Enclosure

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PARAMETER IE-176

DRAFT

CLOSEOUT OF IE BULLETIN 79-13: CRACKING IN FEEDWATER SYSTEM PIPING

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Revision 5

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NOTICE

ABSTRACT

This report documents closeout of IE Bulletin 79-13 regarding cracks in the feedwater system piping of certain PWRs. Closeout is based on implementation and verification of six required actions by licensees and three required actions by designated applicants for operating licenses (DAOLs). Evaluations of licensee responses, NRC/Regional inspection reports, and NRC memoranda in accordance with specific criteria indicates that the bulletin is closed for all of the 54 PWRs required to respond, including 13 DAOLs. It is concluded that (1) actions required by the bulletin have been taken by the affected facilities, and (2) the concerns expressed in the bulletin were validated in that cracks were found and corrected at [redacted] of the 54 facilities. Background information is provided in the Introduction and Appendix A.

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change as appropriate

INTRODUCTION

In accordance with the Statement of Work in Task Order 37 under Contract 05-85-157-02, this report provides documentation for the closeout of IE Bulletin 79-13 and its two revisions. Documentation is based on the records obtained from the NRC Document Control System. Copies of the bulletin and its two revisions are included in Appendix A.

On May 20, 1979, leaking of coolant from circumferential cracks was reported in two feedwater lines at Cook, Unit 2 in the 16-inch elbows adjacent to two steam generator nozzles. Subsequently, cracks or crack indications were found in all steam generator feedwater lines at similar locations in both units of the Cook plant. Westinghouse is the supplier of the nuclear steam supply system for the Cook facilities.

On May 25, 1979, the NRC sent a letter to all operators of PWRs informing them of the Cook failures and requiring them to submit certain information regarding feedwater piping, pursuant to 10 CFR Part 50.54(f). This letter has been included in Appendix A on pages A-14 and A-15 without the voluminous service lists. Although the letter addressed the subject matter of Bulletin 79-13, it is separate and distinct from the bulletin, and is included herein for completeness alone. The documentation for the closeout of Bulletin 79-13 did not rely on submittals in response to the May 25, 1979 letter, nor on any NRC reviews of such submittals.

The Bulletin 79-13 was issued by the NRC on June 25, 1979 with six required actions. The bulletin requirements included volumetric examinations of feedwater pipe weld areas, visual inspections of feedwater piping supports and snubbers in containment, review of the adequacy of procedures for responding to a feedwater line break, and reporting the sensitivity of methods for detecting feedwater leaks in containment. Revision 1 of the bulletin was issued on August 30, 1979 to require volumetric and visual examinations by designated applicants for operating license (DAOLs). Revision 2 of the bulletin was issued on October 16, 1979 to reduce the scope of the examinations on the basis of prior results.

The potential safety significance of the cracking, as explained in the bulletin, is that likelihood of a feedwater line break is increased if the piping is degraded and a seismic event or water hammer occurs. As a result of the examinations cracks were discovered in feedwater lines of several facilities supplied by Westinghouse and Combustion Engineering. Typically, cracking was found in the steam generator nozzle-to-elbow welds.

Introduction (Cont'd)

Documentation of utility responses and NRC/Region inspection reports is provided in Appendix B, Table B.1 as the basis for bulletin closeout. Also included in Appendix B in Table B.2 is a brief table that identifies cracking found after the initial examinations in response to the bulletin. The NRC staff is aware that some licensees implemented augmented inspections on their feedwater lines subsequent to taking the actions required by the bulletin. The closeout of the Bulletin 79-13 is not contingent on conduct of the augmented inspections because the bulletin required one-time inspections. Thus, other inspections similar to those shown in Table B.2 may have been performed at PWR's, but it is not necessary to capture them in this closeout report. Abbreviations used in this report and associated documents are listed in Appendix C.

