.1 Detection Specimens

Detection specimens shall conform to the following requirements.

- (a) There shall be a minimum of three flaws in each specimen.
- (b) The specimen set shall contain a minimum of 10 flaws.

1.2 Sizing Specimens

- (a) The sizing test matrix shall contain a minimum of 10 flaws; at least 50% of which shall be cracks.
- (b) Any notches included in the test set shall meet the requirements and limitations of Appendix IV, 1.1 (e).

2.0 CONDUCT OF PERFORMANCE DEMONSTRATION

2.1 Detection Test

Procedure and equipment qualifications shall be performed as a "blind test."

2.2 Depth Sizing

- (a) Depth sizing will be performed without knowledge of the true flaw depths.
- (b) The sizing results from each of the specimens shall be combined for grading.

3.0 ACCEPTANCE CRITERIA

- | |
|--|
| (a) Examination procedures and equipment are qualified if each flaw is detected and identified. The number of false calls shall not exceed D/10 rounded up to the next whole number, where D is the nominal nozzle ID in. If only a portion of a nozzle is examined, proportional credit for false calls shall be allowed. The total number of false calls shall not exceed 3. |
| (b) Personnel not previously qualified to Appendix IV are qualified for detection if the requirements for procedure qualification in (a) above are satisfied. |
| (c) Examination procedures, equipment, and personnel (not previously qualified to Appendix IV) are qualified for depth sizing if the results of the sizing demonstration meet the sizing acceptance criteria of Appendix IV. |

APPENDIX V (B)
QUALIFICATION REQUIREMENTS FOR NOZZLE INSIDE RADIUS SECTION EXAMINATIONS
FROM THE OUTSIDE SURFACE

1.0 PROCEDURE REQUIREMENTS

- | |
|--|
| The examination procedure shall include or provide for the following: |
| (a) A computational model that calculates misorientation angles and the maximum metal path distance to the required inspection volume. Misorientation angle is shown in Fig. VB-1. These calculations apply to the central ray of the ultrasonic beam. |
| (b) A scope statement that specifies the maximum acceptable misorientation angle and metal path for the examinations. |
| (c) Division of the surface of the required examination volume into grids of 1.0 in. or less in the nozzle axis direction and 10 deg. or less of azimuth. |
| (d) Documenting the misorientation angle and metal path distance in each grid cell location for each search or scan. |
| (e) Documenting the search unit or scan that produces the minimum misorientation angle when multiple search units are used. |

2.0 SPECIMEN REQUIREMENTS

- | |
|--|
| Demonstration specimens shall meet the requirements of Appendix IV, except as modified by (a) through (e). Flaw depths shall be distributed over the range of depths required by Appendix IV. |
| (a) One or more full size or sections of full size nozzle mockups shall be used. |
| (b) Nozzle mockup material and configurations shall be representative of nozzles installed in operating reactor vessels, but may be any thickness, diameter, or radius suitable for demonstration in accordance with 3.0, below. |
| (c) Flaws shall be uniformly distributed in examination zones A and B of Fig. VB-2. At least half of the flaws shall be located within ± 45 deg. of nozzle azimuth angles 90 deg. or 270 deg. |
| (d) All flaws shall be located in the required inspection volume and shall be oriented in the radial axial plane of the nozzle inside radius as shown in Fig. IWB-2500-7. |

50.5a(b)(2)(xv)(H) When applying Supplement 5 to Appendix VIII, at least 50 percent of the flaws in the demonstration test set must be cracks and the maximum misorientation shall be demonstrated with cracks. Flaws in nozzles with bore diameters less than 4 inches may be notches.

(e) For nozzles with bore diameters less than are equal to 4 in., all flaws may be notches. For nozzles greater than 4" in diameter, at least 50% of the flaws in the demonstration test set shall be cracks; the balance may be notches. The maximum misorientation shall be demonstrated with cracks.

3.0 CONDUCT OF PERFORMANCE DEMONSTRATIONS

3.1 Procedure Qualification Demonstrations

(a) The qualification shall demonstrate the following:

- (1) Examination surfaces to be used, i.e., vessel plate, outer blend radius, and nozzle boss;
- (2) Maximum metal path length;
- (3) Maximum misorientation angles.

(b) The demonstration shall include at least 10 flaws for detection and sizing, in one or more mockups.

(c) The initial demonstration shall be performed as a "blind test."

(d) After a successful initial demonstration, the scope of the procedure, 1.0 (b), may be extended by

- (1) additional demonstrations on additional mockups or
- (2) nonblind demonstrations on at least one flaw using scan parameters calculated to provide the desired maximum path length or misorientation angles. Detection shall be demonstrated to specific criteria listed in the examination procedure for any extension of procedure scope.

3.2 Procedure Qualification Documentation

The examination procedure, modeling program and methods, and the qualification results shall be documented to the extent necessary to determine that inservice examinations produce equivalent or smaller misorientation angles than the procedures demonstrated.

3.3 Personnel Qualification

(a) Personnel previously qualified in accordance with the requirements of Appendix VI, for the same type of procedure (manual or automated), from the outside surface, using the same type of instruments and data recording and analysis equipment, shall be qualified as follows:

(1) Successful demonstration shall include at least three additional flaws for each scan surface, which is qualified.

(2) Examinations shall be conducted from each of the scan surfaces covered by the procedure.

(3) The candidate shall demonstrate a selection of essential variables covered by the procedure, but need not demonstrate the full range.

(b) Personnel not previously qualified in accordance with the requirements of Appendix VI shall be qualified as follows:

(1) The candidate shall demonstrate the procedure on one or more mockups.

(2) The demonstration shall contain at least the minimum number of detection and depth sizing flaws specified in Appendix VI.

(3) The demonstration shall include examinations from each of the scan surfaces described in the procedure.

(4) The demonstration need not cover the full range of all the essential variables.

4.0 ACCEPTANCE CRITERIA

4.1 Detection Acceptance Criteria

(a) Examination procedures are qualified if each flaw is detected and identified. The number of false calls shall not exceed $D/10$, rounded up to the next whole number, where D is the nominal nozzle ID, in. The number of false calls shall not exceed three. If only a portion of a nozzle is examined, proportional credit for false calls is to be allowed.

(b) Personnel previously qualified in accordance with the requirements of 3.3(a) are qualified, if each of the flaws presented are detected. The number of false calls shall not exceed the number specified in 4.1(a).

(c) Personnel not previously qualified in accordance with the requirements of Appendix VI are qualified, if the results of the demonstration meet the requirements of Table VI-1. The number of false calls shall not exceed the number specified in 4.1(a).

4.2 Depth Sizing Acceptance Criteria

(a) Examination procedures are qualified if the results of the sizing demonstration meet the requirements of, Appendix VI, 3.2.

(b) Personnel previously qualified in accordance with the requirements of 3.3(a) are qualified, if the results from the sizing test, when added to the candidate's results from Appendix VI, meet the acceptance criteria of Appendix VI, 3.2.

(c) Personnel not previously qualified in accordance with the requirements of Appendix VI are qualified if the results of the demonstration meet the acceptance criteria of Appendix VI, 3.2.

5.0 COMPONENT EXAMINATIONS

The computational model shall be used to demonstrate that the proposed examination variables are within the bounds the qualification demonstration.

(a) Documentation showing coverage and misorientation angle shall be provided for each nozzle examination performed. The documentation shall be used to demonstrate that the component examination will achieve misorientation angles that do not exceed the misorientation angles for which the procedure was qualified.

(b) Modeling need not be applied for repeated examination of nozzles of the same design.

(c) If the misorientation angle or metal path of the component examination exceeds that of the qualification, additional angles and directions may be applied to examine these areas without need for requalification, provided the demonstrated misorientation angle or path length can be achieved.

(d) If 5.0(c) cannot be met, the area shall be declared an area of no coverage.

**APPENDIX VI
QUALIFICATION REQUIREMENTS FOR REACTOR VESSEL WELDS OTHER THAN
CLAD-TO-BASE METAL INTERFACE**

1.0 SPECIMEN REQUIREMENTS

	Qualification test specimens shall meet the requirements listed herein unless a set of specimens is designed to accommodate specific limitations stated in the scope of the examination procedure. The same specimens may be used to demonstrate both detection and sizing qualification.
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1.1 Detection Specimens

Appendix VIII 95/96A Permits the use of specimens which may be full-scale mock-ups.	(a) Specimens shall have sufficient volume to minimize spurious reflections. The specimen need not contain a weld. Specimen length and width shall be at least 12 in. There shall be at least 10 sq. ft of scan surface in the specimen set.
10CFR 50.55a (b)(2)(xv)(D) The following provisions must be used in addition to the requirements of Supplement 6 to Appendix VIII: (3) Flaws smaller than the 50% percent of allowable flaw size, as defined in IWB-3500, need not be included as detection flaws. Flaws which are less than the allowable flaw size, as defined in IWB-3500, may be used as detection and sizing flaws.	(b) The specimen set shall contain at least one sample that is at least 90% of the maximum thickness to be examined. The specimen set shall contain one or more flaws in each of the locations and size ranges shown in Table VI-1. (SEE TABLE VI-1 NOTES 2 AND 3.)
	(c) When the examination procedure requires the examination to be performed from the vessel ID (clad surface), the cladding on the mockup shall be of the same type as the cladding on the component to be examined, with the following exceptions:
	(1) demonstration on shielded metal arc weld (SMAW) single-wire cladding is transferable to multiple-wire or strip-clad processes;
	(2) demonstration on multiple-wire or strip-clad is considered equivalent but is not transferable to SMAW type clad.

**TABLE VI-1
DETECTION AND SIZING TEST FLAWS AND LOCATIONS**

Flaw Depth, In. (Notes 2, 3, and 4)

Flaw Locations	0.075-0.200	0.201-0.3.50	0.351-0.550	0.551-0.750	0.751-2.0
Inner 10% * Note (1)	X	X	S	S	
Outer 10%	X	X	S	S	
11-30% T			X	X	S
31-60% T			X	X	S
61-89% T			X	X	S

LEGEND:

X Applies to detection and sizing flaws

S Applies only to sizing flaws

T Thickness of the test specimen which contains the flaw

NOTES:

(1) Does not apply to clad vessels (see Appendix VI).

(2) Flaws smaller than 50% of allowable flaw size specified in IWB-3500 need not be included as detection flaws without regard for their designation as S or X

(3) Flaws equal to or less than the allowable flaw size may be used as detection flaws without regard to their position in the Table.

(4) The thickness of the test specimen shall be used to determine the a/t ratios in IWB-3500.

95/96 Code same as CC N-622	(a) The surface condition of the test specimens shall be representative of the general condition of the vessel scanning surface.
95/96 Code same as CC N-622	(b) The detection test matrix shall include flaws with the following description.
10CFR 50.55a (b)(2)(xv)(D)(4) (4) Notches are not permitted. 10CFR 50.55a (b)(2)(xv)(E)(4) (4) In lieu of the detection specimen requirements in Subparagraph 1.1(e)(1), a minimum of 55 percent of the flaws must be cracks. The remaining flaws may be cracks or fabrication type flaws, such as slag and lack of fusion. The use of notches is not allowed.	(1) <i>Flaw Type.</i> At least 55%% of the flaws shall be cracks. The balance of flaws may be cracks, or fabrication defects (e.g., lack of fusion and slag inclusions).
10CFR 50.55a (b)(2)(xv)(E)(5) (5) In lieu of paragraphs 1.1(e)(2) and 1.1(e)(3) detection test matrix, personnel demonstration test sets must contain a representative distribution of flaw orientations, sizes, and locations.	(2) Detection and sizing examinations shall include either surface connected flaws or flaws with unflawed ligaments of more than 0.2 in. Procedure demonstrations shall include examples of both.
(5) In lieu of paragraphs 1.1(e)(2) and 1.1(e)(3) detection test matrix, personnel demonstration test sets must contain a representative distribution of flaw orientations, sizes, and locations.	(3) A weld direction shall be established, whether or not the specimen contains a weld. For procedure qualification, at least of 40% of the flaws shall be oriented parallel to the clad direction ± 10 deg. and at least 40% shall be oriented perpendicular to the clad

	direction ± 10 deg. For personnel qualification, at least 20% in either direction is sufficient.
	(4) Flaws for the detection test matrix shall be selected from the detection test flaws included in Table VI-1. The flaws selected shall provide a demonstration of the minimum and maximum metal path ranges to be demonstrated as well as a uniform distribution of flaw sizes and locations.
	(5) The number of flaws in a personnel detection demonstration shall be selected from Table VI-2. Procedure qualifications shall include at least 20 flaws uniformly distributed over the ranges defined in Table VI-1.
	(6) The requirements of IWA-3000 shall be used to determine whether closely-spaced flaws are to be treated as separate flaws.

1.2 Sizing Specimens

	(a) Qualification demonstrations shall contain at least 10 flaws for personnel and 20 for procedures at least 55% of which shall be cracks. The remainder may be manufacturing defects, such as slag, lack of fusion, or combinations thereof.
	(b) Sizing specimens shall conform with the requirements of 1.1(b), 1.1(c), 1.1(d), and 1.1(e), except that the test matrix shall be selected from the sizing and detection test flaws included in Table VI-1.

2.0 CONDUCT OF PERFORMANCE DEMONSTRATIONS

2.1 Detection Test

	(a) Flaw locations shall be obscured to maintain a "blind test." Divulging particular specimen results or candidate viewing of unmasked specimens is prohibited.
10CFR 50.55a (b)(2)(xv)(D)(2) (2) In lieu of the location acceptance criteria requirements in Subparagraph 2.1(b), a flaw will be considered detected when reported within 1.0 inch	(b) If a flaw is reported within the greater of 1.0 in. or 10% of the metal path length to the flaw, from its true location (x, y, and z) it shall be considered detected. All other reported flaws shall be considered false calls.

or 10 percent of the metal path to the flaw, whichever is greater, of its true location in the X and Y directions.

2.2 Length and Depth Sizing Test

	(a) Each reported flaw shall be length sized.
	(b) For the length sizing test, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the length of the flaw in each region.
	(c) When only depth sizing is being tested, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.

