CP&L

Carolina Power & Light Company
P.O. Box 10429
Southport, NC 28461-0429

JUN 01 1995

SERIAL: BSEP 95-0216

U. S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NO. 1
DOCKET NO. 50-325/LICENSE NO. DPR-71
RESPONSE TO NRC BULLETIN 80-13
EXAMINATION OF CORE SPRAY SYSTEM SPARGERS

Gentlemen:

The purpose of this letter is to submit the results of visual examinations of the in-vessel core spray piping and spargers for the Brunswick Steam Electric Plant, Unit 1. The in-vessel core spray piping and spargers are being examined in accordance with NRC Bulletin 80-13 dated May 12, 1980.

Enclosure 1 provides the results of the in-vessel examinations performed during the Brunswick Unit 1 Reload 9 outage (April - May 1995) and the basis for continued operation of Unit 1 until the next refueling outage. During the Unit 1 Reload 8 outage, two linear indications were identified in the in-vessel core spray piping ("B" loop) during visual examinations using a remotely-operated underwater camera. As described in the enclosed information, no siginificant change has been observed in either indication.

The conclusion of the enclosed analysis is that the Unit 1 core spray piping is acceptable in the as-found condition for the next operating cycle. The predicted crack length at the end of an eighteen month operating cycle will not reduce the structural or hydraulic design margins for the piping and sparger below allowable values. Therefore, the condition of the invessel core spray piping does not impose any restictions to unit 1 operation during the next operating cycle (Cycle 10). The piping will be re-inspected and evaluated during Unit 1 Refueling Outage 10 (B111R1), which is currently scheduled to begin in September 1996.

Please refer any questions regarding this submittal to Mr. George Honma at (910) 457-2741.

Sincerely,

R. P. Lopriore
Manager — Regulatory Affairs
Brunswick Nuclear Plant

WRM/wrm

IE11
1/1

9506070287 950601
PDR ADOCK 05000325
P PDR

Enclosures

cc: Mr. S. D. Ebneter, Regional Administrator, Region II
Mr. D. C. Trimble, NRR Project Manager - Brunswick Units 1 and 2
Mr. C. A. Patterson, NRC Senior Resident Inspector - Brunswick Units 1 and 2
The Honorable H. Wells, Chairman - North Carolina Utilities Commission

ENCLOSURE 1

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NO. 1
DOCKET NO. 50-325
LICENSE NO. DPR-71
RESPONSE TO NRC BULLETIN 80-13
EXAMINATION OF CORE SPRAY SYSTEM SPARGERS

Form 1

ENGINEERING SERVICE REQUEST

ESR #	Rev #	WR/JO #	Other Documents (ACR, FACTS, etc.)
9400063	1		

Plant/Unit	Primary System #	Primary System Name	☐ Multiple Systems Affected
BNP	1005	B21,B11-NUCLEAR BOILER (INC.RX VESSEL &	

Title	Originator/Phone
CORE SPRAY PIPING REPAIR	GILLMAN, TOM /850-3182

Problem/Proposed Solution/Justification

NOTE: PCN G0024C FAIM NO. A0003477

TITLE: Invessel Core Spray Piping Repair, Tee-Box Seal Welds And Examinations

Project Description: In accordance with IE Bulletin 80-13, a visual inspection (PT 90.1) of the Unit 1 core spray spargers and invessel core spray piping was performed during refuel outage 8. The inspection identified two linear indications in the B loop. One indication is in the heat affected zone of a circumferential weld which is located in the invessel piping between the B-loop inlet nozzle and the sparger. This weld is located approximately 18"

DUE DATE - -

☒ Continued

SCREENING

Quality Class	Is a 10CFR 50.59 Safety Review required per (plant specific procedure)?	Response Type
A Safety-Related	☒ The Safety Evaluation for this ESR was revised. See installation package for signatures. ☐ This ESR Revision does not affect the previous Safety Analysis(es) or Unreviewed Safety Question determination(s). 1st QSR: _____ Date: _____ 2nd QSR: _____ Date: _____	EVAL Other