SUMMARY

1. The bulletin is closed for the following 19 operating facilities for which required actions, repairs, and modifications of cracked feedwater piping have been completed satisfactorily (Criterion 1, see page B-11):

Beaver Valley 1	Palisades	Surry 1,2
Cook 1,2	Point Beach 1,2	Turkey Point 3,4
Ginna	Robinson 2	Yankee-Rowe 1
Kewaunee	Salem 1	Zion 1,2
Millstone 2	San Onofre 1	

2. The bulletin is closed for the following 17 operating facilities for which required actions were completed and no indications of cracking in the feedwater piping were found during the initial examinations (Criterion 2, see page B-11):

Arkansas 2	Haddam Neck	Oconee 1,2,3
Calvert Cliffs 1,2	Indian Point 2,3	Prairie Island 1,2
Farley 1	Maine Yankee	St. Lucie 1
Fort Calhoun 1	North Anna 1	Trojan

3. The bulletin is closed for the following 13 facilities owned by designated applicants for operating licenses (OAOLs) who committed to perform inspections following hot functional tests (Criterion 3, see page B-11):

Diablo Canyon 1,2	North Anna 2	Sequoyah 1,2
Farley 2	Salem 2	Summer 1
McGuire 1	San Onofre 2,3	Watts Bar 1,2

4. The bulletin is closed for the following five (5) facilities for which volumetric examinations were not required (Criterion 4, see page B-11):

Arkansas 1	Davis-Besse 1	TMI 1
Crystal River 3	Rancho Seco 1	

5. The bulletin is open for no facilities.

SUMMARY (contd)

6. According to the documentation listed in Table B.1, cracking occurred in feedwater system piping of the following 18 facilities:

Beaver Valley 1	Palisades	San Onofre 1
Cook 1, 2	Point Beach 1, 2	Surry 1, 2
Ginna	Robinson 2	Turkey Point 3, 4
Kewaunee	Salem 1	Zion 1, 2
Millstone 2		

Note: Although no cracking in feedwater system piping was found at Yankee-Rowe, welds were identified as being unacceptable by present day codes. All unacceptable welds were either repaired or replaced.

7. The following two (2) facilities are excluded from this evaluation of the bulletin closeout because they are shut down indefinitely or permanently (SDI):

Indian Point 1 TMI 2

8. The basis for the remaining areas of concern (below) was cracking that was found after initial bulletin closeout at Beaver Valley 1, Farley 1, Indian Point 2, Maine Yankee, St. Lucie 1, Trojan, and Turkey Point 4. (see Table B.2, page B-13).

REMAINING AREAS OF CONCERN

Table B.2 identifies seven facilities where cracking was discovered years after initial examinations were completed. For two of these seven facilities, Beaver Valley 1 and Turkey Point 4, cracking recurred after repairs and modifications were completed. For the other five facilities, Farley 1, Indian Point 2, Maine Yankee, St. Lucie 1, and Trojan, cracking was discovered years after initial examinations revealed no indications of cracking.

These findings indicate that long term corrective actions to prevent transient conditions that promote cracking have not been sucessfully implemented. As a result, there is a remaining concern that cracking in feedwater system piping continues to be a potential problem.

CONCLUSIONS

1. All the affected utilities have satisfactorily performed the required actions in the Bulletin 79-13.

2. The safety concern articulated in the bulletin were validated by the fact that cracking was discovered and corrective actions were taken at 18 of the 54 affected facilities.

3. Some licensees have incorporated augmented inspections of the feedwater line into their in-service inspection programs. The search for appropriate documents to closeout Bulletin 79-13 showed that such inspections have resulted in detection of piping degradation in several instances. Such reports were noted when encountered, and a tabulation of them is provided in Table B.2. The Table B.2 does not necessarily represent all instances of observed feedwater line degradation and correction that have occured in the industry since issuance of Bulletin 79-13.

4. From metallurgical analyses, the mode of cracking failure has been identified as thermal fatigue assisted by corrosion and loading stresses. Thermal fatigue has been identified as the dominant failure mechanism. Large thermal gradients result from stratification and oscillations that occur in the steam generator feedring during low water level conditions of the steam generator, and at start-up, shut down, and hot standby.