**TABLE VI-2
PERFORMANCE DEMONSTRATION PERSONNEL DETECTION TEST
ACCEPTANCE CRITERIA**

NUMBER OF FLAWS	MINIMUM DETECTION CRITERIA
7	7
8	8
9	9
10	10
11	11
12	11
13	12
14	13
15	14
16	14
17	15
18	16
19	17
20	18

3.0 ACCEPTANCE CRITERIA

3.1 Detection Acceptance Criteria

10CFR 50.55a (b)(2)(xv)(D)(2) Paragraph 3.1, Detection Acceptance Criteria—For procedure qualification, all flaws within the scope of the procedure are detected. (same as N-622)	(a) Procedure qualifications shall demonstrate detectability of each flaw within the scope of the procedure.
10CFR 50.55a (b)(2)(xv)(D)(1)(i) and (ii)...	(b) Personnel are qualified if the results of the performance demonstration satisfy the acceptance criteria of Table VI-2 and no
The following provisions must be used in addition	

<p>to the requirements of Supplement 6 to Appendix VIII:</p> <p>(1) Paragraph 3.1, Detection Acceptance Criteria—Personnel are qualified for detection if:</p> <p>(i) <i>No surface connected flaw greater than 0.25 inch through wall has been missed.</i></p> <p>(ii) No embedded flaw greater than 0.50 inch through wall has been missed.</p>	<p>surface connected flaw greater than 0.25 in. depth or imbedded flaw (distance from nearest surface exceeds 10%T) greater than 0.5 in. was missed.</p>
<p>Same as Case N-622</p>	<p>(c) For procedures and personnel demonstrations, the number of false calls, shall not exceed A/10, rounded to the next whole number, where A is the total scan area of specimens in the test measured in square feet.</p>

3.2 Sizing Acceptance Criteria

<p>10 CFR 50.55a (b)(2)(xv)(E)(3) In lieu of the length sizing criteria requirements of Subparagraph 3.2(b), a length sizing acceptance criteria of 0.75 inch RMS must be used.</p>	<p>(a) The RMS error of the flaw lengths estimated by ultrasonics, as compared with the true lengths, shall not exceed 0.75 in.</p>
<p>10 CFR 50.55a (b)(2)(xv)(E)(1) When applying Supplement 6 to Appendix VIII, the following provisions must be used: A depth sizing requirement of 0.25 inch RMS must be used in lieu of the requirements of subparagraphs 3.2(a), 3.2(c)(2), and 3.2(c)(3).</p>	<p>(b) The RMS error of the flaw depths estimated by ultrasonics, as compared with the true depths, shall not exceed 0.25 in.</p>
<p>95/96A Appendix VIII Supplement 6 paragraph 3.2 (c) performance demonstration results reported by the candidate, when plotted two-dimensional plot (Fig. VIII-S4-1) with the depth estimated by ultrasonics plotted along the ordinate true depth plotted along the abscissa, satisfy the following statistical parameters:</p> <p>(1) slope of the linear regression line is not less than 0.70;</p>	<p>(c) The slope of the linear regression line shall be at least 0.7. The slope of the linear regression line is calculated as shown in Fig. VI-1.</p>

APPENDIX VII QUALIFICATION REQUIREMENTS FOR NOZZLE-TO-VESSEL WELD EXAMINATIONS CONDUCTED FROM THE BORE

<p>10 CFR 50.55a(b)(2)(xiv)(K) (K) When performing nozzle-to-vessel weld examinations, the following provisions must be used when the requirements contained in Supplement 7 to Appendix VIII are applied for nozzle-to-vessel welds in conjunction with Supplement 4 to Appendix VIII, Supplement 6 to</p>	<p>Successful demonstrations in accordance with Appendixes IV and VI qualify procedures and personnel for nozzle-to-vessel weld examinations conducted from the bore, when the following requirements are met.</p>
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<p>Appendix VIII, or combined Supplement 4 and Supplement 6 qualification.</p> <p>(1) For examination of nozzle-to-vessel welds conducted from the bore, the following provisions are required to qualify the procedures, equipment, and personnel:</p>	
<p>(i) For detection, a minimum of four flaws in one or more full-scale nozzle mock-ups must be added to the test set. The specimens must comply with Supplement 6, Paragraph 1.1, to Appendix VIII, except for flaw locations specified in Table VIII S6-1. Flaws may be either notches, fabrication flaws or cracks. Seventy five percent of the flaws must be cracks or fabrication flaws. Flaw locations and orientations must be selected from the choices shown in § 50.55a(b)(2)(xv)(K)(4), Table VIII-S7-1—Modified, except flaws perpendicular to the weld are not required. There may be no more than two flaws from each category, and at least one subsurface flaw must be included.</p>	<p>(a) The demonstration shall contain at least four flaws in one or more full-scale nozzle mock-ups. The specimens shall comply with Appendix VI, 1.1, except that, flaw locations and orientations shall be selected from Table VII-1. At least one flaw from each category shall be included. At least 75% of the flaws shall be cracks or fabrication flaws. The balance may be notches. At least one flaw parallel to the weld shall provide a metal path distance with 10% of the equivalent path length to the weld centerline of the thickest component to be examined.</p>
	<p>(b) For detection, the requirements of Appendix VI, 2.1 apply. Each flaw shall be detected with no false calls.</p>
<p>(ii) For length sizing, a minimum of four flaws as in § 50.55a(b)(2) (xv)(K)(1)(i) must be included in the test set. The length sizing results must be added to the results of combined Supplement 4 to Appendix VIII and Supplement 6 to Appendix VIII. The combined results must meet the acceptance standards contained in § 50.55a(b)(2)(xv)(E)(3)</p>	<p>(c) For length sizing, the sizing results shall be added to the results of Appendixes VI and VI. The combined results shall meet the acceptance standards of Appendix VI, 3.2.</p>
<p>(iii) For depth sizing, a minimum of four flaws as in § 50.55a(b)(2) (xv)(K)(1)(i) must be included in the test Supplement 4, Paragraph 1.1, to Appendix VIII, for the inner 15 percent of the wall thickness and Supplement 6, Paragraph 1.1, to Appendix VIII, for the remainder of the wall thickness. The depth sizing results must be combined with the sizing results from Supplement 4 to Appendix VIII for the inner 15 percent and to Supplement 6 to Appendix VIII for the remainder of the wall thickness. The combined results must meet the depth sizing acceptance criteria contained in §§ 50.55a(b)(2) (xv)(C)(1), 50.55a(b)(2)(xv)(E)(1), and 50.55a(b)(2)(xv)(F)(3).</p>	<p>(d) For depth sizing, the flaw depths shall distributed over the ranges of Appendix IV, 1.1 for the inner 15% of the wall thickness, and Appendix VI, 1.1 for the remaining wall thickness. For the inner 15%, the depth sizing results shall be combined with the sizing results from Appendix IV. For the remaining wall thickness, the depth sizing results shall be combined with the sizing results from Appendix VI. The combined results shall meet the depth sizing acceptance criteria of Appendix IV, 3.2 and Appendix VI, 3.2, respectively.</p>

TABLE VII-1

FLAW LOCATIONS AND ORIENTATIONS

	Parallel to Weld	Perpendicular to Weld
Inner 15% OD Surface Subsurface	X	X
	X	
	X	

APPENDIX VIII QUALIFICATION REQUIREMENTS FOR BOLTS AND STUDS

1.0 SPECIMEN REQUIREMENTS

Same	Qualification test specimens shall meet the requirements listed herein, unless a set of specimens is designed to accommodate specific limitations stated in the scope of the examination procedure.
	1.1 Specimens shall conform to the following requirements
	(a) The qualification process shall be performed with a full-scale section bolt or stud that is sufficient to contain the beam path and demonstrate the scanning technique.
	(b) The qualification specimen shall be of similar chemical composition, tensile properties, and metallurgical structure as the bolt or stud to be examined. The scan surface of the qualification specimen shall have a configuration similar to the bolt or stud to be examined.
10 CFR 50.55a(b)(2)(xiv)(L) (L) As a modification to the requirements of Supplement 8, Subparagraph 1.1(c), to Appendix VIII, notches may be located within one diameter of each end of the bolt or stud.	(c) Circumferentially oriented notches shall be located in the procedure qualification specimens at the minimum and maximum qualified metal paths. Notches located within one diameter of the end of the bolt or stud opposite the search unit are suitable for demonstrating the maximum metal path distance.
Same	Personnel qualification specimens may have notches at any location within the inspection volume. These notches are required on the outside threaded surface and the inner bore hole surface of bored studs with maximum depths and reflective areas as specified in Table VIII-1.

Same	Additional notches may be located within the range specified in (c) above, provided they do not interfere with detection of other notches.
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2.0 CONDUCT OF PERFORMANCE DEMONSTRATIONS

Same	Specimen identification and notch locations shall be obscured to maintain a "blind test." A flaw shall be considered detected when the notch, as defined in 1.1, is found. The reported notch axial location shall be within the greater of $\pm 1/2$ in., or $\pm 5\%$ of the bolt or stud length, of the true location.
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3.0 ACCEPTANCE CRITERIA

	3.1 Examination procedures and personnel are qualified for detection when each qualification notch (as described in 1.1) has been detected and its response equals or exceeds the reporting criteria specified in the procedure. The notch response shall have a minimum peak signal to peak noise ratio of 2:1.
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TABLE VIII-1

MAXIMUM NOTCH DIMENSIONS

Bolt or Stud Diameter	Depth, in. ¹	Reflective Area, sq. in.
Larger than 4 in.	0.157	0.059
2 in. to 4 in.	0.107	0.027

Note(1) For threaded surfaces, depth is measured from bottom of thread root to bottom of notch.

**SUPPLEMENT 12
QUALIFICATION REQUIREMENTS FOR COORDINATED IMPLEMENTATION OF
SELECTED ASPECTS OF SUPPLEMENTS 2, 3, 10, AND 11**

1.0 DETECTION AND LENGTH SIZING

(a) Ferritic Piping
<i>(1) The requirements of Supplement 3 are satisfied by demonstration on wrought austenitic piping when the following requirements are met.</i>
(a) For detection qualification, at least three additional flawed grading units and six additional unflawed units in ferritic piping shall be added to the test set. A grading unit shall include at least 3 in. continuous weld length. All 9 ferritic grading units shall be correctly identified.
(b) For length sizing qualification, at least three additional flaws in ferritic piping shall be added to the test set. All flaws shall be sized within the length criteria of Supplement 2, paragraph 3.2.
(2) Examinations of specimens during a successful detection or length sizing demonstration on dissimilar metal welded piping may be applied toward a Supplement 3 demonstration when the following requirements are met.

(a) Grading units shall include at least 6 in. continuous weld length. The grading unit shall contain only the ferritic-side base metal and inside surface clad. The austenitic base metal, butt weld, and weld preparation buttering shall not be a part of the grading unit.

(b) The examinations performed on the ferritic side of the dissimilar metal weld specimens shall use the same ultrasonic procedure essential variable values, or, when appropriate, the same criteria for selecting values, as the examinations performed on the ferritic specimens.

**APPENDIX XIII
REQUIREMENTS FOR COORDINATED IMPLEMENTATION OF SELECTED ASPECTS OF
APPENDIX IV AND VI**

1.0 GENERAL

10 CFR 50.55a(b)(2)(F)

The following provisions may be used for personnel qualification: for combined Supplement 4 to Appendix VIII and Supplement 6 to Appendix VIII qualification. Licensees choosing to apply this combined qualification shall apply all of the provisions of Supplements 4 and 6 including the following provisions:

Candidates meeting the requirements of this Appendix in its entirety are considered qualified to Appendixes IV and VI. Detection and sizing may be performed separately.

2.0 COMBINED APPENDIX VI AND APPENDIX VI QUALIFICATION

10 CFR 50.55a(b)(2)(F)

(1) For detection and sizing, the total number of flaws must be at least 10. A minimum of 5 flaws shall be from Supplement 4, and a minimum of 50 percent of the flaws must be from Supplement 6. At least 50 percent of the flaws in any sizing must be cracks. Notches are not acceptable for Supplement 6.

Personnel qualification for Appendix IV and VI may be combined as follows:

(a) For detection, the total number of Appendix IV and VI flaws shall be at least 10 of which at least 50% shall be Appendix IV flaws and at least 5 shall be from Appendix VI.

(1) For detection and sizing, the total number of flaws must be at least 10. A minimum of 5 flaws shall be from Supplement 4, and a minimum of 50 percent of the flaws must be from Supplement 6. At least 50 percent of the flaws in any sizing must be cracks. Notches are not acceptable for Supplement 6.

(b) For sizing, the total number of Appendix IV and VI flaws shall be at least 10, of which at least 50% shall be Appendix IV flaws. At least 50% of the flaws in any sizing shall be cracks.

3.0 ACCEPTANCE CRITERIA

(2) Examination personnel are qualified for detection and length sizing when the results of any combined performance demonstration satisfy the acceptance criteria of Supplement 4 to Appendix VIII.

(a) Examination personnel are qualified for detection and length sizing when the results of any combined performance demonstration satisfy the acceptance of Appendix VI.

(3) Examination personnel are qualified for depth

(b) Examination personnel are qualified for depth

sizing when Supplement 4 to Appendix VIII and Supplement 6 to Appendix VIII flaws are sized within the respective acceptance criteria of those supplements.

sizing when Appendix IV and VI flaws are sized within the respective acceptance criteria of those Appendixes.

APPENDIX C
Sample Request for Relief – Welds Examined from the Inside Surface

LICENSEE/UTILITY NAME
PLANT NAME, UNIT ____
10-YEAR INTERVAL
REQUEST FOR RELIEF No. ____

SYSTEM/COMPONENT(S) FOR WHICH RELIEF IS REQUESTED

Class 1, Category B-J Pressure Retaining Piping welds adjacent to or attaching to Reactor Class Pressure Vessel Nozzles

CODE REQUIREMENTS

ASME Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, 1995 Edition with 1996 Addenda, Appendix I, requires that Austenitic and ferritic welds be examined using personnel, procedures and equipment qualified to the requirements of Appendix VIII, Supplements 2, and 3.

The 1999 Edition of 10 CFR 50.55(a) Codes and Standards was revised by Federal Register Notice 64 FR 51400, September 22, 1999. This revision requires that Appendix VIII, Supplements 2 and 3 be implemented by May 22, 2000.

RELIEF REQUESTED

Relief is requested in accordance with 10 CFR 50.55a(g)(6)(i) from Section XI, Appendix VIII Supplements 2 and 3 for welds examined from the inside surface.

BASIS FOR RELIEF

The concept of personnel performance demonstrations for ultrasonic examination qualifications was introduced to the nuclear industry in the 1989 Edition, 1989 Addenda, of Section XI. The Performance Demonstration Initiative was formed in 1991 to implement the requirements of Appendix VIII. When the Performance Demonstration Initiative (PDI), proposed an alternative implementation schedule, during the public comment period, it did not consider the inside surface examinations of Category B-J welds performed from the inside surface.

Qualifications for piping examinations from the outside surface were initiated in 1994. Examinations from the inside surface were considered in the design and fabrication of piping samples. However, it was the intention of PDI to complete the piping qualifications that are performed from the inside surface, in conjunction with the nozzle to shell and dissimilar metal welds. These examinations are normally performed using the RPV examination device. A stand-alone qualification for the one or two B-J welds past the RPV nozzle will require additional qualification specimens, which are not currently available. Performing separate qualifications at

this time and later returning to perform the nozzle and dissimilar metal weld qualifications places an undo burden on the vendors and owners.

{Alternative 1, if applicable}

The subject welds can be made accessible for examination from the outside surface at the _____ Nuclear Power Plant. However, this would be at a cost of _____ and total radiation dose of _____. Total costs and exposure figures include sand plug removal, scaffolding, de-insulation, weld preparation, PT examination, PT clean up and disposal of mixed waste, UT examination, re-insulation and installation of the sand plugs. In addition, this would require implementation of new examination procedures, and modifications of the existing inspection plan.

{Alternative 2}

The outside surface or the subject welds are not accessible for UT examination at the _____ Nuclear Power Plant. The examinations will be performed in conjunction with nozzle to shell weld and dissimilar metal weld examinations (*applicable for PWR Vessels*) performed from the nozzle bore.

Vendors will be required to perform an additional qualification exercise if required to implement Appendix VIII examinations on the subject welds by May 22, 2000. It is estimated that the total cost to each inspection vendor could exceed \$100,000.00. If these qualifications were performed at the same time as the dissimilar metal weld qualifications the additional costs would be minimal. These combined demonstrations could be performed according to the requirements of Supplement 12 to appendix VIII. Modifications of Supplement 12 are currently in progress within the ASME Code to address piping examination from the inside surface. The required implementation date for Supplement 12 is November 22, 2000.

PDI has been administering Supplement 2 and 3 exams since 1994. These demonstrations have not included dissimilar metal welds or examinations from the pipe inside surface. A Supplement 10 (DSM weld) program is under development and qualified examinations are expected to begin by the effective Rulemaking date of November 22, 2002. This implementation date gives the industry adequate time to prepare samples, procedures, protocols, and demonstrations prior to outages scheduled on or after this date.

