

IGSCC AUGMENTED EXAMINATIONS NUREG 0313 REV. 2

Iowa Electric Light and Power Company
Duane Arnold Energy Center

APPROVALS

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1.0 Purpose

The purpose of this program is to delineate the methods, schedules, and requirements for examination of Austenitic Stainless Steel Piping welds susceptible to Intergranular Stress Corrosion Cracking (IGSCC) and to satisfy the requirements of Generic Letter 88-01.

2.0 Applicability

- 2.1 This program is applicable to piping and welds defined in NRC Generic Letter 88-01 which is based upon NUREG 0313 Rev. 2.
- 2.2 This procedure is applicable to the inspection frequency as given in Section 6.1.

3.0 Definitions

The following definitions supplement those contained in the glossary of terms, Appendix B to the Quality Assurance Manual.

- 3.1 Intergranular Stress Corrosion Cracking (IGSCC) - cracking that normally occurs in the heat affected zone of the weld in Austenitic Stainless Steel weldments and is caused by the tensile stresses, corrosive environment and sensitized material.
- 3.2 EPRI- Electric Power Research Institute
- 3.3 Weld Overlay - A continuous bond of weld metal on the outside surface of the pipe directly over the defect. This is designed to provide a structural design margin comparable to that in the original pipe design.

4.0 Responsibilities and Authorities

- 4.1 The ASME XI Administrator shall be responsible for:
 - 4.1.1 Selection of augmented examinations that conform to the requirements of Appendix A.
 - 4.1.2 Assignment of Inservice Inspection (ISI) report numbers.
 - 4.1.3. Review of examination results. This review should include any previous examinations performed.

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- 4.1.4. Preparation of Augmented Inspection Summary Reports and transmittal to Nuclear Licensing.
- 4.2 The Authorized Nuclear Inservice Inspector shall be responsible for:
 - 4.2.1 Verification that repairs/replacements, for ASME B&PV Code Section XI components, are performed in accordance with the requirements of the DAEC Repair/Replacement Program. (if applicable)
 - 4.2.2 Verification that the required pressure tests are performed and documented. (if applicable)
- 4.3 The Corporate NDE Level III shall be responsible for:
 - 4.3.1 Development of DAEC Nondestructive Examination (NDE) procedures.
 - 4.3.2 Review and approval of the selected vendors to be used for the NDEs.
 - 4.3.3 Review and approval of vendors NDE procedures.
 - 4.3.4. Technical review of NDE reports.
 - 4.3.5. Interfacing with internal groups, such as the ASME Section XI Group and with outside agencies, such as the Authorized Nuclear Inservice Inspector (ANII) or other audit agencies pertaining to NDE qualifications, certification, examinations, and procedures.
- 4.4. NDE examiners are responsible for:
 - 4.4.1. Performing NDE in accordance with DAEC approved procedures.
 - 4.4.2. Notifying the ANII of witness or hold points (if applicable).
- 4.5 Nuclear Licensing responsible for:
 - 4.5.1 Transmittal of Augmented Inspection Summary Reports to the NRC.

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5.0 Requirements

- 5.1 NDE shall be performed in accordance with written, approved, and preplanned procedures, checklists, or other instructions.
- 5.2 NDE examiners shall be qualified and certified according to the requirements of ASME Section XI, SNT-TC-1A, and meet the requirements of NUREG 0313, Revision 2.
- 5.3 NDE examiners utilized for evaluation shall be certified Level II or Level III in IGSCC ultrasonic examination.
- 5.4 Personnel evaluating examination results shall have successfully completed the EPRI IGSCC upgraded performance capability demonstration test as required by NUREG 0313 Rev. 2.

6.0 Instructions

- 6.1 Frequency of Augmented Austenitic Stainless Steel Piping Weld Examinations
 - 6.1.1. All Austenitic Stainless Steel welds on piping 4 inches in diameter and greater and which operate at 200 F degrees or more shall be grouped in the following categories:
 - 6.1.1.1. Category A - Welds consisting of resistant materials.
 - 6.1.1.2. Category B - Welds consisting of nonresistant materials and which have received stress improvement within 2 years of operation.
 - 6.1.1.3. Category C - Welds consisting of nonresistant materials and which have received stress improvement after 2 years of operation.
 - 6.1.1.4. Category D - Welds consisting of nonresistant materials and which have received no stress improvement.
 - 6.1.1.5. Category E - Welds which are cracked and have received weld overlay or stress improvement.
 - 6.1.1.6. Category F - Welds which are cracked and have received no repair.

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6.1.1.7. Category G - Welds consisting of nonresistant material and which have not received any inspection.

