UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

EVALUATION OF NRC GENERIC LETTER 88-01 RESPONSE

CAROLINA POWER & LIGHT COMPANY

BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2

DOCKET NOS. 50-325 AND 50-324

1.0 INTRODUCTION

Carolina Power & Light Company (CP&L), the licensee, submitted its response to NRC Generic Letter 88-01, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping" for Brunswick Steam Electric Plant, Units 1 & 2, (Brunswick) by letter dated July 18, 1988, and additional information as requested by the staff was provided by letter dated June 29, 1989. Generic Letter (GL) 88-01 requested Licensees and construction permit holders to resolve the IGSCC issues for BWR piping made of austenitic stainless steel that is 4 inches or larger in nominal diameter and contains reactor coolant at a temperature above 200 degrees Fahrenheit during power operation regardless of Code classification. The licensee was requested to address the following:

1. The current plans regarding pipe replacement and/or other measures taken to mitigate IGSCC and provide assurance of continued long term integrity and reliability.

2. The Inservice Inspection (ISI) Program to be implemented at the next refueling outage on ISI and that the ISI Program for piping covered by the scope of GL-88-01 will be in conformance with staff positions on schedule, methods and personnel, and sample expansion included in GL-88-01.

3. The Technical Specification change to include a statement in the section on ISI that the ISI Program for piping covered by the scope of this letter will be in conformance with the staff positions on schedule methods and personnel, and sample expansion included in GL-88-01 (See model BWR Standard Technical Specification enclosed in GL-88-01.) It is recognized that the Inservice Inspection and Testing sections may be removed from the Technical Specifications in the future in line with the Technical Specifications improvement programs. In this case, this requirement shall remain with the ISI section when it is included in an alternative document.

4. The confirmation of your plans to ensure that the Technical Specification related to leakage detection will be in conformance with the staff position on leak detection included in GL-88-01.

5. The plans to notify the NRC in accordance with 10CFR50.55a(g) of any flaws identified that do not meet IWB-3500 criteria of Section XI of the ASME

Code for continued operation without evaluation, or a change found in the condition of the welds previously known to be cracked and your evaluation of the flaws for continued operation and/or your repair plans.

2.0 DISCUSSION

The licensee's response to NRC GL-88-01 has been reviewed by the staff with the assistance of its contractor, Viking Systems International (VSI). The Technical Evaluation Reports (TER) provided as Attachments 1 and 2 are VSI's evaluation of the licensee's response to NRC GL-88-01. The staff has reviewed the TER and concurs with the evaluation, conclusions, and recommendations contained in the TER. However, the staff has changed its position with regard to frequency of leakage monitoring. After discussions with several BWR operators, the staff concluded that monitoring every four hours creates an unnecessary administrative hardship on the plant operators. Thus, the staff recommends that RCS leakage measurements be taken every eight hours instead of every four hours as required in GL-88-01. Although the staff's position has changed with regard to frequency of monitoring of leakage, the staff found that leakage detection surveillance requirement in the Technical Specifications (TS) of Brunswick, Units 1 & 2 does not meet the staff's position of measuring leakage once approximately every four hours per GL-88-01, or the staff's revised position of approximately every eight hours. The licensee proposed to implement the requirement to monitor leakage at approximately four hour intervals in other plant documents rather than the TS. The proposed alternative is not acceptable because it is not in conformance with the staff position as the requirement implemented in the other plant documents would not be as enforceable as that in the TS. Furthermore, this item of leakage monitoring frequency was approved to be included in the TS by the Committee to Review Generic Requirements (CRGR) as part of GL-88-01. In addition, the staff's position to measure leakage approximately every eight hours will be included in the Improved Standard Technical Specification for BWR plants. Thus, the surveillance requirement should be revised as recommended in Section 2.7 of the attached TERs with the exception that, the licensee may apply the staff's new position to monitor leakage at approximately every eight hours instead of every four hours as required per GL-88-01.