Attempting to meet an implementation date of May 22, 2000 for examining the subject welds from the inside surface would be impractical and would pose undo hardship on the industry. Relief is therefore requested in accordance with 10 CFR 50.55a(a)(3)(ii). Compliance with the specified requirements of the Rulemaking would result in hardship or unusual difficulty without a compensating increase in the level of safety.

ALTERNATIVE EXAMINATIONS

Current industry practice specific to inside surface ultrasonic examinations would continue until November 22, 2002.

IMPLEMENTATION SCHEDULE

(Per Utility Need)

APPENDIX D
Sample Request for Relief - Alternative Supplement 4 Length Sizing Criteria

LICENSEE/UTILITY NAME
PLANT NAME, UNIT _____
10-YEAR INTERVAL
REQUEST FOR RELIEF No. _____

SYSTEM/COMPONENT(S) FOR WHICH RELIEF IS REQUESTED

ASME Section XI, Class 1, Examination category B-A, Item no. B1.10 longitudinal and circumferential shell welds and B1.20 Head welds

CODE REQUIREMENTS

ASME Section XI, 1995 Edition, 1996 Addenda, Appendix VIII, Supplement 4, Subparagraph 3.2(b), length sizing qualification criteria requires that flaw lengths estimated by ultrasonics be the true length $-\frac{1}{4}$ inch $+1$ inch.

RELIEF REQUESTED

Relief is requested in accordance with 10 CFR 50.55a(a)(3)(i) to use a length sizing qualification criteria of 0.75 inch Root Mean Square Error (RMSE).

BASIS FOR RELIEF

Qualifications administered by the Performance Demonstration Initiative (PDI) have used a length sizing qualification criteria of 0.75 inch RMSE since the inception of these demonstrations in 1994. The 0.75 inch RMSE length sizing tolerance is included in ASME Code Case N-622. Relief for use of this Code Case has been previously granted.

The " performed an assessment of the PDI program in 1995. As a part of this assessment, they reviewed exceptions to the ASME Code, which were parts of the PDI Program. The Assessment report states that that NRC *"does not take exception" to the 0.75-inch RMSE length sizing tolerance*", Ref 1.

Conversations between NRC Staff and representatives from (PDI) were held On January 12, 2000. In this conversation, it was acknowledged that the 0.75-inch RMSE length sizing criteria should have been addressed in the modifications provided for Supplement 4 to Appendix VIII in 10 CFR 50.55a(b)(2)(xv)(C), Ref. 2. It was also stated that this would be corrected in future revisions.

ALTERNATIVE EXAMINATION

In lieu of the length sizing requirements the ASME Section XI, 1995 Edition, 1996 Addenda, Appendix VIII, Supplement 4, Subparagraph 3.2(b) a length sizing qualification criteria of 0.75 inch RMSE will be used.

IMPLEMENTATION SCHEDULE

(Per Utility Need)

REFERENCE

1. NRC Assessment of the PDI Program, Jack R. Strosnider, Chief Materials and Chemical Engineering Branch, to Bruce J. Sheffel, Chairman, PDI, March 6, 1996, Table 2, Item 94-005, p34.
2. Meeting Summary, Teleconference between NRC and representatives from PDI, D. G. Naujock, Metallurgist, NDE & Metallurgy Section, to Edmund J. Sullivan, Chief NDE & Metallurgy Section, Chemical Engineering Branch, Division of Engineering, U.S. NRC, March 6, 2000.

APPENDIX E
Sample Request for Relief – Austenitic Welds Single Side Access

LICENSEE/UTILITY NAME
PLANT NAME, UNIT _____
10-YEAR INTERVAL
REQUEST FOR RELIEF No. _____

SYSTEM/COMPONENT(S) FOR WHICH RELIEF IS REQUESTED

Components with single side access, subject to ultrasonic examination with Appendix VIII to the 1995 Edition with 1996 Addenda of ASME Section XI.

CODE REQUIREMENTS

10 CFR 50.55a(b)(2)(xv)(A), 10 CFR 50.55a(b)(2)(xv) G, and 10 CFR 50.55a(b)(2)(xvi), define new requirements for coverage and qualification demonstrations. These requirements affect both piping and RPV examinations.

RELIEF REQUESTED

Relief is requested in accordance with 10 CFR 50.55a(a)(3)(ii). Previously issued RPV qualifications do not meet the new requirements for single side access, that are listed in the Final Rule, 10 CFR 50.55a(b)(2)(xv)(G)(1), (2), and 10 CFR 50.55a(b)(2)(xvi)(A).

BASIS FOR RELIEF

The PDI Program is in agreement with the Final Rule regarding single side access for piping. The Final Rule requires that if access is available, the weld shall be scanned in each of the four directions (parallel and perpendicular to the weld) where required. Coverage credit may be taken for single side exams on ferritic piping. However, for austenitic piping, a procedure must be qualified with flaws on the inaccessible side of the weld.

Current technology is not capable of reliably detecting or sizing flaws on the far side of an austenitic weld for configurations common to US nuclear applications. To demonstrate that the best available technology was applied, PDI provides a best effort qualification instead of a complete single side qualification. PDI Performance Demonstration Qualification Summary (PDQS) austenitic piping certificates list the limitation that single side examination is performed on a best efforts basis. This will require that the far side of the weld, which can only be accessed from one side, must be listed as an area of no coverage.

RPV qualifications have been performed which met all requirements of the ASME Code and the PDI Program at the time of qualification. Some of these qualifications list a single side capability. However, these demonstrations do not meet the new requirements for single side access, qualifications that are listed in the Final Rule, 10 CFR 50.55a(b)(2)(xv)(G)(1), (2), and 10 CFR

50.55a(b)(2)(xvi)(A). Utilities and PDQS certificate holders, which list single side qualifications, will be notified of these differences. New certificates will be issued as amended single side procedures are demonstrated and qualified. There are currently no qualified procedures.

ALTERNATIVE EXAMINATIONS

As qualified through the Performance Demonstration Initiative, the best available techniques will be used from the accessible side of the weld.

IMPLEMENTATION SCHEDULE

(Per Utility Need)

APPENDIX F
Sample Request for Relief - Continue Using ASNT SNT-TC-1A for Ultrasonic Examinations

LICENSEE/UTILITY NAME
PLANT NAME, UNIT ____
10-YEAR INTERVAL
REQUEST FOR RELIEF No. ____

SYSTEM/COMPONENT(S) FOR WHICH RELIEF IS REQUESTED

All components subject to ultrasonic examination with Appendix VIII to the 1995 Edition with 1996 Addenda of ASME Section XI.

CODE REQUIREMENTS

Subarticle IWA-2300 requires qualification of NDE personnel to CP-189, 1991 Edition, and the additional requirements of Division 1.

RELIEF REQUESTED

Relief is requested from the provisions of Sub-article IWA-2300, Qualification of Nondestructive Examination Personnel.” This requires that personnel performing NDE shall be qualified and certified using a written practice prepared in accordance with CP-189, and the additional requirements of Division 1.

BASIS FOR RELIEF

10 CFR 50.55a was amended in the Federal Register (Volume 64, No. 183 dated September 22, 1999) to require the use of the 1995 Edition, with the 1996 Addenda for Appendix VIII qualification requirements. This also imposes the requirements of IWA and Appendix VII of the 1995 Edition, with 1996 Addenda of Section XI. This includes Sub-article IWA-2300, which requires a written practice prepared in accordance with CP-189, 1991 Edition, as amended by the requirements of Division 1.

This requires development, implementation, and to the extent possible consolidation, of multiple certification requirements into one or more written practices. This is needed to address the various NDE certification requirements contained in SNT-TC-1A, for non-Appendix VIII applications and CP-189, for Appendix VIII applications. These are further modified by IWA-2300 and Appendix VII, as amended respectively by the 1989 Edition of Section XI or the 1995 Edition with 1996 Addenda of Section XI.

Relief is requested in accordance with 10 CFR 50.55a(a)(3)(ii) to continue basing all requirements for initial certification and recertification of ultrasonic examination personnel on the 1989 Edition

of Section XI. This includes use of ASNT SNT-TC-1A, 1984, as amended by IWA-2300 and Appendix VII of Section XI, 1989 Edition.

A comparison of the implementation requirements for Appendix VIII examinations using the 1984 Edition of SNT-TC-1A as modified by IWA-2300 and Appendix VII of the 1989 Edition of Section XI with the 1991 Edition of CP-189 as modified by IWA-2300 and Appendix VII of the 1995 Edition and 1996 Addenda of Section XI is considered to be unwieldy and subjective because of their myriad differences. Therefore, three less complex comparisons of technically significant items are attached. One compares IWA-2300 from the 1995 Edition with the 1996 Addenda to the 1989 Edition. Another compares Appendix VII to the 1995 Edition with the 1996 Addenda to the 1989 Edition. The last compares the 1991 Edition of CP-189 with the 1984 Edition of SNT-TC-1A as modified by Appendix VII.

There are major differences between CP-189 and SNT-TC-1A. However, as illustrated in the comparisons, these are minimized by the moderating effects of the applicable IWA-2300 requirements and especially the Appendix VII requirements. Compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. For example, the 1995 Edition with the 1996 Addenda requires near vision acuity of 20/25 or greater Snellen fraction while the 1989 Edition requires Jaeger No. 1 print. Development and administration of a second or consolidated program would not enhance safety or quality and would create a burden particularly in developing an additional written practice, tracking of certifications, duplication of paperwork, etc. This duplication would also apply to NDE vendor programs.

Current certifications are not affected, paragraph IWA-2310 in the 1995 Edition with 1996 Addenda states that certifications based on SNT-TC-1A are valid until recertification is required.

The certified examiners will meet PDI qualification requirements. As stated by the NRC in the resolution of comments to the Final Rule, *"In fact, some licensees have recently submitted limited alternatives to Code requirements that referenced PDI qualifications as the technical bases for relief. Pursuant to 10 CFR 50.55a(a)(3), the NRC has authorized these alternatives on a plant-specific basis."*

ALTERNATE EXAMINATIONS

Initial certification and recertification of NDE personnel shall continue to be conducted in accordance with the requirements contained in the 1989 Edition of ASME Section XI.

IMPLEMENTATION PERIOD

(Per Utility Need)

**COMPARISON OF THE QUALIFICATION AND CERTIFICATION REQUIREMENTS OF
ULTRASONIC EXAMINERS CERTIFIED TO CP-189, 1991, AND SNT-TC-1A, 1984, AS
MODIFIED BY IWA AND APPENDIX VII OF 1989 AND 95/96 EDITION OF SECTION XI
RESPECTIVELY**

The following is a summary of pertinent technical aspects of the implementation requirements contained in Subparagraph IWA-2300 to the two Editions of ASME Section XI identified below.

The comparison is complicated because some of the requirements may be modified or omitted, simply because they are defined in another location or by another document. Several requirements, such as those for limited certification, differ somewhat, but the differences are not considered technically relevant and they are not detailed in this technical comparison. These complications are representative of the increased burden when administering more than one program or a program based on varying requirements.

1995 Ed with 1996 Add of Section XI	1989 Edition of Section XI
IWA-2310 – Written practice is prepared using ANSI/ASNT “Standard” CP-189, 1991 Edition. Certifications based on SNT-TC-1A remain valid until recertification.	IWA-2310 – Written practice is prepared using ASNT “Recommended Practice” SNT-TC-1A, 1984 Edition. Certifications based on earlier editions remain valid until recertification.
IWA-2311 – The written practice shall specify the duties and responsibilities of the Principle Level III.	
IWA-2312 – NDE methods listed in CP-1989 – Similar to 1989 IWA-2311	IWA-2311 – NDE methods listed in SNT-TC-1A – Similar to 95/96 IWA 2312
IWA-2313 – NDE methods not listed in CP-189 – Similar to 1989 IWA-2312	IWA-2312 – NDE methods not listed in SNT-TC-1A – Similar to 1989 IWA-2313
IWA-2314 – Level I and II recertified every 3 years, Level III every 5 years by examination per CP-189. ASNT Level III not required	IWA-2313 – Level I and II recertified every 3 years, Level III every 5 years by examination per SNT-TC-1A.
IWA-2321 – Snellen 20/25 using lower case letters with a known pre-measured height (see IWA-2322). Per Administered in accordance with a procedure, and by personnel, approved by an NDE Level III designated by the employer.	IWA-2321- Jaeger number 1 or equivalent, conducted by personnel qualified to conduct the examinations
IWA-2322 – Requires use of 10x magnifier to measure height of letters.	

1995 Ed. with 1996 Add. Of Sect. XI	1989 Edition of Section XI
IWA-2323 – Level III qualifications evaluated by Basic, Method, Specific, and Practical examinations and the Demonstration examination (Level II Practical)	IWA-2322 – Level III qualifications determined by Basic, Method, and Specific examinations per SNT-TC-1A. (Demonstration examination would be required by Section XI, Appendix VIII)
CP-189 General, Specific and Practical examinations administered and graded by a Level III.	IWA-2323 – Level I and II qualifications determined by General and Specific examinations, and a Practical hands-on examination administered by a Level III.
95/96 Appendix VII is similar to 1989 Appendix VII (See detailed comparison following).	IWA-2324 – Defines requirements for administration of examinations. This is Modified by Appendix VII.
IWA-2330 – Level I responsibilities. Identical to 1989 IWA-2330	IWA-2330 – Level I responsibilities. Identical to 95/96 IWA-2330
IWA-2340 – Level III education. Similar to 1989 IWA-2340	IWA-2340 – Level III education. Similar to 95/96 IWA-2340
IWA-2350 – Defines limited certification. Provides more definition than 1989.	IWA-2350 – Defines limited certification requirements.
IWA-2360 – Allows certification directly to Level II. Defines additional Level III responsibilities.	Appendix VII allows certification directly to Level II. Defines similar Level III responsibilities.
IWA-2370 – Contains experience requirements for Level II candidates.	1989 Appendix VII contains requirements that are more stringent.

The following is a summary of pertinent technical aspects of the implementation requirements contained in Subparagraph IWA-2300 to the two Editions of ASME Section XI identified below.

The comparison is again complicated because some of the requirements may be modified or omitted, simply because they are defined in another location or by another document. These complications are again representative of the increased burden when administering more than one program or a program based on varying requirements.

95/96 APPENDIX VII	1989 APPENDIX VII
VII-1000 – Scope – Modifies the requirements of IWA-2300 for Ultrasonic examiners	VII-1000 - identical to 95/96 Code
VII-2000 – Qualification Levels – Identifies 5 qualification Levels as defined in CP-189	VII-2000 – essentially the same. Defines NDE Instructor qualification since it is not included in SNT-TC-1A.
VII-3000 – Written Practice – Defines the written practice, including the definition of an “outside agency” as an independent company or a functionally independent organization within the same company.	VII-3000 Identical to 95/96 Code except “outside agency” is not defined.
VIII-4000 –	Qualification Requirements
CP-189 contains no simultaneous experience provisions.	Table VII-4110-1 states the simultaneous experience provision of SNT-TC-1A is not applicable.
Paragraph VII-4223 requires previously qualified individuals to meet the requirements for training	Both Appendices in paragraph VII-4300 state that to be considered for examination the Level I, II, and III candidates shall have successfully completed the training required in VII-4200.
Paragraph VII-4240 states that no examination is required for the annual retraining.	
Paragraph VII-4310 (a) states that a random selection process must be controlled by the written practice so no individual takes the same examination more than once.	
Paragraph VII-4310 (b) allows the use of “grading units” to produce a specimen bank for the practical examination.	