6.1.2. The following shall be used in scheduling the categories:

6.1.2.1. Category A - 25% every 10 years (at least 12% in 6 years).

6.1.2.2. Category B - 50% every 10 years (at least 25% in 6 years).

* 6.1.2.3. Category C - All within the next 2 refueling cycles (Note-100% of the inspections were performed in the refueling outage in 1987), then all every 10 years (at least 50% in 6 years).

* 6.1.2.4. Category D - All every 2 refueling cycles.

* 6.1.2.5. Category E - 50% next refueling outage, then all every 2 refueling cycles.

6.1.2.6. Category F - All every refueling outage.

6.1.2.7. Category G - All next refueling outage.

* Only these categories presently affect DAEC.

6.2 Assignment of Augmented Austenitic Stainless Steel Piping Weld Examinations.

6.2.1. The ASME Section XI Administrator or his designee shall schedule inspections and assign report numbers to the Augmented Austenitic Stainless Steel piping weld examinations as tabulated in Appendix A.

6.2.1.1. The implementing schedule attempts to equalize the work load until October 31, 1995. Other drywell activities may result in unanticipated opportunities for augmented inspections. If that occurs, other inspections maybe substituted as an effort to minimize plant outage time and reduce overall program costs.

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- 6.2.2. The ASME Section XI Group shall notify Quality Control of the examinations to be performed.
- 6.2.3. The Corporate NDE Level III shall assign the examination activities to an EPRI qualified UT examiner.
- 6.3 Augmented Examinations of Austenitic Stainless Steel Piping Welds.
 - 6.3.1 Ultrasonic examinations shall be performed with DAEC approved procedures.
 - 6.3.2 Ultrasonic examinations shall be performed by qualified personnel as defined in Section 5 of this procedure.
 - 6.3.3. NDE equipment shall be calibrated by the requirements of the Quality Assurance Manual.
- 6.4 Results of Augmented Austenitic Stainless Steel Piping Examinations.
 - 6.4.1 The Corporate NDE Level III shall review the results and determine if examination results are acceptable. The examination results shall be formally transmitted to the ASME Section XI Administrator.
 - 6.4.1.1. If unacceptable indications are detected the ASME Section XI Administrator shall be notified, by the Corporate NDE Level III, as soon as practical. In turn the Manager, Design Engineering will be notified by the ASME Section XI Administrator.
 - 6.4.2 The ASME Section XI Administrator shall initiate any appropriate corrective action needed on unacceptable welds.
 - 6.4.3. The ASME Section XI Administrator shall maintain all reports as lifetime plant records.
- 6.5 Sample Expansion Method for Augmented Austenitic Stainless Steel Piping Weld Inspections.
 - 6.5.1. If a newly detected flaw does not meet the requirements of IWB-3500 criteria of ASME Section XI, the number of augmented examinations shall be expanded by the criteria as described below.

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6.5.2. The additional number of IGSCC Categories A,B,C or D welds inspected shall be equal to the number to the original sample in that category.

6.5.2.1. Welds shall be selected for inclusion in the additional sample in the same distribution (according to pipe size, system, and location) to the original sample, unless considerations, such as accessibility, personnel exposure, etc., make other selection preferable.

6.5.2.2. If any cracked welds are found in the additional augmented sample, all remaining welds in the category shall be examined, unless considerations such as inaccessibility, personnel exposure, etc., dictate otherwise.

6.5.3. The additional number of IGSCC Category E welds (Weld Overlay/Repairs) inspected shall be expanded to include all other Category E welds if significant crack growth or additional cracks are found.

6.5.3.1. Significant crack growth for overlaid welds is defined as crack extension deeper than 75% of the original wall thickness, or for cracks originally deeper than 75% of the pipe wall, evidence of crack growth into the effective weld overlay.

6.5.3.2. Significant crack growth for Stress Improvement (SI) mitigated Category E welds is defined as growth to a length or depth exceeding the criteria for SI mitigation (either 10% of circumference in length or 30% of wall in depth).

6.6. Repairs of Unacceptable Welds

6.6.1. Repairs to welds will be considered on a case by case basis.

6.7. Reporting of the Results of Augmented Austenitic Stainless Steel Piping Examinations

6.7.1. If no new flaws have been discovered the NRC shall be notified of the results within 90 days of the completion of the refueling outage.

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6.7.2. If any indications are identified that do not meet the criteria in ASME Section XI for continued operation (without evaluation), NRC approval of flaw evaluations and/or repairs in accordance with IWB 3640 and IWA 4130 is required before resumption of operation.