Engineering Disciplines (Print Name, Sign, Date)		Engineering/Plant Programs (Print Name, Sign, Date)
Mechanical	JOHN W VOSS JR 5/23/95	
Civil/Seismic	JOHN W VOSS JR 5/23/95	
Materials	5/22/95	
System Eng	Philip Gore 5/23/95	
System Eng	N/A	
System Eng	N/A	

Form 1 ENGINEERING SERVICE REQUEST

ESR #	Rev #	Title
9400063	1	CORE SPRAY PIPING REPAIR

Problem/Proposed Solution/Justification

downstream of the B-loop tee box. This linear indication is approximately 4" long. The second indication is on a tee-to-sparger are circumferential weld on one of the lower B-loop spargers. This indication is approximately 3" long. The tee and sparger are located inside the shroud at a lower elevation than the inlet piping where the other indication is located.

An evaluation based on inspection results from B110R1 is requested.

Form 1 — ENGINEERING SERVICE REQUEST

ESR #	Rev #	Title
9400063	1	CORE SPRAY PIPING REPAIR

Plant Customers *(Print Name, Sign, Date)*

Specialty Reviews

Design Verification

JOHN W VOSS JR
BY DESIGN REVIEW

- ☐ NAS Before Approval/Implementation — Reference: _____
- ☐ NAS Before Closeout — Reference: _____
- ☐ PNSC Before Approval/Implementation
- ☐ NRC Before Implementation — Reference: _____

Problem Resolution:

ESR 94-00063 was revised to change the ESR Attachment file names to the recommended standard and to document Metallurgy discipline review of the Safety Evaluation.

ESR 94-00063 Revision 1 evaluation is attached. The Evaluation is stored on the LAN at Address x:\pr\esr.oos\attach\final\9400063a.wp

The Safety Review Package is attached. The Safety Review is stored on the LAN at Address x:\pr\esr.oos\attach\final\9400063s.wp

☐ Continued

APPROVAL

Is this a modification which constitutes a reduction in design margin?

- ☐ Yes (PGM approval is required)
- ☒ No (Engineering Mgr signs for PGM)

Interim Approval Required?

☐ Yes ☒ No ☐ N/A

Responsible Engineer TOM GILLMAN — 5/22/95

Responsible Manager *(Print Name, Sign, Date)* W Blair Wilson — 5/23/95

Plant General Manager *(Print Name, Sign, Date)* N/A

ESR 94-00063 EVALUATION

UNIT 1 CORE SPRAY PIPING EVALUATION BASED ON B110R1 IVVI EXAMINATION RESULTS

LIST OF EFFECTIVE PAGES

PAGE	REVISION
1	1
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	1
12	1
13	1
14	1

TABLE OF CONTENTS

PURPOSE

This ESR Evaluation is required as part of CP&L's commitment to USNRC IE Bulletin No. 80-13, "Cracking in Core Spray Spargers," dated May 12, 1980. As such, this evaluation accomplishes the following:

1) Documents the In-Vessel Visual Inspections (IVVI) performed on the Invessel Core Spray piping during Refueling Outage (RFO) B110R1.

2) Evaluates the current IVVI data relative to previous inspection results and analyses.

3) Provides justification to use the Core Spray piping/spargers for another operating cycle in the as-found condition. (i.e. concludes that BNP 1 can safely operate in the present condition during the next fuel cycle (Cycle 10) without any operational changes or restrictions.)

CONCLUSIONS

The BNP 1 Invessel Core Spray piping/spargers are "acceptable as is" for Operating Cycle 10. Crack growth experienced during Cycle 9 was substantially less than postulated by previous analysis. Furthermore, the postulated crack lengths at the end of Cycle 10 are fully bounded by previous analysis and will not reduce the structural or hydraulic design margins below allowable values. Therefore, the condition of the invessel core spray piping does not impose any restrictions to BNP 1 operation during the next cycle.