95/96 APPENDIX VII	1989 APPENDIX VII
Paragraph VII-4330 (a) Level III examinations per IWA-2300, Basic, Method, Specific, Practical, Demonstration, contains rules for Level II practical examination. An Appendix VIII practical is acceptable.	While the 1989 Appendix VIII contains no requirements for a practical examination, it would be required for the mandatory Appendix VIII.
Paragraph VII-4330 (b) allows recertification of Level III personnel using only the Method and Specific examinations.	IWA-2313 requires recertification using Basic, Method, and Specific written examinations
VII-5000 QUALIFICATION RECORDS	Essentially the same
Not addressed	VII-6000 – Defines duties of the ANII
VII SUPPLEMENTS	Essentially the same

The following is a summary of pertinent technical aspects of the implementation requirements contained in CP-189, 1991; and SNT-TC-1A, 1984.

Comparisons are not detailed in those areas where CP-189 is modified by the requirements of Appendix VII. Please note that the word "should" typically identifies what is considered a requirement in SNT-TC-1A, while CP-189 typically uses the word "shall". Industry practice is to treat SNT-TC-1A recommendations as requirements. Several paragraphs are identified as similar. For example, while SNT-TC-1A does not specifically require suspension of an examiners certification for a lapsed vision examination, as does CP-189, it is industry practice to do so.

CP-189	SNT-TC-1A
1.0 – Scope – CP-189 is a standard that establishes the minimum requirements.	1.0 – Scope – SNT-TC-1A is a recommended practice establishing guidelines.
2.0 – Definitions – More inclusive (19 terms) and more concise. Some Modified by Appendix VII.	2.0 – Definitions – Less inclusive (7 terms)
3.0 – Levels	Of Qualification
3.1 – Classification	Modified by Appendix VII
3.2 – Level III	4.3 (3) – Similar to CP-189
3.3 – Level II	4.3 (2) – Similar to CP-189
3.4 – Level I	Modified by Appendix VII
3.5 – Trainee	4.2 – Similar to CP-189
3.6 – NDE Instructor	Modified by Appendix VII
4.0 Qualification	Requirements
4.1 – Training	Modified by Appendix VII
4.2 – Experience	Modified by Appendix VII
4.3 – Previous Training and Experience	Modified by Appendix VII
4.4 – NDT Instructor	Modified by Appendix VII
4.5 – Outside services	Modified by Appendix VII
5.0 – Qualification	And Certification
5.1 – Procedure	Modified by Appendix VII
5.2 – Procedure requirements	Modified by Appendix VII
5.3 – Approval – "written practice" approved by Level III	Modified by Appendix VII – Requires that "written practice" specify responsibilities.
6.0 Examinations	
6.1 – Vision	Modified by IWA-2300
6.2 – Level III Examination	Modified by Appendix VII
6.3 – Level I and II Examination	Modified by Appendix VII
6.4 – Administration and grading	Modified by Appendix VII
6.5 – Reexamination	Modified by Appendix VII

CP-189	SNT-TC-1A
6.6 – Administration of Examinations – prohibits one’s self or one’s subordinate from preparing or administering an examination.	Not specifically addressed
7.0 Expiration, Suspension, Reinstatement of Employer	Revocation, and Certification
7.1 – Expiration	Similar to CP-189
7.2 – Suspension	Similar to CP-189
7.3 – Revocation	Similar to CP-189
7.4 – Reinstatement	Similar to CP-189
8.0 Employer	Recertification
8.1 – NDT Level I and II	Modified by Appendix VII
8.2 – NDT Level III	Modified by Appendix VII
9.0	Records
9.1 – Responsibility for Documentation	Modified by Appendix VII
9.2 – Contents of Certification Record	Modified by Appendix VII

APPENDIX G
Sample Request for Relief - Use CP-189 for Qualification of Ultrasonic Examination Personnel

LICENSEE/UTILITY NAME
PLANT NAME, UNIT _____
10-YEAR INTERVAL
REQUEST FOR RELIEF No. _____

SYSTEM/COMPONENT(S) FOR WHICH RELIEF IS REQUESTED

All components subject to ultrasonic examination (UT) [or alternatively nondestructive examination (NDE)] in accordance with the _____ Edition and _____ Addenda of ASME Section XI.

CODE REQUIREMENTS

Subarticle IWA-2300, requires qualification of NDE [UT] personnel to ASNT SNT-TC-1A, 1984, and the additional requirements of Division 1.

RELIEF REQUESTED

Relief is requested in accordance with 10 CFR 50.55a(a)(3)(i) to base all requirements for initial certification and recertification of UT [NDE] personnel on the 1995 Edition with the 1996 Addenda of Section XI. The proposed alternatives will provide an acceptable level of quality and safety. Relief is requested from the provisions of Subarticle IWA-2300, "Qualification of Nondestructive Examination Personnel" in the _____ Edition and _____ Addenda of ASME Section XI. This requires that personnel performing UT [NDE] shall be qualified and certified using a written practice prepared in accordance with ASNT SNT-TC-1A, 1984, and the additional requirements of Division 1.

BASIS FOR RELIEF

10 CFR 50.55a was amended in the Federal Register (Volume 64, No. 183 dated September 22, 1999) to require the 1995 Edition, with the 1996 Addenda of Section XI for Appendix VIII qualification requirements. This also imposes the requirements of IWA and Appendix VII of the 1995 Edition, with 1996 Addenda of Section XI. This includes Subarticle IWA-2300, which requires a written practice prepared in accordance with CP-189, 1991, as amended by the requirements of Division 1.

This requires development and implementation of a written practice to address the various requirements contained in SNT-TC-1A, Appendix VII, and CP-189 as amended by different Editions and Addenda of Section XI.

In accordance with the 95 Edition, 96 Addenda, current certifications are not affected. Paragraph IWA-2310 states that certifications based on SNT-TC-1A are valid until recertification is required. Paragraph IWA-2310 additionally states that nondestructive and visual examination personnel qualified and certified in accordance with the requirements of this Division are qualified and certified to perform examinations in accordance with the requirements of previous Editions and Addenda.

ALTERNATIVE EXAMINATIONS

Initial certification and recertification of UT [NDE] personnel shall be conducted in accordance with the requirements contained in the 1995 edition with the 1996 Addenda of Section XI.

IMPLEMENTATION SCHEDULE

(Per Utility Need)

APPENDIX H
Sample Request for Relief – Corrosion Resistant Cladding

SYSTEM/COMPONENT(S) FOR WHICH RELIEF IS REQUESTED

ASME Section XI, Class 1, Table IWB-2500-1, Examination category B-J similar metal welds containing austenitic weld material applied as Corrosion Resistant Cladding (CRC) on the inside surface.

CODE REQUIREMENTS

By Federal Register Notice dated September 22, 1999, 10CFR 50.55a requires Licensees to implement the ASME Code, Section XI, 1995 Edition, 1996 Addenda, Appendix VIII. Ordinarily, Supplement 2 "Qualification Requirements For Wrought Austenitic Piping Welds", as specified by 59/96 Appendix I, I-2220, would be applicable. However, the presence of cladding adds additional challenges to the examination that are beyond the scope of Supplement 2.

RELIEF REQUESTED

Relief is requested from Appendix I I-2220, which requires procedures, equipment, and personnel qualification according to Appendix VIII for piping welds.

BASIS FOR RELIEF

Relief is requested in accordance with 10 CFR 50.55a(a)(3)(i). The proposed alternatives would provide an acceptable level of quality and safety. Current technology is not capable of reliably detecting or sizing flaws when the beam passes through austenitic weld material. PDI is presently working on developing a program for qualification of procedures and personnel to address CRC welds.

ALTERNATIVE EXAMINATIONS

Welds containing CRC will be examined using equipment that is optimized and procedures that are qualified on representative mockups of the existing weld.

IMPLEMENTATION SCHEDULE

(Per Utility Need)

APPENDIX I
Sample Request for Relief - Code Case 613

LICENSEE/UTILITY NAME
PLANT NAME, UNIT _____
10-YEAR INTERVAL
REQUEST FOR RELIEF No. _____

SYSTEM/COMPONENT (S) FOR WHICH RELIEF IS REQUESTED

Class 1 Reactor Pressure Vessel Pressure-retaining Nozzle-to-Vessel welds.

CODE REQUIREMENTS

Rules for Inservice Inspection of Nuclear Power Plant Components, Section XI, 1989 Edition, Examination Category B-D Full Penetration Welds of Nozzles in Vessels. Code Item B3.90, Figure IWB-2500-7 (a) & (b).

ASME Section V, 1989 Edition, Article 4, Paragraphs; T-441.3.2.5 *Angle Beam Scanning*, T-3.2.6 *Scanning for Reflectors Oriented Parallel to the Weld*, and T-441.3.2.7 *Scanning for Reflectors Oriented Transverse to the Weld*.

RELIEF REQUESTED

Pursuant to 10 CFR 50.55a (a)(3)(i), (Plant Name) requests to use the alternative requirements of Code Case N-613 in lieu of the requirements of ASME Section XI Figures IWB-2500-7 (a) and IWB-2500-7 (b). We also request to use this Code Case in lieu of the requirements of ASME Section V, Article 4 for the performance of the required volumetric examinations as specified in Table IWB-2500-1 Category B-D of the 1989 Edition of ASME Section XI. These examinations will be performed during the second inspection interval.

BASIS FOR RELIEF

(Plant Name) is currently required to perform in-service examinations of selected welds in accordance with the requirements of 10 CFR 50.55a, plant technical specifications, and the 1989 Edition of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, Rules for In-Service Inspection of Nuclear Power Plant Components. This Code edition invokes the examination volume requirements of Figures IWB-2500-7 (a) and IWB-2500-7 (b). This Code edition also invokes the examination requirements of Appendix I, Article I-2000 which reference ASME Section V, Article 4 that essentially prescribes twenty (20) year old examination methodology. (Plant Name) will perform the required examinations using the methodology of Code Case N-622 as presented in Relief Request #__. This will provide added assurance that the Reactor Vessel welds have remained free of service related flaws thus enhancing quality and ensuring plant safety and reliability.

The examination volume for the Reactor Vessel pressure retaining nozzle-to-vessel welds extend far beyond the weld into the base metal, and is unnecessarily large. This extends the examination time significantly, and results in no net increase in safety, as the area being examined is a base metal region which is not prone to in-service cracking and has been extensively examined before the vessel was put into service and during the First Inservice examination.

The implementation of Code Case N-613 is also expected to reduce on-vessel examination time by as much as 12 hours, which translates to significant cost savings and reduced personnel radiation exposure.

ALTERNATIVE EXAMINATIONS:

- 1) Perform examinations in accordance with Code Case N-613
- 2) Perform examinations in accordance with ASME Code, Section XI, Div. 1, 1995 Edition, 1996 Addenda, Appendix VIII Supplement VII
- 3) Periodic system pressure tests per Category B-P, Table IWB-2500-1

IMPLEMENTATION SCHEDULE:

(Per Utility Need)

ATTACHMENTS TO THE RELIEF:

Code Case N-613

(Relief Request courtesy of FP&L, Relief was granted; similar relief was subsequently granted to FENCO (Davis-Besse))

APPENDIX J
Sample Request for Relief - Code Case N-583

LICENSEE/UTILITY NAME
PLANT NAME, UNIT _____
10-YEAR INTERVAL
REQUEST FOR RELIEF No. _____

SYSTEM/COMPONENT (S) FOR WHICH RELIEF IS REQUESTED

All components subject to ultrasonic examination in accordance with the 1995 Edition and 1996 Addenda of ASME Section XI, Appendix VIII.

CODE REQUIREMENTS

Subsubarticle VII-4240 requires a minimum of 10 hours of annual training.

RELIEF REQUESTED

Relief is requested in accordance with 10 CFR 50.55a(a)(3)(i) from the provisions of Subsubarticle VII-4240, Annual Training. This requires supplemental training on an annual basis to impart knowledge of new developments, material failure modes, and any pertinent technical topics as determined by the employer. The extent of training shall be a minimum of 10 hours per year.

BASIS FOR RELIEF

10 CFR 50.55a was amended in the Federal Register (Volume 64, No. 183 dated September 22, 1999) to require the 1995 Edition, with the 1996 Addenda of Section XI for Appendix VIII qualification requirements. This also imposes the requirements of Appendix VII of the 1995 Edition, with 1996 Addenda of Section XI. This includes Subarticle VII-4240, which requires a minimum of 10 hours of annual training.

Paragraph 2.4.1.1.1 in the Federal register contained the following statement,

"The NRC had determined that this requirement (10 hours of training on an annual basis) was inadequate for two reasons. The first reason was that the training does not require laboratory work and examination of flawed specimens. Signals can be difficult to interpret and, as detailed in the regulatory analysis for this rulemaking, experience and studies indicate that the examiner must practice on a frequent basis to maintain the capability for proper interpretation. The second reason is related to the length of training and its frequency. Studies have shown that an examiner's capability begins to diminish within approximately 6 months if skills are not maintained. Thus, the NRC had determined that 10 hours of annual training is not sufficient practice to maintain skills, and that an examiner

must practice on a more frequent basis to maintain proper skill level ... The PDI program has adopted a requirement for 8 hours of training, but it is required to be hands-on practice. In addition, the training must be taken no earlier than 6 months prior to performing examinations at a licensee's facility. PDI believes that 8 hours will be acceptable relative to an examiner's abilities in this highly specialized skill area because personnel can gain knowledge of new developments, material failure modes, and other pertinent technical topics through other means. Thus, the NRC has decided to adopt in the Final Rule the PDI position on this matter. These changes are reflected in § 50.55a(b)(2)(xiv)".

This paragraph of the Final Rule states:

"(xiv) Appendix VIII personnel qualification. All personnel qualified for performing ultrasonic examinations in accordance with Appendix VIII shall receive 8 hours of annual hands-on training on specimens that contain cracks. This training must be completed no earlier than 6 months prior to performing ultrasonic examinations at a licensee's facility."

Code Case N-583 responds to an inquiry about what alternative to the annual training requirements of Appendix VII-4240 may be used. The reply states "... supplemental practice may be used to maintain UT personnel examination skills. Personnel shall practice UT techniques by examining or by analyzing prerecorded data from materials or welds containing flaws similar to those that may be encountered during inservice examinations. This practice shall be at least 8 hr per year and shall be administered by an NDE Instructor or Level III; no examination is required.

Relief is requested in accordance with 10 CFR 50.55a(a)(3)(i) to use Code Case N-583 for annual training of ultrasonic examination personnel. When completed no earlier than 6 months prior to performing ultrasonic examinations at a licensee's facility this training will also satisfy the requirements of 10 CFR 50.55a(b)(2)(xiv) of the Final Rule.

ALTERNATIVE EXAMINATIONS

Annual training, as required by VII-4240, shall be conducted in accordance with Code Case N-583.

IMPLEMENTATION SCHEDULE

(Per Utility Need)

APPENDIX K
Sample Appendix VIII Program

This appendix describes a sample program for Implementing the Requirements of Section XI, Appendix VIII, as amended by 10CFR 50.55a. It identifies areas that should be considered for inclusion in the utilities Inservice Inspection program.

10CFR 50.55a, as amended by the Federal Register Notice 64 FR 51370 dated September 22, 1999 (Final Rule), requires implementation of Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems".

The Final Rule requires implementation of Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems", to Section XI, Division 1, 1995 Edition with the 1996 Addenda with modifications as stated in 10 CFR 50.55a(b)(2)(xiv, xv and xvi).