RECOMMENDATIONS

It is recommended that licensees who have incorporated augmented insevice inspections of feedwater piping into their inspection programs continue to perform such inspections. This recommendation is based on reports of observed feedwater piping degradation subsequent to Bulletin 79-13. Although the staff has not accessed every such report, those that have been encountered appear to justify such a recommendation. As the feedwater piping is covered by the ASME code, the in-sevice inspection reports maintained by the licensees would be expected to contain a complete set of documentation on observed piping degradation and the corrective actions taken by the licensee. The staff did not see justification to attempt to access such reports.

APPENDIX A

Background Information and Required Actions

Notes:

1. Figures 1, 2, and 3 (see pages A-5, A-6, and A-7) apply to revisions 1 and 2 as well as to the initial issue of the bulletin and are not repeated in this appendix.

2. Revision 1 and the initial issue are alike except for page headings and the addition of actions to be taken by designated applicants for operating licenses. For actions required of the utilities, see pages A-9 through A-11.

3. Revision 2 was issued to reduce the number and extent of the examinations required by action items 2(a) and 2(b) of the initial issue (see page A-3).

4. The schedule for submitting the written report is based on the date of the original bulletin (see page A-16).

5. Farley 2, San Onofre 3, and Sequoyah 2 were identified by the NRC as designated applicants for operating licenses (DAOLs) although they are not listed on page A-12 (see notes 5 and 6, pages B-9 and B-10 respectively).

6. The original letter to all PWRs on May 25, 1979 (shown on page A-18 and A-19) included service lists associated with each licensee.

APPENDIX B

Documentation of Bulletin Closeout

TABLE B.1 BULLETIN CLOSEOUT STATUS

Facility	Utility	Docket	Facility Status 06-25-79 (1)	NRC Region	NSSS	Utility Response Date	Inspection Report and Date	Closeout Status and Criterion (2)
Arkansas 1	AP&L	50-313	OL	IV	B&W	07-12-79 11-29-79(3)	80-05(04-14-80)	Closed 4
Arkansas 2	AP&L	50-368	OL	IV	C-E	07-12-79 08-21-79 09-14-79 10-18-79	80-05(04-14-80)	Closed 2
Beaver Valley 1	DLC	50-334	OL	I	W	07-16-79 07-17-79	79-08(09-17-79) 79-15(09-17-79) 79-20(10-12-79)	Closed 1
Calvert Cliffs 1	BG&E	50-317	OL	I	C-E	07-16-79 10-08-79		Closed 2 (4)
Calvert Cliffs 2	BG&E	50-318	OL	I	C-E	07-16-79 10-08-79	79-18(12-12-79)	Closed 2 (4)
Cook 1	IMECO	50-315	OL	III	W	07-20-79	81-10(05-27-81)	Closed 1
Cook 2	IMECO	50-316	OL	III	W	07-20-79	81-07(05-27-81)	Closed 1
Crystal River 3	FPC	50-302	OL	II	B&W	07-16-79 07-25-79 12-13-79(3)	84-09(04-18-84)	Closed 4
Davis-Besse 1	TECO	50-346	OL	III	B&W	07-13-79 08-06-80(3)	81-08(04-22-81)	Closed 4

Notes indicated by numbers in parentheses are located on page B-9. The criteria for closeout as indicated by indicated by the notation "Closed —" are located on page B-11

TABLE B.1 BULLETIN CLOSEOUT STATUS (contd)

Facility	Utility	Docket	Facility Status 06-25-79 (1)	NRC Region	NSSS	Utility Response Date	Inspection Report and Date	Closeout Status and Criterion (2)
Diablo Canyon 1	PG&E	50-275	DAOL	V	W	12-12-79(3) 11-26-86 01-28-87(3)	81-10(05-27-81)	Closed 3 (5)
Diablo Canyon 2	PG&E	50-323	DAOL	V	W	12-12-79(3) 02-08-85(3) 07-02-87 08-04-87(3)	85-02(04-03-85)	Closed 3 (5)
Farley 1	APCO	50-348	OL	II	W	07-16-79 07-26-79 08-27-79 01-30-80(3) 03-19-84	80-19(07-28-80)	Closed 2
Farley 2	APCO	50-364	DAOL	II	W	04-14-80 09-26-80(3) 12-02-80 12-09-82(3)	82-26(11-24-82)	Closed 3 (5,6)
Fort Calhoun 1	OPPD	50-285	OL	IV	C-E	07-13-79 08-08-79 10-25-79 11-09-79(3) 02-29-80(3)	81-31(12-03-81)	Closed 2
Ginna	RG&E	50-244	OL	I	W	07-12-79 07-27-79 10-30-79 09-05-80(3)	89-06(07-28-89)	Closed 1

Notes indicated by numbers in parentheses are located on page B-9.