3.0 CONCLUSION

Based on the review of the licensee's NRC GL-88-01 response the staff concludes that the response as evaluated is acceptable with the exception of the licensee's position concerning leak detection frequency to be implemented in other documents rather than the T.S. The licensee is requested to submit a TS change that would require monitoring leakage at approximately four or eight hour intervals.

The staff also concludes that the proposed IGSCC inspection and mitigation program will provide reasonable assurance of maintaining the long-term structural integrity of austenitic stainless steel piping in the Brunswick, Units 1 and 2.

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Dated:

FINAL

TECHNICAL EVALUATION REPORT ON RESPONSE FROM CAROLINA POWER AND LIGHT COMPANY TO GENERIC LETTER 88-01 PERTAINING TO THE BRUNSWICK STEAM ELECTRIC PLANT, UNIT 1

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ABSTRACT

This report contains an evaluation of the licensee (Carolina Power and Light Company) submittal for Brunswick Steam Electric Plant, Unit 1 which was submitted in response to the NRC Generic Letter 88-01 in which Carolina Power and Light was requested to: (1) Furnish their current plans relating to piping replacement and other measures to mitigate IGSCC, inspection, repair, and leakage detection. (2) Indicate whether they plan to follow the NRC Staff positions, or propose alternative measures. Carolina Power and Light Company's plans are evaluated in Section 2 of this report in terms of compliance to NRC Staff positions. Although Carolina Power and Light Company follows the NRC Staff guidelines pertaining to leakage detection including frequency of leakage monitoring, they proposed that the requirement for leakage monitoring be included in a document other than the Technical Specification. This alternative proposal is discussed in Section 2.7 of this report.

SUMMARY

The Licensee, Carolina Power and Light Company (CP&L), submitted a response to the NRC Generic Letter 88-01. CP&L's response pertaining to the austenitic stainless steel piping in the Brunswick Steam Electric Plant, Unit 1 (a BWR nuclear power plant) was evaluated in terms of: (1) Their previous and planned actions to mitigate IGSCC to provide assurance of continued long-term service. (2) Their Inservice Inspection (ISI) Program. (3) Their Technical Specifications pertaining to ISI and their plans to ensure that leakage detection will be in conformance with the NRC Staff position. (4) Their plans to notify the NRC of significant flaws identified (or changes in the condition of the welds previously known to be cracked) during inspection.

CP&L endorses all of the 13 NRC Staff positions which are outlined in Generic Letter 88-01; however, they attached a provision to that on Hydrogen Water Chemistry that they reserve judgment until operating data are available on the use of HWC at Brunswick 1. Also, they proposed that the control of the four-hour monitoring requirement for leakage be contained in an alternate document to the Technical Specification (TS).

Extensive mitigating actions have been performed at Brunswick 1 including piping replacement, solution heat treating, stress improvement (using both IHSI and MSIP), and application of weld overlays. Additional piping replacement is planned. Currently, only 22 welds (of a total of 262 within the scope of Generic Letter 88-01) remain unmitigated, and they have been inspected and found to be free of cracks.

An ISI program proposed for Brunswick 1 conforms with the NRC Staff positions on schedule, methods and personnel, sample expansion, and reporting requirements. A list of welds to be inspected was provided, and a preliminary draft of a proposed change to the TS on ISI to conform with the NRC Staff position was submitted.

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1. INTRODUCTION

Intergranular stress corrosion cracking (IGSCC) near weldments in Boiling Water Reactor (BWR) piping has been occurring for almost 20 years. Substantial efforts in research and development have been sponsored by the BWR Owners Group for IGSCC Research, and the results of this program, along with other related work by vendors, consulting firms and confirmatory research sponsored by the NRC, have permitted the development of NRC Staff positions regarding the IGSCC problems. The technical basis for NRC Staff positions is detailed in Reference 1, and further background is provided in Reference 2.

The results of these research and development programs prompted the NRC to issue Generic Letter 88-01 (see Reference 3) requesting all licensees of BWR's and holders of construction permits to:

(1) Furnish their current plans relating to piping replacement, inspection, repair, and leakage detection.