The Final Rule requires accelerated implementation of Appendix VIII according to the following schedule as defined in 10 CFR 50.55a(b)(6)(C):

COMPONENT	SUPPLEMENT	R E Q U I R E D IMPLEMENTATION DATE
Piping and Bolting	1, 2, 3, and 8	May 22, 2000
RPV	4 and 6	November 22, 2000
Overlay	11	November 22, 2001
Nozzle	5 and 7	November 22, 2002
Dissimilar metal welds	10	November 22, 2002
Combined Qualifications	12 & 13	November 22, 2002

Performance Demonstration Program

Appendix VIII provides requirements for performance demonstration for ultrasonic examination procedures, equipment, and personnel used to detect and size flaws. The Appendix VIII requirements shall be implemented by qualifying applicable ultrasonic examination procedures, equipment, and personnel through Change 1 of the Performance Demonstration Initiative Program Description, the additional requirements of (your written practice) for certification of ultrasonic examination personnel to Appendix VII requirements, and the individual ultrasonic examination procedures. The following Code Cases are approved for use *(or as applicable)*:

Code Case N-583 – Annual Training Alternative

Code Case N-613 – Ultrasonic Examination of Full Penetration Nozzles in Vessels

Code Case N-622 – Ultrasonic Examination of RPV and Piping, Bolts, and Studs.

The Performance Demonstration Initiative (PDI) is an organization formed of all U.S. nuclear utilities, to provide an efficient, cost-effective, and technically sound implementation of ultrasonic examination performance demonstration requirements. The EPRI NDE Center is the Performance Demonstration Administrator (PDA) for the program. Rev. 1 Change 1 of the PDI Program Description document, though written to Code Case N-622, meets or exceeds the requirements of the Final Rule, with the exception of four implementation issues. These issues are resolved by the following approved requests for relief (*note, include other requests for relief such as corrosion resistant cladding as applicable*):

1 - Piping Examinations conducted from the Inside Surface

Appendix VIII does not specifically address piping examinations performed from the inside during the RPV examination. No procedures or personnel are currently qualified to perform examinations from the inside surface. Request for Relief _____ approves a modification to the implementation schedule for these welds.

(PWR utilities planning to examine category B-J similar metal piping welds, from the inside surface, after May 22, 2000 will be required to request relief from the implementation requirements of 10 CFR 50.55a(b)(6)(C). A sample relief request and technical basis is included as Appendix C).

2 - RPV Length Sizing Tolerance

Paragraph 2.4.1 in the summary of comments issued with the Final Rule, stated that the PDI requirements are directly contained in paragraph 10 CFR 50.55a(b)(xv). However, the Final Rule inadvertently omits the length sizing qualification criteria of 0.75 inch RMSE used to qualify all examiners. The 0.75-inch RMSE criterion is included in Code Case N-622. NRC has indicated that this was an oversight and that it will be corrected in a future revision of the Final Rule. Request for Relief _____ approves use of Appendix 4 for RPV Length sizing tolerance.

(All utilities planning to perform RPV examinations to the requirements of Appendix VIII will be required to submit a request for relief to allow the appropriate length sizing acceptance criteria. NRC has previously granted relief for use of Code Case N-622 Appendix 4. This criterion was also subject of review during the NRC Assessment of the PDI Program (1). A sample relief request and technical basis is included as Appendix D).

3 - Single Side Access

10 CFR 50.55a(b)(2)(xv)(A), 10 CFR 50.55a(b)(2)(xv) G and 10 CFR 50.55a(b)(2)(xvi) define new requirements for coverage and qualification demonstration. These requirements affect both piping and RPV examinations.

Coverage credit will be taken for single side exams on ferritic piping. For austenitic piping, current technology is not capable of reliably detecting or sizing flaws on the far side of an austenitic weld for configurations common to US nuclear applications. Request for Relief _____ is approved to use the best available techniques for these applications.

(In lieu of a full single side qualification, PDI offers a best effort approach, which demonstrates that the best available technology is applied. This best effort approach does not meet the requirements of the Final Rule. PDI Performance Demonstration Qualification Summary (PDQS) austenitic piping certificates list the limitation that single side examination is performed on a best efforts basis. This will require that the far side of the weld, which can only be accessed from one side, must be listed as an area of no coverage. If a request for relief is required, the technical basis may state that the best available techniques were used from the accessible side of the weld. A Sample Request for Relief is included as Appendix E)

There are currently no RPV procedures qualified for single side access that meet the intent of 10 CFR 50.55a(b)(2)(xv)(G) and CFR 50.55a(b)(2)(xvi)(A). Request for Relief _____ is approved to use the best available techniques for these applications.

Utilities planning on performing RPV examinations using procedures qualified to Appendix VIII by PDI, should not take credit for single side coverage unless the PDQS states that the procedure meets the intent of 10 CFR 50.55a(b)(2)(xv)(G) and CFR 50.55a(b)(2)(xvi)(A). There are currently no RPV procedures qualified for single side access. A request for relief similar to Appendix E above is appropriate.

4 - Referenced Code Sections

“The ASME has stated that provisions of the same vintage are to be used; i.e., provisions from the same edition and addenda.

(Utilities, may submit a RFR for examinations covered by Appendix VIII. A sample relief request is included as Appendix F. Utilities that wish to update all examinations to the 95 edition with the 96 Addenda will need to request relief for those examinations which are not addressed by Appendix VIII, a sample relief request is included as Appendix G).

Responsibilities

(Identify the responsible organizations and interface structure established to implement Appendix VIII and assure qualified examinations are performed.

APPENDIX L

Status of PDI Compliance with Applicable Portions of the Final Rule

On a paragraph-by-paragraph basis, the following defines the status of PDI compliance with applicable portions of the Final Rule. The Final Rule is in ***bold italic print***. In some instances, a direct quote from the NRC document "RESOLUTION OF PUBLIC COMMENTS" is provided as supplemental information. *It is italicized.*

xiv) Appendix VIII personnel qualification. All personnel qualified for performing ultrasonic examinations in accordance with Appendix VIII shall receive 8 hours of annual hands-on training on specimens that contain cracks. This training must be completed no earlier than 6 months prior to performing ultrasonic examinations at a licensee's facility.

Status - Users should include Code Case N-583 in their ISI program.

Supplemental information from NRC resolution of public comments:

"The concept of 40 hours of practice as a minimum on actual flaw specimens was contained in the version of Appendix VII approved at the working group level. Forty hours was originally considered a reasonable length of time for personnel to receive adequate class room and laboratory training. In addition, the 40 hours was intended to provide knowledge of new developments, material failure modes, and other pertinent technical topics. Subsequently, a higher level committee reduced the number of hours required to 10 and eliminated the requirement for laboratory training. The reduction by 75% in required training and the elimination of laboratory training was not founded on a detailed technical basis. This reduction apparently stemmed more from a desire to reduce workload than to ensure that personnel were adequately trained."

Supplemental information from NRC resolution of public comments:

"...The comment is correct in that Code Case N-583 was recently approved by the Code for use. The Code case would further reduce the number of hours of required training from 10 to eight. However, because the 8 hours of training is required to be hands-on practice, the NRC has concluded that this will be acceptable because interested personnel can gain knowledge of new developments, material failure modes, and other pertinent technical topics through other means. Hence, the NRC agrees to reduce the proposed 40 hours of annual training to 8 hours of hands-on training on specimens containing flaws. The training must be taken no earlier than six months prior to performing examinations at a licensee's facility. These changes are reflected in § 50.55a(b)(2)(xiv) of the Final Rule."

(xv) Appendix VIII specimen set and qualification requirements. The following provisions may be used to modify implementation of Appendix VIII of Section XI, 1995 Edition with the

1996 Addenda. Licensees choosing to apply these provisions shall apply all of the provisions except for those in § 50.55a(b)(2)(xv)(F) which are optional.

(A) When applying Supplements 2 (wrought austenitic piping) and 3 (Ferritic Piping) to Appendix VIII, the following examination coverage criteria requirements must be used:

(1) Piping must be examined in two axial directions and when examination in the circumferential direction is required, the circumferential examination must be performed in two directions, provided access is available.

Status - PDI-UT-1 and PDI-UT-2 address this requirement in paragraph 6.3.

Status - Appendix VIII does not specifically address piping examinations performed from the inside during the RPV examination. PDI is addressing this problem by proposing appropriate recommendations for the revision of Appendix VIII. PDI had intended that piping examinations performed from the inside surface would be implemented in tandem with the dissimilar metal weld examination qualifications. However, this is not reflected in the implementation schedule. No procedures or personnel are currently qualified to perform examinations from the inside surface.

PWR utilities planning to examine category B-J similar metal piping welds, from the inside surface, after May 22, 2000 will be required to request relief from the implementation schedule requirements of 10 CFR 50.55a(b)(6)(C). A sample relief request and technical basis is included as Appendix C.

(2) Where examination from both sides is not possible, full coverage credit may be claimed from a single side for ferritic welds. Where examination from both sides is not possible on austenitic welds, full coverage credit from a single side may be claimed only after completing a successful single sided Appendix VIII demonstration using flaws on the opposite side of the weld.

Status - The PDI Program is in agreement with the Final Rule regarding single side access for piping. The Final Rule requires that if access is available the weld shall be scanned in each of the four directions (parallel and perpendicular to the weld) where required. Coverage credit may be taken for single side exams on ferritic piping. However, for austenitic piping, a procedure must be qualified with flaws on the inaccessible side of the weld. Current technology is not capable of reliably detecting or sizing flaws on the far side of an austenitic weld, for configurations common to US nuclear applications. In lieu of a full single side qualification, PDI offers a best effort approach, which demonstrates that the best available technology is applied. This best effort approach does not meet the requirements of the Final Rule. PDI Performance Demonstration Qualification Summary (PDQS) austenitic piping certificates list the limitation that single side examination is performed on a best efforts basis. This will require that the far side of the weld, which can only be accessed from one side, must be listed as an area of no coverage. If a request for relief is required, the technical basis may state that the best available techniques were used from the accessible side of the weld. A Sample Request for Relief is included as Appendix E.

Supplemental information from NRC resolution of public comment:

“...The limitations associated with single side examinations of stainless steel piping to reliability detect and size flaws on the far side of the weld is well documented. In a public meeting between PDI and the NRC on June 18, 1998, PDI clearly stated they do not endorse single sided inspection of austenitic welds because current technology cannot consistently meet Appendix VIII criteria. Qualified single side examination procedures, equipment and personnel should only be used in situations that are not feasible for two sided examinations. Examinations shall be performed from both sides of the weld on the same surface, wherever feasible.”

Supplemental information from NRC resolution of public comments:

“The NRC has modified the Final Rule to minimize, where possible, the impact on previously qualified procedures that demonstrate the ability to detect defects from a single side. The revised PDI program addresses the NRC’s concerns. The adoption in the Final Rule of Appendix VIII as implemented by PDI means that the current test specimens are acceptable. As discussed in the Documented Evaluation for the proposed Rule, the specimens and procedures defined in the Appendix VIII supplements were designed for and are suitable for two-sided examinations. Given the uniqueness in some instances of single side examinations, re-qualification may be necessary to demonstrate proficiency for these special cases.”

(B) The following provisions must be used in addition to the requirements of Supplement 4 (Clad/Basemetal Interface of Reactor Vessel) to Appendix VIII:

(1) Paragraph 3.1, Detection acceptance criteria—Personnel are qualified for detection if the results of the performance demonstration satisfy the detection requirements of ASME Section XI, Appendix VIII, Table VIII– S4–1 and no flaw greater than 0.25 inch through wall dimension is missed.

Status – PDI qualifications comply

(2) Paragraph 1.1(c), Detection test matrix—Flaws smaller than the 50 percent of allowable flaw size, as defined in IWB–3500, need not be included as detection flaws. For procedures applied from the inside surface, use the minimum thickness specified in the scope of the procedure to calculate a/t. For procedures applied from the outside surface, the actual thickness of the test specimen is to be used to calculate a/t.

Status – Appendix VIII does not specifically address piping examinations performed from the inside. PDI is addressing this problem by proposing appropriate recommendations for the revision of Appendix VIII. PDI had intended that piping examinations performed from the inside surface would be implemented in tandem with the dissimilar metal weld examination qualifications. However, this is not reflected in the implementation schedule. No procedures or personnel are currently qualified to perform examinations from the inside surface.

Status - PDI qualifications comply for procedures applied from the outside surface.

(C) When applying Supplement 4 to Appendix VIII, the following provisions must be used:

(1) A depth sizing requirement of 0.15 inch RMS shall be used in lieu of the requirements in Subparagraphs 3.2(a) and 3.2(b).

Status – PDI qualifications are based on the above requirement for depth sizing. However, the Final Rule inadvertently omits the length sizing qualification criteria of 0.75 inch RMSE used to qualify all examiners. The 0.75-inch RMSE criterion is included in Code Case N-622. NRC has indicated that this was an oversight and that it will be corrected (4) in a future revision of the Final Rule.

All utilities planning to perform RPV examinations to the requirements of Appendix VIII will be required to submit a RFR to allow the appropriate length sizing acceptance criteria. NRC has previously granted relief for use of Code Case N-622 Appendix 4. This criterion was also subject of review during the NRC Assessment of the PDI Program (Ref.1). A sample RFR and technical basis is included as Appendix D.

(2) In lieu of the location acceptance criteria requirements of Subparagraph 2.1(b), a flaw will be considered detected when reported within 1.0 inch or 10 percent of the metal path to the flaw, whichever is greater, of its true location in the X and Y directions.

Status – PDI qualifications comply

(3) In lieu of the flaw type requirements of Subparagraph 1.1(e)(1), a minimum of 70 percent of the flaws in the detection and sizing tests shall be cracks. Notches, if used, must be limited by the following:

(i) Notches must be limited to the case where examinations are performed from the clad surface.

(ii) Notches must be semielliptical with a tip width of less than or equal to 0.010 inches.

(iii) Notches must be perpendicular to the surface within ± 2 degrees.

Status – PDI qualifications comply

Supplemental information from NRC resolution of public comments:

“... the NRC has reconsidered its position on specimen set cracks. The Final Rule will permit non-crack flaws on a limited basis for vessel and nozzle test specimen sets. For these components, the NRC has concluded that a mix of cracks and notches is acceptable as long as they provide a similar detection and sizing challenge to that seen in actual service induced degradation. But, as discussed in detail in the Documented Evaluation for the

propose Rule, the NRC believes that flaws in test specimens used for UT should be representative of the flaws normally found or expected to be found in operating plants. For wrought austenitic, ferritic, and dissimilar metal welds, these flaws can best be represented with cracks. Cracks span the ultrasonic spectra of flaw surface conditions from rough to smooth, jagged to straight, single to multiple tip, tight to wide tip. Notches generally have smooth surfaces that reflect a narrow ultrasonic spectra that represents a small population of flaws contained in-service components. Some variations in UT examination techniques may be more challenged with a notch located in specific locations, whereas, other variations in UT examination techniques may not. Hence, the Final Rule permits a limited population of notches and fabrication flaws for Supplements 4, 5, 6, and 7.”

(4) In lieu of the detection test matrix requirements in paragraphs 1.1(e)(2) and 1.1(e)(3), personnel demonstration test sets must contain a representative distribution of flaw orientations, sizes, and locations.

Status – PDI qualifications comply

(D) The following provisions must be used in addition to the requirements of Supplement 6 (Reactor Vessel Welds other than Clad/basemetal Interface) to Appendix VIII:

(1) Paragraph 3.1, Detection Acceptance Criteria—Personnel are qualified for detection if:

(i) No surface connected flaw greater than 0.25 inch through wall has been missed.

(ii) No embedded flaw greater than 0.50 inch through wall has been missed.