TABLE B.1 BULLETIN CLOSEOUT STATUS (contd)

Facility	Utility	Docket	Facility Status 06-25-79 (1)	NRC Region	NSSS	Utility Response Date	Inspection Report and Date	Closeout Status and Criterion (2)
Haddam Neck	CYAPCO	50-213	OL	I	W	07-13-79 08-03-79 11-05-79 08-01-80(3)	86-27(11-25-86)	Closed 2
Indian Point 2	ConEd	50-247	OL	I	W	07-16-79 08-17-79 11-23-79(3) 12-30-80(3)	83-11(05-11-83)	Closed 2
Indian Point 3	PASNY	50-286	OL	I	W	07-13-79 10-12-79 11-15-79(3)	83-17(10-25-83)	Closed 2
Kewaunee	WPS	50-305	OL	III	W	07-26-79	81-03(05-19-81)	Closed 1
Maine Yankee	MYAPCO	50-309	OL	I	C-E	07-13-79 10-04-79	80-14(10-22-80)	Closed 2
McGuire 1	DUPCO	50-369	DAOL	II	W	09-19-79(7) 10-19-79(7) 01-03-80(3) 09-11-80(3) 01-16-81(3)	86-13(06-26-86)	Closed 3 (5)
Millstone 2	NNECO	50-336	OL	I	C-E	07-13-79 08-22-79 04-24-80(3) 05-19-80(3)	80-19(10-27-80)	Closed 1

Notes indicated by numbers in parentheses are located on page B-9.

TABLE B.1 BULLETIN CLOSEOUT STATUS (contd)

Facility	Utility	Docket	Facility Status 06-25-79 (1)	NRC Region	NSSS	Utility Response Date	Inspection Report and Date	Closeout Status and Criterion (2)
North Anna 1	VEPCO	50-338	OL	II	W	07-13-79 09-12-79 12-04-79(3) 12-17-79 04-01-80(3)	80-30(09-30-80)	Closed 2
North Anna 2	VEPCO	50-339	DAOL	II	W	07-13-79 08-08-79 04-01-80(3) 06-11-82(3) 06-28-82(3) 08-13-82(3)	84-06(02-01-85)	Closed 3 (5)
Oconee 1	DUPCO	50-269	OL	II	B&W	07-13-79 07-23-79 02-18-80 02-25-80 03-19-80 06-27-80	80-01(01-17-80) 80-03(02-25-80) 80-25(07-17-80)	Closed 2 (8)
Oconee 2	DUPCO	50-270	OL	II	B&W	07-13-79 07-23-79 06-19-80 06-27-80 07-10-80	80-10(05-15-80) 80-19(07-01-80) 80-22(07-17-80)	Closed 2 (8)
Oconee 3	DUPCO	50-287	OL	II	B&W	07-13-79 07-23-79 06-27-80		Closed 2 (8)

Notes indicated by numbers in parentheses are located on page B-9.

TABLE B.1 BULLETIN CLOSEOUT STATUS (contd)