(2) Indicate whether they:
   (a) Plan to follow the staff positions, or
   (b) Propose alternative measures.

Specifically, Generic Letter 88-01 stated that an acceptable licensee response would include the following items:

(1) Current plans regarding pipe replacement and/or other measures taken or to be taken to mitigate IGSCC and provide assurance of continued long-term piping integrity and reliability.

(2) An inservice inspection (ISI) program to be implemented at the next refueling outage for austenitic stainless steel piping.

(3) A change to the Technical Specifications to include a statement

in the section on ISI that the inservice inspection program for piping will be in conformance with the staff positions on schedule, methods and personnel.

(4) Confirmation of plans to ensure that the Technical Specification related to leakage detection will be in conformance with the Staff position on leak detection.

(5) Plans to notify the NRC, in accordance with 10CFR50.55a(o), of any flaws identified that do not meet IWB-3500 criteria of Section XI of the ASME Code for continued operation without evaluation, or a change found in the condition of the welds previously known to be cracked, and an evaluation of the flaws for continued used operation and/or repair plans.

This report contains a technical evaluation of the response which Carolina Power and Light Company (called CP&L in this report) submitted in response to the NRC Generic Letter 88-01 pertaining to the Brunswick Steam Electric Plant, Unit 1 (hereafter called either Brunswick 1 or BSEP 1).

2. EVALUATION OF RESPONSE TO GENERIC LETTER 88-01

This evaluation consisted of a review of the response to NRC Generic Letter 88-01 of January 25, 1988 by Carolina Power pertaining to Brunswick 1 to determine if their performance and plans are in conformance with the NRC Staff positions or if proposed alternatives are acceptable. Proposed inspection schedules and amendments to the Technical Specification were included in the review.

2.1 Documents Evaluated

Review was conducted on the information pertaining to Brunswick

1 provided by the Licensee in the following documents.

(1) "Response to Generic Letter 88-01 and IGSCC Inspection Plans - BSEP-1 Refueling Outage 6, Brunswick Steam Electric Plant, Units 1 and 2, Docket Nos. 50-325 and 50-324, License Nos. DPR-71 and DPR-62," Carolina Power & Light Company, P.O. Box 1551, Raleigh, NC 27602, July 18, 1988.

(2) "Response to Staff's Request for Additional Information Pertaining to Carolina Power & Light Company's Response to Generic Letter 88-01, Brunswick Steam Electric Plant, Units 1 and 2, Docket Nos. 50-325 and 50-324, License Nos. DPR-71 and DPR-62," Carolina Power & Light Company, P.O. Box 1551, Raleigh, NC 27602, July 29, 1989.

Hereafter, in this report, these documents will be referred to as CP&L Submittals No. 1 and No 2, respectively, and collectively as the CP&L Submittals.

2.2 Review of CP&L's Responses to Staff Positions and Implementation of Those Positions.

Generic Letter 88-01 outlines thirteen NRC Staff positions pertaining to (1) materials, (2) processes, (3) water chemistry, (4) weld overlay, (5) partial replacement, (6) stress improvement of cracked weldments, (7) clamping devices, (8) crack evaluation and repair criteria, (9) inspection methods and personnel, (10) inspection schedules, (11) sample expansion, (12) leak detection, and (13) reporting requirements. Generic Letter 88-01 states that the licensee should indicate in their submittal whether they endorse these NRC Staff positions or propose alternative positions. CP&L Submittal No. 1 did not specifically state acceptance or rejection of most of the thirteen NRC Staff positions, but the CP&L positions

on several of the thirteen items were implied in discussions in CP&L Submittal No. 1, and additional information was provided in CP&L Submittal No. 2. These positions are presented in Table 1.