Status – PDI qualifications comply

(2) Paragraph 3.1, Detection Acceptance Criteria—For procedure qualification, all flaws within the scope of the procedure are detected.

Status – PDI qualifications comply

(3) Paragraph 1.1(b) for detection and sizing test flaws and locations—Flaws smaller than the 50 percent of allowable flaw size, as defined in IWB-3500, need not be included as detection flaws. Flaws which are less than the allowable flaw size, as defined in IWB-3500, may be used as detection and sizing flaws.

Status – PDI qualifications comply

(4) Notches are not permitted.

Status – PDI qualifications comply

(E) When applying Supplement 6 to Appendix VIII, the following provisions must be used:

(1) A depth sizing requirement of 0.25 inch RMS must be used in lieu of the requirements of subparagraphs 3.2(a), 3.2(c)(2), and 3.2(c)(3).

Status – PDI qualifications comply

(2) In lieu of the location acceptance criteria requirements in Subparagraph 2.1(b), a flaw will be considered detected when reported within 1.0 inch or 10 percent of the metal path to the flaw, whichever is greater, of its true location in the X and Y directions.

Status – PDI qualifications comply

(3) In lieu of the length sizing criteria requirements of Subparagraph 3.2(b), a length sizing acceptance criteria of 0.75 inch RMS must be used.

Status – PDI qualifications comply

(4) In lieu of the detection specimen requirements in Subparagraph 1.1(e)(1), a minimum of 55 percent of the flaws must be cracks. The remaining flaws may be cracks or fabrication type flaws, such as slag and lack of fusion. The use of notches is not allowed.

Status – PDI qualifications comply

(5) In lieu of paragraphs 1.1(e)(2) and 1.1(e)(3) detection test matrix, personnel demonstration test sets must contain a representative distribution of flaw orientations, sizes, and locations.

Status – PDI qualifications comply

(F) The following provisions may be used for personnel qualification for combined Supplement 4 to Appendix VIII and Supplement 6 to Appendix VIII qualification. Licensees choosing to apply this combined qualification shall apply all of the provisions of Supplements 4 and 6 including the following provisions:

(1) For detection and sizing, the total number of flaws must be at least 10. A minimum of 5 flaws shall be from Supplement 4, and a minimum of 50 percent of the flaws must be from Supplement 6. At least 50 percent of the flaws in any sizing must be cracks. Notches are not acceptable for Supplement 6.

Status – PDI qualifications comply

(2) Examination personnel are qualified for detection and length sizing when the results of any combined performance demonstration satisfy the acceptance criteria of Supplement 4 to Appendix VIII.

Status – The Final Rule inadvertently omits the length sizing qualification criteria of 0.75 inch RMSE used to qualify all examiners to supplement 4. The 0.75-inch RMSE criterion is included in Code Case N-622. NRC has indicated that this was an oversight and that it will be corrected (4) in a future revision of the Final Rule.

All utilities planning to perform RPV examinations to the requirements of Appendix VIII will be required to submit a RFR to allow the appropriate length sizing acceptance criteria. NRC has previously granted relief for use of Code Case N-622 Appendix 4. This criterion was also subject of review during the NRC Assessment of the PDI Program (Ref.1). A sample RFR and technical basis is included as Appendix D.

(3) Examination personnel are qualified for depth sizing when Supplement 4 to Appendix VIII and Supplement 6 to Appendix VIII flaws are sized within the respective acceptance criteria of those supplements.

Status – PDI qualifications comply

(G) When applying Supplement 4 to Appendix VIII, Supplement 6 to Appendix VIII, or combined Supplement 4 and Supplement 6 qualification, the following additional provisions must be used, and examination coverage must include:

(1) The clad to base metal interface, including a minimum of 15 percent T (measured from the clad to base metal interface), shall be examined from four orthogonal directions using procedures and personnel qualified in accordance with Supplement 4 to Appendix VIII.

Status – PDI qualifications comply. During procedure review, PDI will verify that this coverage is included. During examination the utility should verify that the scans are performed.

(2) If the clad-to-base-metal-interface procedure demonstrates detectability of flaws with a tilt angle relative to the weld centerline of at least 45 degrees, the remainder of the examination volume is considered fully examined if coverage is obtained in one parallel and one perpendicular direction. This must be accomplished using a procedure and personnel qualified for single-side examination in accordance with Supplement 6. Subsequent examinations of this volume may be performed using examination techniques qualified for a tilt angle of at least 10 degrees.

Supplemental information from NRC resolution of public comments:

“The final rule adopts the revised PDI program, and the proposed modification related to microstructures has been changed in the final rule to be consistent with the PDI program.”

Examination is required to be performed from 4 directions extending from the clad-to-base metal interface to 15% through-wall. Examinations on the remaining 85% may be performed from one side of a weld may be conducted with procedures and personnel demonstrated at PDI; i.e., confirmed proficiency with single sided examinations by a procedure that shows the ability to detect flaws at angles up to 45 degrees from the normal."

(3) The examination volume not addressed by § 50.55a(b)(2)(xv)(G)(1) is considered fully examined if coverage is obtained in one parallel and one perpendicular direction, using a procedure and personnel qualified for single sided examination when the provisions of § 50.55a(b)(2)(xv)(G)(2) are met.

(4) Where applications are limited by design to single side access, credit may be taken for the full volume provided the examination volume is covered from a single direction perpendicular to the weld and the weld volume is examined from at least one direction parallel to the weld.

Status – RPV qualifications have been performed which met all requirements of the ASME Code and the PDI Program at the time of qualification. Some of these qualifications list a single side capability. However, these demonstrations do not meet the new requirements for single side access, qualifications that are listed in the Final Rule, 10 CFR 50.55a(b)(2)(xv)(G)(1), (2), and 10 CFR 50.55a(b)(2)(xvi)(A). Utilities and PDQS certificate holders which list single side qualifications will be notified of these differences. New certificates will be issued as amended single side procedures are demonstrated and qualified.

It is clear that RPV Supplement 4 and 6 procedures will require additional qualification for single side access. The extent of procedure and personnel requalification, which must be performed to qualify vessel examination for single side access, remains unresolved at this time. A test block has been fabricated to demonstrate the required capabilities.

Utilities planning on performing RPV examinations using procedures qualified to Appendix VIII by PDI, should not take credit for single side coverage unless the PDQS states that the procedure meets the intent of 10 CFR 50.55a(b)(2)(xv)(G) and CFR 50.55a(b)(2)(xvi)(A) as applicable. There are currently no qualified procedures. A request for relief similar to that contained in Appendix E may be used if required.

(H) When applying Supplement 5 (Nozzle Inside Radius Section) to Appendix VIII, at least 50 percent of the flaws in the demonstration test set must be cracks and the maximum misorientation shall be demonstrated with cracks. Flaws in nozzles with bore diameters equal to or less than 4 inches may be notches.

Status – PDI qualifications comply

(I) When applying Supplement 5, Paragraph (a), to Appendix VIII, the following provision must be used in calculating the number of permissible false calls: (1) The number of false calls allowed must be $D/10$, with a maximum of 3, where D is the diameter of the nozzle.

Status – PDI qualifications comply

(J) When applying the requirements of Supplement 5 to Appendix VIII, qualifications for the nozzle inside radius performed from the outside surface may be performed in accordance with Code Case N-552, “Qualification for Nozzle Inside Radius Section from the Outside Surface,” provided that 10 CFR 50.55a(b)(2)(xv)(I)(1) is also satisfied.

Status – The PDI program will fully comply with this requirement. With the addition of 10 CFR 50.55a(b)(2)(I)(1), Code Case N-552 is equivalent to Appendix 5B of Code Case N-622. Note, since this Code Case is referenced in the Final Rule a sample RFR was considered unnecessary and is not included in this Guide.

(K) When performing nozzle-to-vessel weld examinations, the following provisions must be used when the requirements contained in Supplement 7 (Nozzle-to-Vessel Weld) to Appendix VIII are applied for nozzle-to-vessel welds in conjunction with Supplement 4 to Appendix VIII, Supplement 6 to Appendix VIII, or combined Supplement 4 and Supplement 6 qualification.

(1) For examination of nozzle-to-vessel welds conducted from the bore, the following provisions are required to qualify the procedures, equipment, and personnel:

(i) For detection, a minimum of four flaws in one or more full-scale nozzle mock-ups must be added to the test set. The specimens must comply with Supplement 6, Paragraph 1.1, to Appendix VIII, except for flaw locations specified in Table VIII S6-1. Flaws may be either notches, fabrication flaws or cracks. Seventy five percent of the flaws must be cracks or fabrication flaws. Flaw locations and orientations must be selected from the choices shown in § 50.55a(b)(2)(xv)(K)(4), Table VIII-S7- 1—Modified, except flaws perpendicular to the weld are not required. There may be no more than two flaws from each category, and at least one subsurface flaw must be included.

Status – The PDI Program will fully comply with this requirement. As in Code Case N-613, this paragraph allows omitting circumferential scans for flaws oriented perpendicular to the weld. A utility should still request use of Code Case N-613 because the definition of a more realistic examination volume is very beneficial.

(ii) For length sizing, a minimum of four flaws as in § 50.55a(b)(2)(xv)(K)(1)(i) must be included in the test set. The length sizing results must be added to the results of combined Supplement 4 to Appendix VIII and Supplement 6 to Appendix VIII. The combined results must meet the acceptance standards contained in § 50.55a(b)(2)(xv)(E)(3)

Status – The PDI Program will fully comply with this requirement. It should be further noted that the four additional flaws apply to personnel demonstrations. Procedure qualifications will include a minimum of 12 flaws (three times the minimum).

(iii) For depth sizing, a minimum of four flaws as in § 50.55a(b)(2)(xv)(K)(1)(i) must be included in the test set. Their depths must be distributed over the ranges of Supplement 4, Paragraph 1.1, to Appendix VIII, for the inner 15 percent of the wall thickness and Supplement 6, Paragraph 1.1, to Appendix VIII, for the remainder of the wall thickness. The depth sizing results must be combined with the sizing results from Supplement 4 to Appendix VIII for the inner 15 percent and to Supplement 6 to Appendix VIII for the remainder of the wall thickness. The combined results must meet the depth sizing acceptance criteria contained in §§ 50.55a(b)(2)(xv)(C)(1), 50.55a(b)(2)(xv)(E)(1), and 50.55a(b)(2)(xv)(F)(3).

Status – The PDI Program will fully comply with this requirement. It should be further noted that the four additional flaws apply to personnel demonstrations. Procedure qualifications will include a minimum of 12 flaws (three times the minimum).

(2) For examination of reactor pressure vessel nozzle-to-vessel welds conducted from the inside of the vessel,

(i) The clad to base metal interface and the adjacent examination volume to a minimum depth of 15 percent T (measured from the clad to base metal interface) must be examined from four orthogonal directions using a procedure and personnel qualified in accordance with Supplement 4 to Appendix VIII as modified by §§ 50.55a(b)(2)(xv)(B) and 50.55a(b)(2)(xv)(C).

The PDI Program will fully comply with this requirement. However, utilities should request use of Code Case N-613. It should be noted that the PDI Program will include both Supplements 4 and 6 since Supplement 4 (Clad/Basemetal Interface) does not cover the full 15%.

(ii) When the examination volume defined in § 50.55a(b)(2)(xv)(K)(2)(i) cannot be effectively examined in all four directions, the examination must be augmented by examination from the nozzle bore using a procedure and personnel qualified in accordance with § 50.55a(b)(2)(xv)(K)(1).

Status – The PDI Program is currently working on the methodology to comply with this requirement.

(iii) The remainder of the examination volume not covered by § 50.55a(b)(2)(xv)(K)(2)(ii) or a combination of § 50.55a(b)(2)(xv)(K)(2)(i) and § 50.55a(b)(2)(xv)(K)(2)(ii), must be examined from the nozzle bore using a procedure and personnel qualified in accordance with § 50.55a(b)(2)(xv)(K)(1), or from the vessel shell using a procedure and personnel qualified for single sided examination in accordance with Supplement 6 to Appendix VIII, as modified by §§ 50.55a(b)(2)(xv)(D), 50.55a(b)(2)(xv)(E), 50.55a(b)(2)(xv)(F), and 50.55a(b)(2)(xv)(G).

Status – Single side qualifications for the RPV are still under consideration by PDI. Utilities should continue to perform examinations from all four directions where possible. Where examination from all four directions is not possible, this should be reported for both the inner 15% and the outer 85%. This does not represent a change from previous practice.

(3) For examination of reactor pressure vessel nozzle-to-shell welds conducted from the outside of the vessel,

(i) The clad to base metal interface and the adjacent metal to a depth of 15 percent T, (measured from the clad to base metal interface) must be examined from one radial and two opposing circumferential directions using a procedure and personnel qualified in accordance with Supplement 4 to Appendix VIII, as modified by §§ 50.55a(b)(2)(xv)(B) and 50.55a(b)(2)(xv)(C), for examinations performed in the radial direction, and Supplement 5 to Appendix VIII, as modified by § 50.55a(b)(2)(xv)(J), for examinations performed in the circumferential direction.

Status – BWR plants should request use of Code Case N-613 for relief from circumferential scans.

(ii) The examination volume not addressed by § 50.55a(b)(2)(xv)(K)(3)(i) must be examined in a minimum of one radial direction using a procedure and personnel qualified for single sided examination in accordance with Supplement 6 to Appendix VIII, as modified by §§ 50.55a(b)(2)(xv)(D), 50.55a(b)(2)(xv)(E), 50.55a(b)(2)(xv)(F), and 50.55a(b)(2)(xv)(G).

Status – The PDI Program is currently working on the methodology to comply with this requirement.

(4) Table VIII–S7–1, “Flaw Locations and Orientations,” Supplement 7 to Appendix VIII, is modified as follows:

Table VIII – S7 - MODIFIED		
Flaw Locations and Orientations		
	Parallel to weld	Perpendicular to Weld
Inner 15 percent	X	X
OD Surface	X	
Subsurface	X	

Status – PDI qualifications comply

(L) As a modification to the requirements of Supplement 8 (Bolts and Studs), Subparagraph 1.1(c), to Appendix VIII, notches may be located within one diameter of each end of the bolt or stud.

Status – PDI qualifications comply

(xvi) Appendix VIII single side ferritic vessel and piping and stainless steel piping examination.

(A) Examinations performed from one side of a ferritic vessel weld must be conducted with equipment, procedures, and personnel that have demonstrated proficiency with single side examinations. To demonstrate equivalency to two sided examinations, the demonstration must be performed to the requirements of Appendix VIII as modified by this paragraph and §§ 50.55a(b)(2)(xv) (B) through (G), on specimens containing flaws with non-optimum sound energy reflecting characteristics or flaws similar to those in the vessel being examined.

(B) Examinations performed from one side of a ferritic or stainless steel pipe weld must be conducted with equipment, procedures, and personnel that have demonstrated proficiency with single side examinations. To demonstrate equivalency to two sided examinations, the demonstration must be performed to the requirements of Appendix VIII as modified by this paragraph and § 50.55a(b)(2)(xv)(A).

Status – 10 CFR 50.55a(b)(2)(xv)(A), 10 CFR 50.55a(b)(2)(xv) (G), and 10 CFR 50.55a(b)(2)(xvi), define new requirements for coverage and qualification demonstration. These requirements affect both piping and RPV examinations.