Facility	Utility	Docket	Facility Status 06-25-79 (1)	NRC Region	NSSS	Utility Response Date	Inspection Report and Date	Closeout Status and Criterion (2)
Palisades	CPC	50-255	OL	III	C-E	07-13-79 07-30-79 11-26-79 12-11-79	80-15(09-23-80)	Closed 1
Point Beach 1	WEPCO	50-266	OL	III	W	07-12-79 08-28-79 11-19-79	80-17(12-04-80)	Closed 1
Point Beach 2	WEPCO	50-301	OL	III	W	07-06-79 07-12-79 08-28-79 11-19-79	80-17(12-04-80)	Closed 1
Prairie Island 1	NSP	50-282	OL	III	W	07-13-79 08-29-79 02-15-80(3)	82-01(02-24-82)	Closed 2
Prairie Island 2	NSP	50-306	OL	III	W	07-13-79 08-29-79 02-15-80(3)	81-08(04-15-81)	Closed 2
Rancho Seco 1	SMUD	50-312	OL	V	B&W	07-13-79 12-19-79 04-28-80(3)	80-09(05-19-80) 80-14(04-23-80)	Closed 4
Robinson 2	CP&L	50-261	OL	II	W	07-18-79 07-24-79 06-01-81(3)	82-21(07-23-82)	Closed 1 (9)

Notes indicated by numbers in parentheses are located on page B-9.

TABLE B.1 BULLETIN CLOSEOUT STATUS (contd)

Facility	Utility	Docket	Facility Status 06-25-79 (1)	NRC Region	NSSS	Utility Response Date	Inspection Report and Date	Closeout Status and Criterion (2)
Salem 1	PSE&G	50-272	OL	I	W	07-12-79 08-24-79 11-15-79(3)	80-23(12-05-80)	Closed 1
Salem 2	PSE&G	50-311	DAOL	I	W	09-18-79(7) 11-15-79(3)		Closed 3 (5)
San Onofre 1	SCE	50-206	OL	V	W	07-16-79 08-10-79 05-15-80(3,10) 05-29-80(3,10) 08-07-80(3)	80-15(06-20-80) 81-42(01-22-82) 84-23(10-24-84) 84-30(12-21-84)	Closed 1
San Onofre 2	SCE	50-361	DAOL	V	C-E	09-19-79(7) 01-18-80(3) 03-04-80(3) 01-15-86(3)		Closed 3 (6)
San Onofre 3	SCE	50-362	DAOL	V	C-E	09-19-79(7) 01-18-80(3) 03-04-80(3) 01-15-86(3)		Closed 3 (6)
Sequoyah 1	TVA	50-327	DAOL	II	W	09-19-79(7) 09-25-79(7) 12-17-79(7) 12-29-82(3) 11-14-83(3)	83-20(10-21-83)	Closed 3 (5)

Notes indicated by numbers in parentheses are located on page B-9.

TABLE B.1 BULLETIN CLOSEOUT STATUS (contd)

Facility	Utility	Docket	Facility Status 06-25-79 (1)	NRC Region	NSSS	Utility Response Date	Inspection Report and Date	Closeout Status and Criterion (2)
Sequoyah 2	TVA	50-328	DAOL	II	W	09-19-79(7) 09-25-79(7) 07-09-81 12-29-82(3) 11-14-83(3)	83-20(10-21-83)	Closed 3 (5)
St. Lucie 1	FPL	50-335	OL	II	C-E	07-17-79 10-29-79	80-30(10-03-80)	Closed 2
Summer 1	SCE&G	50-395	DAOL	II	W	09-20-79(7) 03-12-80(3) 01-30-81(3) 03-27-81		Closed 3 (6)
Surry 1	VEPCO	50-280	OL	II	W	(11)	81-07(03-17-81)	Closed 1
Surry 2	VEPCO	50-281	OL	II	W	07-13-79 08-23-79 09-05-79 12-17-79 12-17-79(3) 04-08-80(3) 04-24-80(3)	80-26(08-08-80)	Closed 1
TMI 1	Met-Ed/ GPUN	50-289	OL	I	B&W	06-26-79 07-13-79 08-17-79 06-02-80(3)	81-26(11-02-81)	Closed 4

Notes indicated by numbers in parentheses are located on page B-9.