7.0 Records

7.1 NDE Examiner's qualification and certification records shall be maintained as Quality Assurance Record by the Quality Control Department.

7.2 NDE equipment qualification and certification records shall be maintained as Quality Assurance Records by the Quality Control Department.

7.3 The final original Augmented Examination Records shall be maintained by the ASME section XI Group.

8.0 References

8.1 ASME Section XI 1980 Edition through and including the 1981 Winter Addenda.

8.2 NUREG 0313, Revision 2

8.3 NRC Generic Letter 88-01, dated Jan. 25, 1988

9.0 Attachments

9.1 Appendix A - Second Ten Year Internal Augmented Austenitic Stainless Steel Examination Table.

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APPENDIX A

SECOND 10 YR. AUGMENTED AUSTENITIC STAINLESS STEEL EXAMINATION TABLE

SYS	WELD ID	IGSCC COMPONENT		REFUELING OUTAGE NO.					
		CATEGORY	DIAMETER	08	09	10	11	12	13

RH	RHB-F003	C	18.00	1	1				
RH	RHC-F002	C	20.00	1	1		1		
RH	RHC-J001	C	20.00	1			1		
RH	RHD-F002	C	20.00	1				1	
RH	RHD-J001	C	20.00	1				1	
RC	RCA-F002	C	22.00	1	1				
RC	RCA-J003	C	22.00	1	1				
RC	RCA-J004	C	22.00	1				1	
RC	RCA-J005	C	22.00	1				1	
RC	RCA-J006	C	22.00	1				1	
RC	RCA-J008	C	22.00	1				1	
RC	RCA-J012	C	22.00	1	1				
RC	RCA-J013	C	22.00	1			1		
RC	RCA-J015	C	22.00	1			1		
RC	RCA-J021	C	22.00	1		1			
RC	RCA-J022	C	22.00	1		1			
RC	RCA-J024	C	22.00	1		1			
RC	RCA-J028	C	22.00	1					1
RC	RCA-J030	C	22.00	1					1
RC	RCA-J032	C	22.00	1					1
RC	RCA-J038	C	22.00	1					1
RC	RCA-J041	C	22.00	1					1
RC	RCA-J043	C	22.00	1					1
RM	RMA-J007	C	16.00	1		1			
RM	RMA-J011	C	16.00	1	1				
RM	RMA-J005	C	16.00	1		1			
RM	RMA-J001	C	16.00	1			1		
RM	RMA-J006	C	22.00	1	1				
RM	RMA-J008	C	10.00	1		1			
RM	RMA-J010	C	10.00	1		1			
RM	RMA-J004	C	10.00	1					1
RM	RMA-J002	C	10.00	1			1		
RR	RRF-J007	C	10.00	1					1
RR	RRF-J005	C	10.00	1		1			
RR	RRF-J003	*C	10.00	1		1		1	
RR	RRE-J007	C	10.00	1				1	
RR	RRE-J005	C	10.00	1		1			
RR	RRE-J003	*C	10.00	1		1		1	
RR	RRE-F002A	*C	10.00	1	1		1		1
RR	RRF-F002A	*C	10.00	1	1		1		1

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SECOND 10 YR. AUGMENTED AUSTENITIC STAINLESS STEEL EXAMINATION TABLE

SYS	WELD ID	IGSCC COMPONENT		REFUELING OUTAGE NO.					
		CATEGORY	DIAMETER	08	09	10	11	12	13
RR	RRG-F002A	*C	10.00	1	1		1		1
RR	RRG-J007	C	10.00	1					1
RR	RRG-J005	C	10.00	1					1
RR	RRG-J003	*C	10.00	1		1		1	
RR	RRH-J007	C	10.00	1			1		
RR	RRH-J005	C	10.00	1			1		
RR	RRH-J003	*C	10.00	1		1		1	
RR	RRH-F002A	*C	10.00	1	1		1		1
RC	RCB-F002	C	22.00	1	1				
RC	RCB-J003	C	22.00	1	1				
RC	RCB-J004	C	22.00	1					1
RC	RCB-J005	C	22.00	1					1
RC	RCB-J006	C	22.00	1		1			
RC	RCB-J007	C	22.00	1		1			
RC	RCB-J009	C	22.00	1		1			
RC	RCB-J015	C	22.00	1	1				
RC	RCB-J016	C	22.00	1			1		
RC	RCB-J018	C	22.00	1			1		
RC	RCB-J024	C	22.00	1			1		
RC	RCB-J025	C	22.00	1			1		
RC	RCB-J027	C	22.00	1			1		
RC	RCB-J031	C	22.00	1			1		
RC	RCB-J033	C	22.00	1			1		
RC	RCB-J035	C	22.00	1				1	
RC	RCB-J041	C	22.00	1				1	
RC	RCB-J044	C	22.00	1				1	
RC	RCB-J046	C	22.00	1				1	
RM	RMB-J008	C	16.00	1					1
RM	RMB-J012	C	16.00	1		1			
RM	RMB-J006	C	16.00	1	1				
RM	RMB-J001	C	16.00	1			1		
RM	RMB-J007	C	22.00	1	1				
RM	RMB-J009	C	10.00	1		1			
RM	RMB-J011	C	10.00	1		1			
RM	RMB-J005	C	10.00	1				1	
RM	RMB-J002	C	10.00	1			1		
RR	RRB-J007	C	10.00	1					1
RR	RRB-J005	C	10.00	1					1
RR	RRB-J003	*C	10.00	1		1		1	
RR	RRB-F002A	*C	10.00	1	1		1		1