EVALUATION

1.0 DESIGN INPUTS

1.1 American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, 1980 Edition through Winter 1981 Addenda

1.2 Technical Specifications for Brunswick Steam Electric Plant Unit 1

1.3 IVVI Inspection data from BNP-1 Refueling Outages 8 (B109R1) and 9 (B110R1)

2.0 EVALUATION

2.1 INDUSTRY EXPERIENCE

Invessel Core Spray (CS) piping/spargers cracking is a BWR industry concern. The first instances of cracking in CS spargers were reported in 1978 at Oyster Creek and in 1980 at Pilgrim. These cases prompted the development of USNRC IE Bulletin 80-13 (Reference 3.1), which requires Licensees to perform a visual inspection of the CS invessel piping/spargers during each refueling outage. Subsequent inspections performed in accordance with 80-13 have revealed invessel CS piping/sparger cracking at several other facilities, including BNP-1 and BNP-2.

2.2 BNP-1 EXPERIENCE

The BNP-1 invessel CS piping and spargers are examined each refueling outage with a remote underwater camera in accordance with BNP Periodic Test OPT-90.1 (Reference 3.2), which complies with IE Bulletin 80-13. The inspections are recorded on video cassette for documentation and trending purposes.

RFO B109R1: During BNP-1 Refueling Outage #8 IVVI inspections, two cracks were discovered in the Core Spray B-loop piping. One crack (*Crack A* for the purposes of this report) was in the heat affected zone (HAZ) of a circumferential weld located approximately 18 inches downstream of the B-loop tee-box on the 5" (NPS) invessel piping. This crack was judged to be approximately 4 inches in length. Another crack (*Crack B* for the purposes of this report) was discovered in the HAZ of a tee-to-sparger arm circumferential

weld on one of the lower B-loop spargers (3½" NPS) and was judged to be approximately 3 inches in length. This condition was evaluated by General Electric (GE) in report GE-NE-523-97-0793 (Reference 3.3), in terms of four relevant issues. The issues and conclusions are summarized in Table 1.

TABLE 1

ISSUE	CONCLUSION
Leakage Through Cracks	Estimated leak rate based on End of Cycle (EOC) postulated crack lengths is well within the margins inherent in the CS system design and performance evaluations.
Structural Integrity of Piping/Spargers	The results of the evaluations confirm that a through-wall crack of up to 240° around the CS pipe circumference would not cause CS line failure and up to 220° around the circumference of CS sparger arm would not cause sparger failure. EOC crack lengths were estimated to be significantly less, therefore structural integrity of CS pipe and spargers will be maintained for all normal operating conditions during Cycle #9.
Lost Parts (loose pieces)	Lost parts analysis concludes that the consequences of a postulated loose piece do not pose a safety concern. (Additionally, because structural integrity was demonstrated, lost parts are not expected.)
Effect on LOCA Analysis	The inherent conservatism present in current LOCA analyses more than offset the amount of leakage postulated through the two cracks. Therefore no change to the present Maximum Average Plant Linear Heat Generation Rate (MAPLHGR) for BNP-1 is required.

RFO B110R1: During BNP-1 Refueling Outage #9 IVVI inspections, the two cracks discovered in the Core Spray B-loop piping/spargers during RFO B109R1 were reinspected. In each case, crack growth was much less than postulated in the GE analysis (Reference 3.3). No additional relevant indications were noted as a result of the IVVI examinations. A summary of RFO B109R1 and RFO B110R1 IVVI data for *Crack A* and *Crack B* and the crack growth estimates from Reference 3.3 are presented in Table 2.

TABLE 2

ATTRIBUTE	*CRACK A*	*CRACK B*
Crack Length from RFO B109R1 IVVI	Approx 4"	Approx 3"
Estimated End Of Cycle Crack Length from Reference 3.3 (RFO B110R1)	≤5.2"	≤4.1"
Crack Length from RFO B110R1 IVVI	Approx 4.2"	Approx 3.2"
Estimated Crack Growth per Operating Cycle (from IVVI Data)	Approx 0.2"	Approx 0.2"

2.3 SAFETY CLASSIFICATION

The internal core spray piping and spargers are non-ASME Code components, however they are classified as safety related since the Core Spray system is part of the Emergency Core Cooling System. The function of internal Core Spray piping and spargers is to provide a contained flow path to direct coolant to the core region in the event of a LOCA.

2.4 *PREVIOUS ANALYSES*

Cracks A and *B* were evaluated by General Electric Company in 1993 (Reference 3.3) for the issues summarized in Table 1. A brief discussion of the GE analysis follows.