TABLE B.1 BULLETIN CLOSEOUT STATUS (contd)

Facility	Utility	Docket	Facility Status 06-25-79 (1)	NRC Region	NSSS	Utility Response Date	Inspection Report and Date	Closeout Status and Criterion (2)
Trojan	PGE	50-344	OL	V	W	07-19-79 08-28-79 09-10-79 05-09-80(10) 07-18-80(3) 10-17-80	80-28(11-28-80)	Closed 2
Turkey Point 3	FPL	50-250	OL	II	W	07-17-79 07-23-79 10-22-80(10)	84-12(04-20-84)	Closed 1
Turkey Point 4	FPL	50-251	OL	II	W	07-17-79 07-23-79 06-09-80(10)	84-12(04-20-84)	Closed 1
Watts Bar 1	TVA	50-390	DAOL	II	W	09-19-79(7) 09-25-79(7) 12-01-83(3)	85-08(03-28-85)	Closed 3 (5)
Watts Bar 2	TVA	50-391	DAOL	II	W	09-19-79(7) 09-25-79(7) 12-01-83(3)	85-08(03-28-85)	Closed 3 (5)
Yankee-Rowe 1	YAECO	50-029	OL	I	W	07-16-79 09-11-79(10) 10-10-79 08-18-80(10)	81-11(07-15-81)	Closed 1

Notes indicated by numbers in parentheses are located on page B-9.

TABLE B.1 BULLETIN CLOSEOUT STATUS (contd)

Facility	Utility	Docket	Facility Status 06-25-79 (1)	NRC Region	NSSS	Utility Response Date	Inspection Report and Date	Closeout Status and Criterion (2)
Zion 1	CECO	50-295	OL	III	W	07-13-79 09-11-79 10-24-79	81-03(03-20-81) 85-04(02-26-85)	Closed 1
Zion 2	CECO	50-304	OL	III	W	07-13-79 09-11-79 10-24-79	79-24(02-14-80)	Closed 1

Notes indicated by numbers in parentheses are located below.

Notes for Table B.1:

1. Facility status is based on the Reference 1, page B-12. The following abbreviations apply to facility status: DAOL, Designated Applicant for Operating License; OL, Operating License.

2. The closeout criteria are on page B-11.

3. Response to Revision 2 of the bulletin.

4. Per the telephone call of 10-12-89, from Monte Conner of Region I to NRC/HQ, Inspection Report 318/79-18 for Unit 2 is intended to close the bulletin for both units at Calvert Cliffs.

5. Farley 2 and Sequoyah 2 have been added to Table B.1 in accordance with the NRC memorandum of March 11, 1980, to S. A. Varga (Division of Project Management) from E. L. Jordan (IE). Also, in accordance with that memorandum, the bulletin has been closed for Salem 2, North Anna 2, Sequoyah 1,2, McGuire 1, Diablo Canyon 1,2, and Watts Bar 1,2 on the basis of having completed or committed to complete the inspections required by the bulletin (see Criterion 3, page B-11).

Notes for Table B.1 (contd):

6. San Onofre 3 has been added to Table B.1 in accordance with the NRC memorandum of June 25, 1980, to R. L. Tedesco (NRR) from E. L. Jordan (IE). Also in accordance with that memorandum, the bulletin has been closed for Farley 2, San Onofre 2,3, and Summer 1 on the basis of utility commitments to perform inspections following hot functional testing (see Criterion 3, page B-11).

7. Response to Revision 1 of the bulletin.

8. See the NRC memorandum dated March 19, 1981, for Oconee 1,2,3 to F. Jape (Resident Inspector) from B. R. Crowley (Engineering Inspection Branch). Per the telephone call of 07-20-89, with Kerry Landis of Region II, this memorandum is the basis for the closeout of the bulletin.

9. Per the telephone call of 05-19-89, from Kerry Landis (RII) to NRC/HQ, Inspection Report 82-21 closes the bulletin for Robinson 2.

10. The response is an LER or an RO.

11. Response dates for Surry 1 are as follows: 07-13-79, 07-18-79, 07-23-79, 07-24-79, 08-21-79, 08-31-79, 09-05-79, 04-08-80(3), 04-24-80(3), 06-03-80, and 11-07-80(3).

CRITERIA FOR CLOSEOUT OF BULLETIN

The bulletin is closed for facilities to which one of the following criteria applies:

1. The utility response and an NRC/Region inspection report indicate that repairs and modifications of cracked feedwater piping were completed in accordance with required actions and that all bulletin requirements were met.