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SYS	WELD ID	IGSCC COMPONENT		REFUELING OUTAGE NO.					
		CATEGORY	DIAMETER	08	09	10	11	12	13
RR	RRA-J007	C	10.00	1		1			
RR	RRA-J005	C	10.00	1		1			
RR	RRA-J003	*C	10.00	1		1		1	
RR	RRA-F002A	*C	10.00		1		1		1
RR	RRC-J007	C	10.00	1				1	
RR	RRC-J005	C	10.00	1				1	
RR	RRC-J004	C	10.00	1	1				
RR	RRC-J004A	C	10.00		1				
RR	RRC-J003	*C	10.00	1		1		1	
RR	RRC-F002A	*C	10.00	1	1		1		1
RR	RRD-J005	C	10.00	1					1
RR	RRD-J003	*C	10.00	1		1		1	
RR	RRD-F002A	*C	10.00	1	1		1		1

TOTAL CAT. C WELDS		93		91	22	25	25	22	24

* THESE WELDS HAVE RECEIVED "INDUCTION HEAT STRESS IMPROVEMENT" AND ARE CONSIDERED CATEGORY "C", BUT BECAUSE OF THE CRACKING PROBLEMS EXPERIENCED IN THE INDUSTRY AND DUE TO A PRIOR COMMITMENT (REF. NRC LETTER DATED 3/5/79 T. IPPOLITO TO D. ARNOLD) THEY WILL BE EXAMINED AS A CATEGORY "D"

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SYS	WELD ID	IGSCC COMPONENT		REFUELING OUTAGE NO.					
		CATEGORY	DIAMETER	08	09	10	11	12	13
CU	CUB-J027	D	4.00		1	1		1	
CS	CSA-F004	D	8.00	1	1	1		1	
CS	CSA-J003	D	8.00	1	1	1		1	
CS	CSA-F002A	D	8.00	1	1	1		1	
CS	CSA-F002	D	8.00	1	1	1		1	
CS	CSB-F004	D	8.00	1	1		1		1
CS	CSB-J003	D	8.00	1	1		1		1
CS	CSB-F002A	D	8.00	1	1		1		1
CS	CSB-F002	D	8.00	1	1		1		1
CU	CUA-J001	D	4.00		1		1		1
CU	CUA-J002	D	4.00		1		1		1
CU	CUA-J004	D	4.00		1		1		1
CU	CUA-J005	D	4.00		1		1		1
CU	CUA-J006	D	4.00	1			1		1
CU	CUA-J009	D	4.00	1			1		1
CU	CUA-J010	D	4.00	1			1		1
CU	CUA-J012	D	4.00		1		1		1
CU	CUA-J013	D	4.00		1		1		1
CU	CUA-J014	D	4.00	1			1		1
CU	CUA-J015	D	4.00		1		1		1
CU	CUA-J017	D	4.00		1		1		1
CU	CUA-J018	D	4.00		1		1		1
CU	CUA-J019	D	4.00		1		1		1
CU	CUA-J020	D	4.00	1			1		1
CU	CUA-J021	D	4.00		1		1		1
CU	CUA-J023	D	4.00		1		1		1
CU	CUA-J024	D	4.00		1		1		1
CU	CUB-J025	D	4.00		1	1		1	
CU	CUB-J022	D	4.00		1	1		1	
CU	CUB-J019	D	4.00		1	1		1	
CU	CUB-J017	D	4.00		1	1		1	
CU	CUB-J016	D	4.00		1	1		1	
CU	CUB-J014	D	4.00		1	1		1	
CU	CUB-J013	D	4.00		1	1		1	
CU	CUB-J011	D	4.00		1	1		1	
CU	CUB-J010	D	4.00		1	1		1	
CU	CUB-J008	D	4.00		1	1		1	
CU	CUB-J005	D	4.00		1	1		1	
CU	CUB-F004	D	4.00		1	1		1	
RH	RHB-J002	D	4.00		1	1		1	
RB	RBA-J001	D	4.00	1		1		1	
RB	RBA-J002	D	4.00		1	1		1	