Leakage Analysis GE estimated leakage through *Cracks A* and *B* (conservatively assumed as through wall cracks extending 180° around the circumference). Then they considered the effect of such leakage on the ability of the Core Spray system to provide design flow to the core region in the event of a core spray injection. The conclusion was that even using conservative leakage rates, there is sufficient margin in the existing core spray system beyond the design minimum such that the amount lost through the indications would not prevent the core spray system from performing as designed.

Structural Analysis GE concluded that neither *Crack A* nor *Crack B* would grow enough in Operating Cycle #9 to affect the structural integrity of the invessel piping or spargers. All design margins for structural integrity of the in-vessel core spray piping and spargers would still be met at the end of the cycle.

Lost Parts Analysis The effect of fragments of the in-vessel core spray piping and spargers breaking loose was considered and there was no postulated adverse effect on any safety related equipment. The subsequent effect of any loose fragments on reactor vessel control rod drive components, fuel assemblies, or any reactor vessel internal components was considered insignificant.

ECCS Analysis GE performed a Limiting Line Break and Single Failure analysis and postulated the impact of CS line/sparger leaks on existing ECCS analyses. The inherent conservatism present in current LOCA analyses more than offsets the amount of leakage postulated through the two cracks. Therefore the present Maximum Average Plant Linear Heat Generation Rate (MAPLHGR) for BNP-1 remains valid.

2.5 DISCUSSION OF EXISTING CONDITION

The crack growth rates determined from IVVI examination data gathered prior to and after Operating Cycle 9 reveal that the growth rates postulated in the previous GE analysis (Reference 3.3) were extremely conservative. This may be due to conservative estimates of (1) the oxidizing species concentrations in the region (No credit was taken for Hydrogen Water Chemistry) , and (2) the stress intensity factor at the crack tips.

A summary of bounding limits from the GE analysis and postulated growth through the end of Operating Cycle #10 is presented in Table 3. The bounding limits listed are those that allow the GE analysis conclusion to remain valid (i.e. that BNP-1 can safely operate during the next eighteen month fuel cycle and that no operational changes or restrictions are required during that period.)

TABLE 3

ATTRIBUTE	*CRACK A*	*CRACK B*
Maximum Evaluated Crack Length From Leakage Analysis [1]	Approx 8.3"	Approx 5.9"
Maximum Permitted Crack Length Based on Structural Analysis (Net Section Collapse Evaluation)	Approx 11.1" (240°)	Approx 7.2" (220°)
Length Data from RFO B110R1 IVVI	Approx 4.2"	Approx 3.2"
Estimated Crack Growth Rate per Operating Cycle from IVVI Data	Approx 0.2"	Approx 0.2"
Postulated Crack Length at End of Operating Cycle #10	Approx 4.4"	Approx 3.4"

[1] The leakage analysis was performed based on an assumed 180 ° crack extent since crack arrest is expected at 180°. (This is due to rapid diminishing of the stress intensity factor caused by orders of magnitude increases in compliance of the pipe as the crack grows.) The GE analysis shows that postulated leakage through the cracks is far below the threshold that would impact existing ECCS analyses. Therefore it is likely that maximum crack lengths permitted by structural analysis could also be justified by leakage analysis without impacting existing ECCS analyses.

The postulated lengths of *Crack A* and *Crack B* at the end of Operating Cycle # 10 are significantly less than the limiting values considered in Reference 3.3. Therefore the GE analysis bounds the existing condition and the conclusions reached by the analysis are considered applicable to the next operating cycle.

In summary, the internal core spray piping and spargers are acceptable in the

as-found condition for the next operating cycle of Unit 1. There is no postulated scenario involving the internal core spray piping/spargers that will affect the safe operation of the plant and all design margins for the core spray system will be maintained during the operating cycle. The predicted crack length at the end of an eighteen month cycle will not reduce the structural or hydraulic design margins for the piping/spargers below allowables. The condition of the internal core spray piping/spargers does not impose any restrictions to plant operation for the next operating cycle.