2. The utility response and an NRC/Region inspection report indicate that required actions were completed and that no cracks were found during initial examinations of the feedwater piping.

3. The NRC memoranda of March 11, 1980, to S. A. Varga (Division of Project Management) from E. L. Jordan (IE) and of June 25, 1980, to T. L. Tedesco (NRR) from E. L. Jordan (IE) close the bulletin for a designated applicant for an operating license (DAOL), on the basis of the applicant having committed to complete the inspections of the bulletin (see notes 5 and 6, pages B-9 and B-10 respectively) following hot functional testing.

   Notes:

   (a) Any problems encountered were to be resolved on a case-by-case basis.

   (b) Recommendations of the Pipe Crack Study Group were to be followed. (See Reference 3, page B-12).

   (c) Radiography is required as clarified by means of the NRC memorandum of March 1980, to R. C. Haynes (RV) from R. A. Hermann (IE).

4. The utility response and an NRC/Region inspection report indicate that volumetric examinations are not required and that visual examinations have been satisfactory (see Action Item 2b, page A-16).

REFERENCES

1. United States Nuclear Regulatory Commission, Licensed Operating Reactors, Status Summary Report, Data as of 02-28-90, NUREG-0020, Volume 14, Number 3, March 1990.

2. Memorandum to E. L. Jordan from R. A. Hermann, both of IE, dated September 18, 1980.

3. United States Nuclear Regulatory Commission, PWR Pipe Crack Study Group, Investigation and Evaluation of Cracking Incidents in Piping in Pressurized Water Reactors, NUREG-0691 Final Draft, June 1980.

4. United States Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, NUREG-0918, Prevention and Mitigation of Steam Generator Water Hammer Events in PWR Plants, November 1982.

5. Summary of Meeting on February 9, 1983 with Maine Yankee Atomic Power Company, Discussion of Feedwater Line Break Event, a report to the licensee from K. L. Heitner, Project Manager, Operating Reactors Branch #3, DL, dated February 14, 1983.

6. United States National Archives and Records Administration, Office of the Federal Register, Code of Federal Regulations, Energy, Title 10, Chapter I, Nuclear Regulatory Commission, Parts 0-199, revised as of January 1, 1990, 10CFR0-199.

TABLE B.2 CRACKING FOUND AFTER INITIAL EXAMINATION, ~~PER ACTION ITEMS 2 AND 3 OF IE BULLETIN 79-13~~

Facility	Utility Response	Inspection Report and Date	Closeout Status and Criterion
Beaver Valley 1		88-01(03-09-88)	Closed 1
Farley 1	03-19-84	84-07(04-05-84) 84-10(04-30-84) 85-22(04-30-85)	Closed 2
Indian Point 2	05-26-89 06-05-89 10-20-89		Closed 2
Maine Yankee	01-31-83 02-17-83		Closed 2
St. Lucie 1		83-08(04-08-83)	Closed 2
Trojan	04-27-88		Closed 2
Turkey Point 4	04-12-84 (Prelim. LER)		Closed 1

Notes:

1. Following a feedwater system radiographic examination during an outage, Beaver Valley 1 identified cracking in the feedwater nozzle in all three steam generators. The affected feedwater elbows were replaced and examined during the outage. This same problem previously occurred in 1979 when all three feedwater elbows were replaced. The licensee plans to inspect these elbows and stated that if the problem recurs the associated corrective action would involve the installation of thermal sleeves.

2. At Farley 1, all three feedwater reducers were replaced because of cracking. The licensee was considering the installation of thermal sleeves, preheating of auxiliary feedwater, or separate auxiliary feedwater nozzles on each steam generator.

3. Indian Point 2 reported that during the spring outage in 1989, cracks were discovered in the feedwater nozzle inner radius for two of the four steam generators inspected. The primary cause of failure was corrosion-fatigue cracking.

4. At Maine Yankee a 10 inch long through-wall crack was found after a leak caused by water hammer and existing cracks. (Ref. memorandum to Gary H. Holahan (NRR) from B. D. Liaw (NRR) dated August 26, 1983). To prevent water hammer incidents from recurring, the licensee has modified the steam generator feedring by sealing the seventy-six 1-inch discharge nozzles on the bottom of the feedring and installing twenty-eight 3-inch "J" tubes on the top of the feedring. This design change will prevent the feedring from emptying and will eliminate or mitigate stresses in the main feedwater lines.