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SYS	WELD ID	IGSCC COMPONENT		REFUELING OUTAGE NO.						
		CATEGORY	DIAMETER	08	09	10	11	12	13	
RB	RBA-J003	D	4.00		1	1		1		
RB	RBA-J006	D	4.00		1	1		1		
RB	RBA-J007	D	4.00	1		1		1		
RB	RBA-J008	D	4.00		1	1		1		
RB	RBA-J009	D	4.00		1	1		1		
RB	RBA-J010	D	4.00		1	1		1		
RB	RBA-J012	D	4.00	1		1		1		
RC	RCA-J005A	D	4.00		1	1		1		
RC	RCA-J018	D	4.00		1	1		1		
RC	RCA-J027	D	4.00		1	1		1		
RC	RCA-J034	D	4.00		1	1		1		
RB	RBB-J001	D	4.00	1			1		1	
RB	RBB-J002	D	4.00		1		1		1	
RB	RBB-J003	D	4.00		1		1		1	
RB	RBB-J006	D	4.00		1		1		1	
RB	RBB-J007	D	4.00		1		1		1	
RB	RBB-J008	D	4.00	1			1		1	
RB	RBB-J009	D	4.00		1		1		1	
RB	RBB-J010	D	4.00	1			1		1	
RB	RBB-J012	D	4.00		1		1		1	
RC	RCB-J021	D	4.00		1		1		1	
RC	RCB-J030	D	4.00		1		1		1	
RC	RCB-J037	D	4.00		1		1		1	
RR	RRF-F002	D	10.00	1	1		1		1	
RR	RRE-F002	D	10.00	1	1		1		1	
RR	RRG-F002	D	10.00	1	1		1		1	
RR	RRH-F002	D	10.00	1	1		1		1	
RR	RRB-F002	D	10.00	1	1		1		1	
RR	RRA-F002	D	10.00	1	1		1		1	
RR	RRC-F002	D	10.00	1	1		1		1	
RR	RRD-F002	D	10.00	1	1		1		1	
JP	JPA-F002	D	4.00	1		1		1		
JP	JPA-J003	D	4.00	1		1		1		
JP	JPB-F002	D	4.00	1		1		1		
JP	JPB-J003	D	4.00	1		1		1		
TOTAL CAT. D WELDS				77	31	62	35	42	35	42

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SYS	WELD ID	IGSCC COMPONENT		REFUELING OUTAGE NO.					
		CATEGORY	DIAMETER	08	09	10	11	12	13
RH	RHB-J001-OVL	E	18.00	1	1	1	1	1	1
RR	RRE-J004/J004A-OVL	E	10.00	1	1	1	1	1	1
RR	RRF-J004/J004A-OVL	E	10.00	1	1	1	1	1	1
RR	RRG-J004/J004A-OVL	E	10.00	1	1	1	1	1	1
RR	RRH-J004/J004A-OVL	E	10.00	1	1	1	1	1	1
RR	RRB-J004/J004A-OVL	E	10.00	1	1	1	1	1	1
RR	RRR-J004/J004A-OVL	E	10.00	1	1	1	1	1	1
RR	RRD-J007-OVL	E	10.00	1	1	1	1	1	1
RR	RRD-J004/J004A-OVL	E	10.00	1	1	1	1	1	1

TOTAL CAT. E WELDS		9		9	9	9	9	9	9

TOTAL WELDS		179		131	92	69	76	66	75

* Refueling Outage No. 8 was performed 2nd quarter 1987

The following acronyms apply to the table above:

- RH - Residual Heat Removal
- RC - Recirculation Pump Suction
- RM - Recirculation Manifold
- RR - Recirculation Riser
- CU - Reactor Water Cleanup
- CS - Core Spray System
- RB - Recirculation System Pump Valve Bypass
- JP - Jet Pump Instrumentation

The outages used in the table above are defined and scheduled as follows:

- 08 - Cycle 8/9 Outage (2/87-6/87)
- 09 - Cycle 9/10 Outage (9/88-12/88)
- 10 - Cycle 10/11 Outage (3/90-6/90)
- 11 - Cycle 11/12 Outage (9/91-12/91)
- 12 - Cycle 12/13 Outage (3/93-6/93)
- 13 - Cycle 13/14 Outage (9/94-12/94)