The PDI Program is in agreement with the Final Rule regarding single side access for piping. The Final Rule requires that if access is available the weld shall be scanned in each of the four directions (parallel and perpendicular to the weld) where required. Coverage credit may be taken for single side exams on ferritic piping. However, for austenitic piping, a procedure must be qualified with flaws on the inaccessible side of the weld. Current technology is not capable of reliably detecting or sizing flaws on the far side of an austenitic weld, for configurations common to US nuclear applications. In lieu of a full single side qualification, PDI offers a best effort approach, which demonstrates that the best available technology is applied. This best effort approach does not meet the requirements of the Final Rule. PDI Performance Demonstration Qualification Summary (PDQS) austenitic piping certificates list the limitation that single side examination is performed on a best efforts basis. This will require that the far side of the weld, which can only be accessed from one side, must be listed as an area of no coverage. RFR is required and the technical basis should state that the best available techniques were used from the accessible side of the weld. A Sample RFR is included as Appendix E.

RPV qualifications have been performed which met all requirements of the ASME Code and the PDI Program at the time of qualification. Some of these qualifications list a single side capability. However, these demonstrations do not meet the new requirements for single side access, qualifications that are listed in the Final Rule, 10 CFR 50.55a(b)(2)(xv)(G)(1), (2), and 10 CFR 50.55a(b)(2)(xvi)(A). Utilities and PDQS certificate holders, which list single side qualifications, will be notified of these differences. New certificates will be issued as amended single side procedures are demonstrated and qualified.

It is clear that RPV Supplement 4 and 6 procedures will require additional qualification for single side access. The extent of procedure and personnel requalification, which must be performed to qualify vessel examination for single side access, remains unresolved at this time. A test block has been fabricated to demonstrate the required capabilities.

Utilities planning on performing RPV examinations using procedures qualified to Appendix VIII by PDI, should not take credit for single side coverage unless the PDQS states that the procedure meets the intent of 10 CFR 50.55a(b)(2)(xv)(G) and CFR 50.55a(b)(2)(xvi)(A). There are currently no qualified procedures. A request for relief similar to that contained in Appendix D may be used if required.

(C) Implementation of Appendix VIII to Section XI. (1) The Supplements to Appendix VIII of Section XI, Division 1, 1995 Edition with the 1996 Addenda of the ASME Boiler and Pressure Vessel Code must be implemented in accordance with the following schedule: Supplements 1, 2, 3, and 8--May 22, 2000; Supplements 4 and 6--November 22, 2000; Supplement 11--November 22, 2001; and Supplements 5, 7, 10, 12, and 13--November 22, 2002.

Status – Timely implementation will require utilities to identify and obtain approval for selected RFR and Code Cases. The following list reiterates important considerations contained in this guideline. It is not intended to be all-inclusive.

1 - Utilities scheduled to examine PWR category B-J similar-metal piping welds from the inside surface will be required to request relief from the implementation schedule requirements of 10 CFR 50.55a(g)(6)(ii)(C). A sample RFR and technical basis is included as Appendix C.

2 - Utilities scheduled to perform RPV examinations using Appendix VIII Supplement 4 must submit a RFR to allow the correct length sizing qualification criteria. NRC has previously granted relief for use of Code Case N-622 Appendix 4. This criterion was also the subject of review during the NRC Assessment of the PDI Program (1). A sample RFR and technical basis is included as Appendix D.

3 - Utilities examining austenitic welds with single side access may have to update/revise/submit a RFR. PDI Performance Demonstration Qualification Summary (PDQS) austenitic piping certificates list the limitation that single side examination is performed on a best efforts basis. This will require that the inaccessible side of the weld be listed as an area of no coverage. A Sample RFR is included as Appendix E.

4 - Utilities planning on performing RPV examinations using procedures qualified to Appendix VIII by PDI (Supplements 4, 6, 7) should not take credit for single side coverage unless the PDQS states that the procedure meets the intent of 10 CFR 50.55a(b)(2)(xv)(G) and CFR 50.55a(b)(2)(xvi)(A). There are currently no qualified procedures that meet these requirements. A RFR similar to that contained in Appendix E may be used if required.

5 – Utilities, whose current written practice complies with the 1989 Edition of Section XI, including Appendix VII, may elect to submit a RFR to continue to use the 1989 Edition of Section XI for NDE certification activities for the duration of the current interval. A sample RFR with basis is included as Appendix F. Alternatively, a utility could submit a RFR to update their written practice for initial certification and recertification of either all NDE or only UT examination personnel to the 95/96 Code. A sample RFR is included as Appendix G.

6 - Utilities planning to examine B-J similar metal (Supplement 2) welds containing CRC after May 22, 2000 will be required to request relief from the implementation requirements of 10 CFR 50.55a(g)(6)(ii)(C). A sample RFR and technical justification is included as Appendix H to this document.

7 - The following Code Cases should be included in the Owners Program:

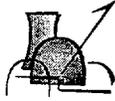
N-552 - Qualification for Nozzle Inside Radius Section from the Outside Surface

N-583 - Annual Training Alternative (Appendix J)

N-613 - Ultrasonic Examination of Full Penetration Nozzles in Vessels (Appendix I)

N-622 - Ultrasonic Examination of RPV and Piping, Bolts, and Studs (Supplement 4)

8 – Utilities must resolve any irregularities between the Final Rule and their implementation of Regulatory Guide 1.150 and GL 88-01.



**GUIDELINE FOR THE
IMPLEMENTATION OF APPENDIX VIII
AND 10CFR 50.55a**

**Presented at
PDI-NRC Semi-Annual Meeting
June, 2000**

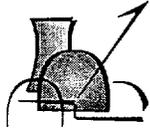
NDE 1

EPRI

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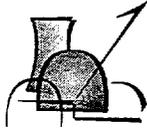
Introduction

- **PDI Implementation Guidelines**
 - **Volume One - Programmatic Issues**
 - Licensee commitments
 - Implementation Documents
 - Requests for Relief
 - Frequently Asked Questions
 - Issued Mid-April in Draft Form
 - Final Issued May 22, 2000
 - Key contacts by e-mail
 - Other Volumes will be issued as the need arises
 - Volume Two - Performance Issues

NDE 2

EPR21

- 1 - Present areas requiring action by the Licensee
- 2 - Provide guidance in the technical arena



Licensee Commitments

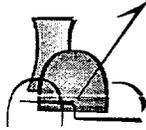
- **Licensee must evaluate commitments:**
 - **Resolve issues with:**
 - **Referenced Code Sections**
 - Appendix VII 1989 Vs Appendix VII 95/96
 - SNT-TC-1A Vs CP-189
 - IWA-2300 1989 Vs IWA-2300 95/96
 - Appendix I - though not referenced by Appendix VIII
 - **Resolve programmatic irregularities between:**
 - Final Rule
 - Licensees implementation of RG 1.150
 - GL 88-01

NDE 3

EPRI

1 - SNT-TC-1A as modified by 1989 Appendix VII and IWA-2300 versus CP-189 as modified by 95/96 Appendix VII and IWA-2300

2 - Appendix VIII references Table I-2000-1 for in course of preparation (cast austenitic)



Implementation Documents

- **Licensees must establish Appendix VIII Program**
 - **Incorporate appropriate Code Cases**
 - N-552 - Qual. for Nozzle IR Section from the Outside Surface
 - N-583 - Annual Training Alternative
 - N-613 - UT of Full Penetration Nozzles in Vessels
 - N-622 - UT of RPV and Piping, Bolts, and Studs (Supp. 4)
 - **Obtain appropriate Relief Requests**
 - Piping exams from Inside Surface
 - RPV Length Sizing tolerance
 - Single Side Access
 - Corrosion Resistant Cladding
 - Referenced Code Sections

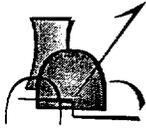
NDE 4

EPRI

1 - N-552 referenced in Final Rule

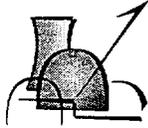
2 - N-583 8 hours hands-on in lieu of 10 hours classroom - as supplemented by Final Rule 6 months prior to - PDI implementation guideline issued

3 - N-613 relief has been granted



Requests for Relief

- **Piping exams from Inside Surface**
 - **System**
 - Category B-J Pressure Retaining Piping welds adjacent to or attaching to Reactor Class Pressure Vessel Nozzles (Primarily PWR Nozzle-Safe End-Pipe Welds)
 - **Basis**
 - PDI Samples not available
 - Originally scheduled with Dissimilar Metal welds
 - Inadvertent oversight during comment period
 - **Relief**
 - Maintain current industry practice until 11/22/2002 (Commensurate with DSM weld commitment)



Requests for Relief (Continued)

- **RPV Length Sizing Tolerance**

- **System**

- Examination category B-A, Item no. B1.10 longitudinal and circumferential shell welds and B1.20 Head welds

- **Basis**

- The statement in the Final Rule "A depth sizing requirement of 0.15 inch RMS shall be used in lieu of the requirements in Subparagraphs 3.2(a) and 3.2(b)" is inappropriate.
- NRC *"does not take exception" to the 0.75-inch RMSE length sizing tolerance*

- **Relief**

- Use a length sizing qualification criteria of 0.75 inch RMSE

NDE 6

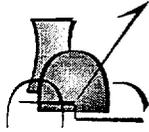
EPRI

Is there a preferential method of obtaining relief?

1 - N-622, Appendix 4?

2 - N-538?

3 - Blanket statement in RFR?



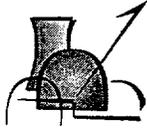
Requests for Relief (Continued)

- **Single Side Access - Austenitic Piping**
 - **System**
 - Components with single side access, subject to ultrasonic examination with Appendix VIII to the 1995 Edition with 1996 Addenda of ASME Section XI
 - **Basis**
 - Current technology is not capable of reliably detecting or sizing flaws on the far side of an austenitic weld for configurations common to US nuclear applications
 - **Relief**
 - Single side exam is performed on a best efforts basis
 - Far side of a weld, which can only be accessed from one side, must be listed as an area of no coverage

NDE 7

EPRI

1 - When should RFR be submitted?



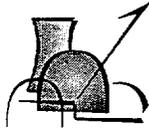
Requests for Relief (Continued)

- **Single Side Access - RPV**
 - **System**
 - Components with single side access, subject to ultrasonic examination with Appendix VIII to the 1995 Edition with 1996 Addenda of ASME Section XI
 - **Basis**
 - Previous demonstrations do not meet the new requirements for single side access (45° Flaw Orient)
 - There are currently no qualified procedures
 - **Relief**
 - As qualified through the Performance Demonstration Initiative, the best available techniques will be used from the accessible side of the weld

NDE 8

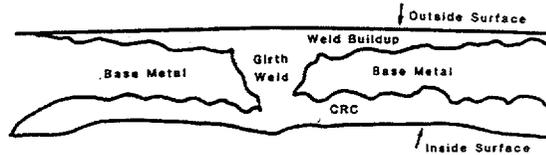
EPRI

- 1 - 45 degree flaw
- 2 - Qualification will be identified on PDQS



Requests for Relief (Continued)

- **Corrosion Resistant Cladding**



- **System**

- Category B-J similar metal welds containing austenitic weld material applied as CRC on the inside surface

- **Basis**

- Current technology is not reliably detecting or sizing flaws when the beam passes through austenitic weld

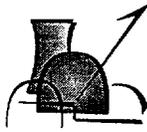
- **Relief**

- PDI is presently working on developing a program for qualification of procedures and personnel to address CRC welds

NDE 9

EPRI

- 1 - Not addressed in Supplement 2 qualification - requires specialized techniques such as those used for dissimilar metal welds/weld overlay.
- 2 - 1989 Appendix I utilizes Appendix III for pipe - appropriate (supplement 4).
- 3 - 95/96 Appendix I - All pipe App. VIII, Other - utilizes Art. 4 of Section V - not appropriate
- 4 - Basic Code techniques must be supplemented - Guidance is available in NP-4891-LD, dated October 1986



Requests for Relief (Continued)

- **Referenced Code Sections**
 - **The Final Rule requires 95/96 Appendix VIII Only**
 - **What Edition of referenced Code section is required**
 - Appendix VII - 95/96 or Code of Record
 - IWA-2300 - 95/96 or Code of Record
 - **What Edition of other Code sections is required**
 - Appendix I
 - Article 4 of Section V
 - Article 5 of Section V
 - **Is a Request For Relief required if 95/96 Code is:**
 - Not used for referenced Code sections
 - Used for Code sections not referenced

NDE 10

EPRI

- 1 - SNT-TC-1A as modified by 1989 Appendix VII and IWA-2300 versus CP-189 as modified by 95/96 Appendix VII and IWA-2300
- 2 - Relief was granted to remain with SNT-TC-1A for IWE/IWL
- 3 - Administrative difficulties - Example 1989 - Jaeger 1 versus 95/96 - Snellen 20/25
- 4 - Is 10CFR 50.59 appropriate?

RPV SINGLE SIDE ACCESS

- ▼ **NRC concerned that Appendix VIII qualifications would allow examination of the inner 15% T in one parallel and one perpendicular direction**
- ▼ **Battelle has found off axis flaws, (tilted 45 from the surface normal), the flaws were:**
 - Acceptable to IWB 3500
 - Not surface connected
 - Consisted of clusters of small defects which may or may not meet the proximity rules of IWA 3300
- ▼ **10CFR 50.55 Final Rule placed additional requirements on coverage**



PDI Response to NRC Concern,

- ▼ **Interpretation: If a badly oriented flaw, of unacceptable size, was located in the inner 15% of the thickness, would it be reliably detected?**
- ▼ **Inner 15% of T should be scanned in 4 directions (2 parallel and 2 perpendicular direction relative to weld centerline)
Where Access is available**
- ▼ **Previous Agreements with NRC stated that the Rule would not invalidate previous Qualifications, and we do not think it does. Some clarifications are needed.**
 - Inspection vendors and utilities have been informed that single side qualifications listed on current qualifications are not in agreement with the Final Rule
- ▼ **Agreement on Qualification Approach is Required**



PDI POPOSED RESPONSE

- ▼ **Postulated Flaw**
- ▼ **Demonstration sample**
- ▼ **Demonstration basis**
- ▼ **Experimental Results**
- ▼ **PDI Technical Basis (General)**
- ▼ **Vendor Technical Basis (Specific)**
- ▼ **Procedure Evaluation**
- ▼ **Procedure Certification**

POSTULATED FLAW

- ▼ **Flaw shall be near the unacceptable flaw size of IWB-3500**
- ▼ **Oriented approximately 45 degrees to the surface normal**
- ▼ **A rough subsurface flaw is appropriate**
 - It is not reasonable to postulate a smooth flaw
 - A flaw, resulting from a repair, would as a minimum have a discontinuous nature.
 - Discontinuous cracking resulting from contamination, intermittent inter-bead lack of fusion or slag are possibilities.
 - PDI has chosen a rough crack at approximately 45 degrees to the surface
 - flaws are located near but not connected to interface and at the extremes of the inner 15% of T.
 - Sizes near acceptability limit



RECOMMENDED APPROACH

▼ **Demonstration Sample**

- Four inch thick SA 508 with SMAW cladding
- Flaws fabricated by same process and vendor as Supplement 4 & 6 test specimens
- Rough Cracks at 45 degrees to surface normal
- Flaw size .096 to 1.96 inch, ligament 0.12 to 1.97 inch

▼ **Demonstration Basis**

- Supplemental Qualification
- Open Demonstration
- Technical justification by PDI and Vendor
- Reissue PDQS with revised scope and criteria



RECOMMENDED APPROACH

▼ **Experimental Results PDI Test Block**

- Conventional Examination approaches provide signal response greater than 20% DAC
- Differences between optimum and non optimum orientations are not grate
- General Conclusion is that unacceptable flaws could be reliably detected
- Flaws of similar size and location in PDI test blocks provided similar amplitude responses
- It is expected that these flaws would be detected and reported.