5. At St. Lucie 1, several areas of feedwater loops A and B were inspected as IE Bulletin 79-13 follow-up and because of problems at another C-E plant. Preliminary NDE results indicate definite cracks in the A-loop safe end. The crack indications were being evaluated.

6. During a 1987 outage at Trojan, feedwater piping into all four steam generators were replaced although only three exhibited flaw indications by ultrasonic testing. The licensee plans to perform augmented inspections as recommended by NUREG-0691, a report prepared by the Pipe Crack Study Group in 1980. (see Reference 3, page B-12).

7. Crack indications were found in feedwater nozzles in two of the three steam generators at Turkey Point 4 during an in-service inspection using ultrasonic and radiographic tests. The components were ~~being~~ replaced during the March 1984 refueling outage.

Note: The above examples of feedwater piping system cracking incidents are representative of cracking that occurred after the initial inspections and actions of IE Bulletin 79-13 were completed. A ~~complete~~ document search was made to address all the facilities that may have experienced post-bulletin cracking. ~~The list justifies the need for continuing inspections at all facilities until long-term solutions are applied to feedwater system cracking.~~

→ using the following search terms

(a) Feedwater nozzle

(b) steam generator nozzle

(c) cracking, piping, elbow as modifier of feedwater and steam generator

APPENDIX C

Abbreviations

APCO	Alabama Power Company
AP&L	Arkansas Power and Light Company
ASME	American Society of Mechanical Engineers, The
B&W	Babcock and Wilcox
BG&E	Baltimore Gas and Electric Company
C-E	Combustion Engineering
CECO	Commonwealth Edison Company
CFR	Code of Federal Regulations
ConEd	Consolidated Edison Company of New York, Inc.
CPC	Consumers Power Company
CP&L	Carolina Power and Light Company
CR	Contractor Report
CYAPCO	Connecticut Yankee Atomic Power Company
DAPL	Designated Applicant for Operating License
DCS	Document Control System (NRC)
DLC	Duquesne Light Company
DUPCO	Duke Power Company
FPC	Florida Power Corporation
FPL	Florida Power & Light Company
GAO	Government Accounting Office
GPUN	GPU Nuclear Corporation
HQ	Headquarters (NRC)
IE	(See NRC/IE)
IEB	Inspection and Enforcement Bulletin (NRC)
IMECO	Indiana and Michigan Electric Company
ISI	Inservice Inspection
IR	Inspection Report (NRC/IE)
LER	Licensee Event Report
Met-Ed	Metropolitan Edison Company
MYAPCO	Maine Yankee Atomic Power Company
NNECO	Northeast Nuclear Energy Company
NRC/IE	Nuclear Regulatory Commission/ Office of Inspection & Enforcement
NSP	Northern States Power Company
NSSS	Nuclear Steam System Supplier
NU	Northeast Utilities
NYPA	New York Power Authority
OL	Operating License
OPPD	Omaha Public Power District
PASNY	Power Authority of the State of New York
PCSG	Pipe Crack Study Group
PGE	Portland General Electric Company

PG&E	Pacific Gas and Electric Company
PSE&G	Public Service Electric and Gas
PWR	Pressurized Water Reactor
R	Region (NRC)
RO	Reportable Occurrence
RCS	Reactor Coolant System
RG&E	Rochester Gas and Electric Corporation
SCE	Southern California Edison Company
SCE&G	South Carolina Electric and Gas Company
SDI	Shut Down Indefinitely or Permanently
SMUD	Sacramento Municipal Utility District
TECO	Toledo Edison Company
TMI	Three Mile Island
TVA	Tennessee Valley Authority
VEPCO	Virginia Electric and Power Company
W	Westinghouse Electric Corporation
WEPCO	Wisconsin Electric Power Company
WPS	Wisconsin Public Service Corporation
YAECO	Yankee Atomic Electric Company