3.0 REFERENCES

3.1 USNRC IE-Bulletin 80-13, "Cracking in Core Spray Spargers", May 12, 1980.

3.2 OPT-90.1, "In-Vessel, Core Spray, and Feedwater Visual Examination", Revision 14

3.3 General Electric Company Report No. GE-NE-523-97-0793, "Core Spray Crack Analysis for Brunswick Steam Electric Plant, Unit 1, July, 1993

3.4 EER No. 93-0479, "Evaluation of Unit 1 Core Spray In-vessel Piping and Spargers", Revision 0, and associated 10 CFR50.59 Safety Evaluation

DOCUMENT UPDATES

No document updates are required as a result of this ESR.

ESR ACTION ITEMS

No ESR action items are required as a result of this ESR. Future inspections and reportings are governed by OPT-90.1 (Reference 3.2), which assures that the USNRC IE-Bulletin 80-13 (Reference 3.1) requirements are met.

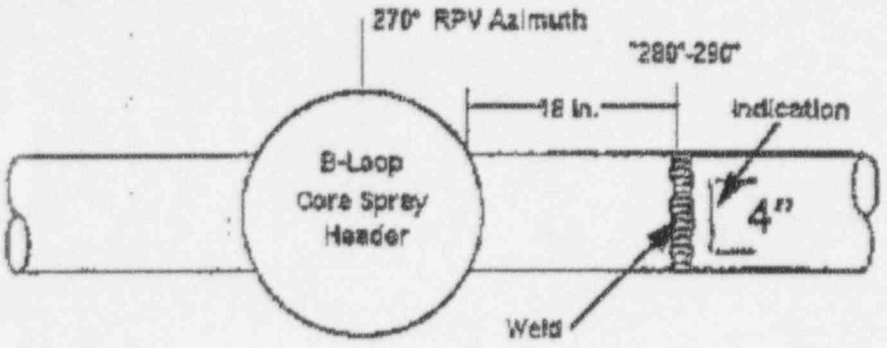

Figure 1: Location of B-Loop Core Spray Piping Indication

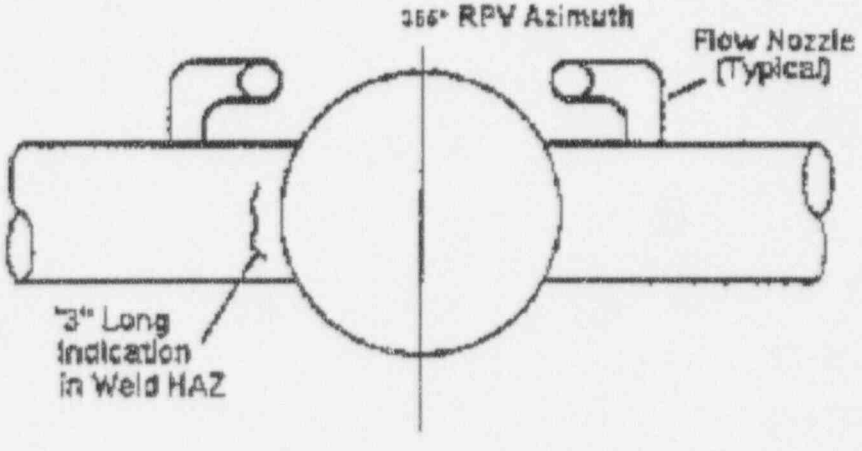

Figure 2: Location of B-Loop Core Spray Sparger Indication

ENCLOSURE 2

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NO. 1
DOCKET NO. 50-325
LICENSE NO. DPR-71
RESPONSE TO NRC BULLETIN 80-13
EXAMINATION OF CORE SPRAY SYSTEM SPARGERS

LIST OF REGULATORY COMMITMENTS

The following table identifies those actions committed to by Carolina Power & Light Company in this document. Any other actions discussed in the submittal represent intended or planned actions by Carolina Power & Light Company. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the Manager-Regulatory Affairs at the Brunswick Nuclear Plant of any questions regarding this document or any associated regulatory commitments.

	Commitment	Committed date or outage
1.	Re-inspect the Unit 1 in-vessel core spray piping and spargers in accordance with NRC Bulletin 80-13.	B111R1