RECOMMENDED APPROACH

▼ **Experimental Results from Shoreham Vessel**

- Flaw #2 NUREG/CR-6471, indicated through wall extent of 32mm
- Flaw is acceptable to ASME Standards
- EPRI measurements indicate clusters of small defects
- Standard evaluation criteria would not consider this a reportable indication
 - does not have echo dynamic pattern of a crack, (does not walk)
 - does not meet IWA 3000 rules of association, (separations are too large to be considered a single flaw)



SUPPLEMENTAL QUALIFICATION

▼ **PDI Technical Basis (General)**

- Provides basis for postulated flaw and general expectations of performance

▼ **Vendor Technical Basis (Specific)**

- Reports vendor specific flaw evaluation criteria and results on PDI Test Block

▼ **Procedure Evaluation**

- PDI evaluates flaw evaluation and reporting criteria and any required changes in light of single side inspection requirements

▼ **Procedure Qualification/Certification**

- PDQS Certificates are issued with amended Scope
- PDQS will state that it is in compliance with the Final Rule



Actions

- ▼ **The “PDI Recommended Approach” to single side supplementary qualifications can be accomplished within the Scope of the existing PDI Program**
- ▼ **NRC is requested to review the PDI Recommended Approach and advise PDI if they have any comments, prior to initiation of qualification demonstrations**
 - Response by August 1 would allow this area to be resolved prior to fall outages
- ▼ **If examination is not possible in all 4 directions, for the inner 15%, is there any solution other than a Request for Relief even if it can be demonstrated that non-optimal flaw orientations can be reliably detected within the inner 15%**
 - NRC response requested

Performance
Demonstration Initiative
(PDI)
Approach to Dissimilar
Metal Qualification

NRC Information Meeting

June 27th-28th

Charlotte, NC

Prepared By; Carl Latiolais & Jeff Landrum

Goals

- **Target Completion Date January 2001**
 - Establish technically justifiable process to qualify procedures and personnel
 - Gain acceptance from utilities and NRC
 - Limit the number of samples required for demonstrations
 - Limit the amount of time required for personnel qualifications
 - Establish guidelines for the expansion of the qualification

Challenges

- Numerous configurations are present within the industry
- Access to examination volume is limited in many situations
- Some site specific mock-ups may be required to expand procedure
- Limited flaw morphology data available

Preliminary Evaluation Efforts

- **Design and Procurement**

- 21 samples have been designed which represent a cross section of industry configurations
- Approximately 150 flaws with varying depths, lengths, orientations, and positions are included in samples
- Objective is to identify essential parameters for an effective demonstrations

Sample Selection Basis

- **Process**

- Industry survey was performed
- Configurations were grouped into categories
 - Small
 - 4.0" (100 mm) - 6.0" (152 mm) in diameter
 - .50" (12 mm) - 1.0" (25 mm) in thickness
 - Medium
 - 12.0" (305 mm) - 18.0" (457 mm) in diameter
 - 1.2" (30 mm) - 1.5" (38 mm) in thickness
 - Large
 - 28.0" (711 mm) - 36.0" (914 mm) in diameter
 - 1.5" (38 mm) - 2.625" (67 mm) in thickness

Sample Selection Basis (Cont.)

- Configurations were then sorted by plant type (PWR/BWR)
- Available Plant failure data was reviewed
- Each configuration was evaluated to determine perceived degree of difficulty
- Number of occurrences in population

Selected Configurations

- **Small Size Category**
 - 4.0” (100 mm) - 6.0” (152 mm)
 - N9 Jet Pump Instrumentation(BWR)
 - Pressurizer Spray (PWR)

Selected Configurations

- **Medium Size Category**
 - 12.0”(305 mm)-18.0” (457 mm)
 - N2 Recirculation (BWR)
 - N4 Feedwater (BWR)
 - N5 Core Spray (BWR)
 - Safety Injection (PWR)
 - Core Flood (Babcock & Wilcox PWR)
 - These include samples of replacement configurations with old safe-end remnants
 - Core Flood samples have ID and OD flaws

Selected Configurations

- **Large Size Category**
 - 28.0” (711 mm) - 36.0” (914 mm)
 - N1 Recirculation (BWR)
 - Inlet and outlet safe-ends (PWR)
 - Includes both Inside and outside surface flaws

Planned Activities

- **Phase I**
 - Fingerprint samples utilizing standard automated techniques
 - Perform manual examination utilizing standard techniques
 - Apply advanced phased array techniques

Planned Activities

- **Phase II**
 - Document changes in essential parameters
 - Document what techniques are required for adequate examination
 - Establish detectability thresholds
 - Establish Sizing Accuracy Limits

Planned Activities

- **Phase III**

- Establish criteria for expansion of the procedure to other configurations
- Develop criteria for determining the required number of site specific mock-ups required
- Utilize information obtained to design PDI samples

Planned Activities

- **Phase IV**
 - Document approach in a technical justification

Expected Results

- Essential parameters will not vary greatly from geometry to geometry
- Not all flaws will be detectable
- Sizing tolerances will be established
- Conventional data analysis processes may require improvement

SUPPLEMENT 11
PDI OVERLAY
DEVELOPMENT PROGRAM

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Overlay

▼ **Supplement 11 Weld Clad Overlay:**

- Examinations and qualifications are presently in accordance with the former Three Party Agreement Between the BWR Owners Group, EPRI and the NRC

▼ **Present Program does not meet Supplement 11 requirements**

- Only available samples are 12.0” diameter with a maximum overlay thickness of .50”
- Flaw density of samples greater than what is required in code

Overlay

- ▼ **Additional Samples must be fabricated**
- ▼ **Program must be revised to address new rules of test administration and grading**

Approach

- ▼ **Revise Code to allow use of existing samples and present testing criteria**
- ▼ **Fabricate a limited number of additional samples with smaller and larger diameters and incorporate into test**

Fabrication Issues

- ▼ **Application of weld overlay is time consuming and very expensive**
 - 100 hours of welding for one 14.0” diameter .50” thick overlay
- ▼ **Common methods of flaw implementation not optimum for weld overlay samples**
- ▼ **Present flaws were made using graphite wool technique**
 - Expensive, time consuming and hard to control
 - Numerous man-hours required to quantify samples and establish truth measurements (Must be done by expert opinion)
- ▼ **Limited amount of funds and time available**

Actions

▼ **NDEC subcommittee has funded research into methods of fabricating additional samples in a faster cheaper way**

- 3 techniques are presently being evaluated
 - EDM notches mechanically closed with Cold Isostatic Pressure (CIP) bonding process
 - EDM notches mechanically closed with Hot Isostatic Pressure (HIP) bonding process
 - In-situ flaw implantation process
- Responses of fabricated flaws are being compared with existing samples and data from field

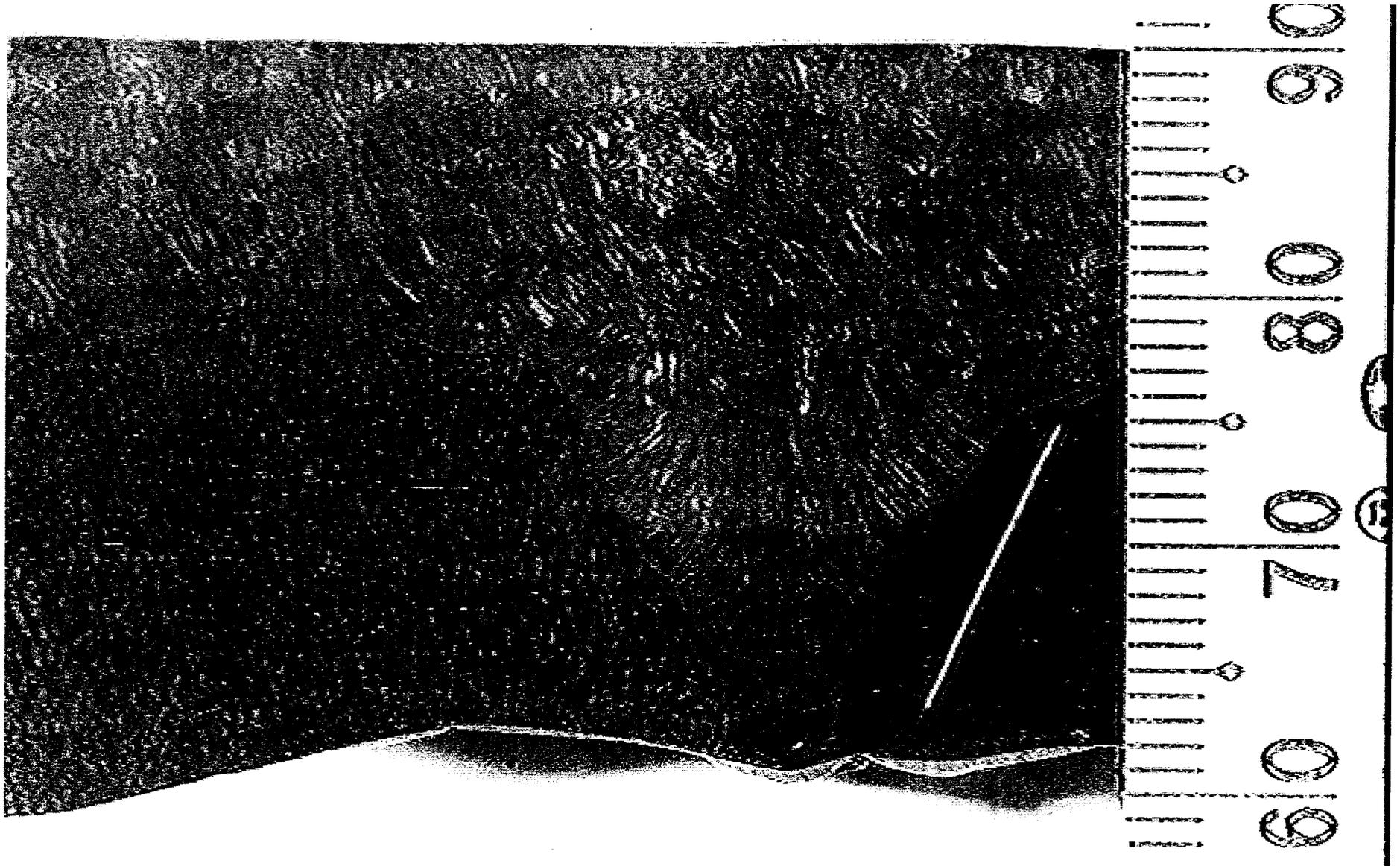
▼ Advantages

- Will allow use of field removed samples that are available at the NDE center
- Actual height of flaw can be mechanically measured (No expert opinion required)
- The amount of welding and machining time will be greatly reduced

Preliminary Results

- ▼ **Response from HIP bonding of EDM notches show promise**
 - Responses comparable to existing overlay samples
 - **Advantages**
 - Can be placed in existing samples without disturbing weld material
 - *No weld signature*
 - Minimum Welding Time Required
- ▼ **In-Situ Process**
 - **Advantages**
 - Response comparable to existing overlay samples
 - Welding time much reduced

HIP Bonding



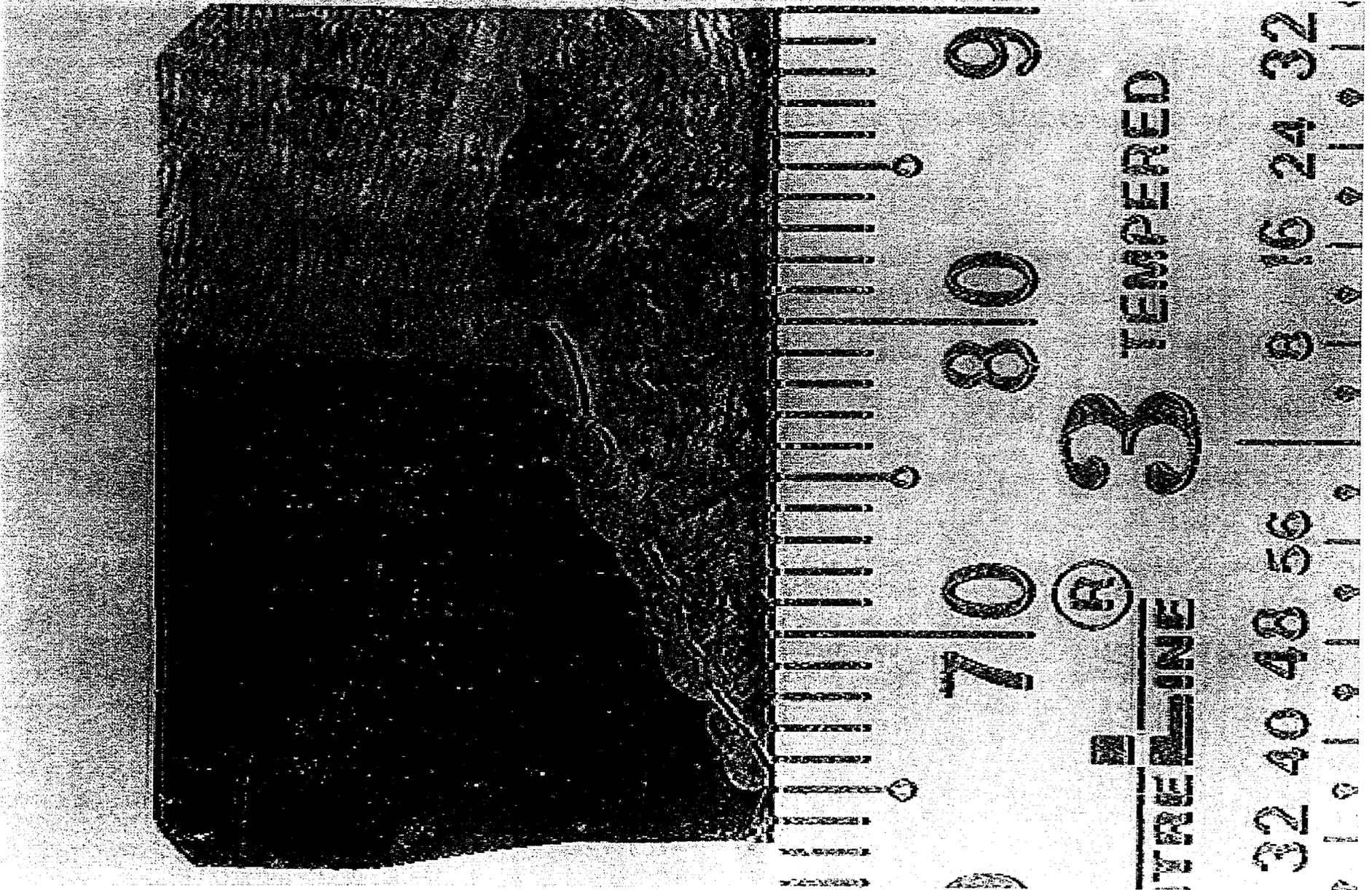
HIP Bonding (Cont.)

▼ **Affects of HIP Bonding**

- Pre-HIP
 - Notch Tip Radius 0.007” -0.010”
- Post HIP
 - Notch Tip Radius 0.001” to 0.004”

▼ **Additional work underway to improve process**

In-Situ Process



In-Situ (Cont.)

- ▼ **Response from In-Situ flaws show promise**
 - **Responses comparable to existing overlay samples**
 - **Advantages**
 - Can be placed in existing samples with much shorter welding time
 - **Disadvantages**
 - Process has limitations on certain types of flaws (Axials)
 - Chance of inducing additional weld flaws
 - Cost High