Note that CP&L indicated endorsement of all thirteen NRC Staff positions, although they applied provisions to one, i.e., that pertaining to Hydrogen Water Chemistry (HWC). Concerning HWC, installation of HWC system for both Brunswick 1 and 2 is currently in progress, but CP&L reserves judgment on this Staff position until it has been fully developed. Concerning leakage detection, although CP&L endorses the NRC Staff position, as discussed in Section 2.7 of this report, requirements for frequency of leakage monitoring comply with the NRC Staff position, but they are not contained in the Technical Specification. Rather they are contained in an alternate document.

2.3 Review of Previous Mitigating Actions Classification of Welds, and Previous Inspections

2.3.1 Summary of Previous Mitigating Actions and IGSCC Classifications of Welds

CP&L Submittal No. 2 contains the following summary of mitigating treatments at Brunswick 1:

> "Partial replacement of susceptible piping systems with carbon steel material or resistant stainless steel materials."
>
> "Stress improvement of selected weldments, using both the Induction Heating Stress Improvement Process, and Mechanical Stress Improvement Process."

Table 1

Summary of CP&L's Responses to Staff Positions

Staff Position	CP&L Accepts NRC Staff Position	CP&L Has/Will Applied In Past	CP&L Has/Will Consider for Future Use
1. Materials	yes	yes[a]	yes[a]
2. Processes	yes	yes[b]	yes
3. Water Chemistry	yes[c]	yes[c]	yes[c]
4. Weld Overlay	yes	yes	possible
5. Partial Replacement	yes	yes	yes
6. Stress Improvement of Cracked Weldments	yes	yes	yes
7. Clamping Devices	yes	yes	possible
8. Crack Evaluation and Repair Criteria	yes	yes	yes
9. Inspection Method and Personnel	yes	yes	yes
10. Inspection Schedule	yes	yes	yes
11. Sample Expansion	yes	yes	yes
12. Leak Detection	yes	yes	yes
13. Reporting Requirements	yes	yes	yes

(a) CP&L redefined the susceptible weld population after issuance of NUREG 0313, Rev. 2 and thereby increased the susceptible weld population.

(b) CP&L has applied SHT and SI but not HSW.

(c) CP&L is currently installing Hydrogen Injection System for BSEP Units 1 and 2. They reserve judgement on this item until it has been fully developed.

"Weld overlay reinforcement to repair flaws detected in reactor recirculation system welds."

Table 2 in this report compares the number of welds in each IGSCC category before and after Refueling Outage No. 6. (Note that that outage occurred between the times that CP&L Submittal No. 1 and No. 2 were prepared). Table 2 also summarizes the mitigating treatments applied to various welds in Brunswick 1. This information is a summary of information pertaining to material identification and mitigating treatments that was extracted from a table in CP&L Submittal

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Table 2

Summary of IGSCC Classifications and Mitigating Treatments at Brunswick 1

IGSCC Categ	No. of Welds Before R.O.#6	No. of Welds After R.O.#6	No. with Res. Matl.	No. with Indicated Treatment SHT	MSIP	IHSI	SI+O.L.	O.L.
A	87	122	113	9				
B	0	0						
C	55	62			7	55		
D	46	22						
E	37	46						
F	0	10					26	20
G	41	0						10*
Totals	266	262	113	9	7	55	26	30

* Overlays on all IGSCC Category F Welds are Leak Barrier Overlays.

No. 2. That table contains a weld-by-weld list which provides the identification, system, configuration, diameter, material, and mitigating treatment(s) for each weld.

The mitigating treatments are discussed in greater detail in the following sections.

2.3.2 Partial Replacement and Solution Heat Treating

Seventy-eight welds were replaced with material that is considered to be corrosion resistant material (per NUREG 0313, Revision 2) either before operation or during the second, third, or fourth refueling outage. Systems that were replaced included the reactor recirculation discharge valve bypass lines, the core spray safe-ends, and a portion of the RWCU system. These welds are properly classified as IGSCC Category A welds. In addition, the core spray piping was replaced with carbon steel.

Nine welds were solution heat treated, according to CP&L Submittal No. 1, and these welds are also classified as IGSCC Category A welds.

During Refueling Outage No. 6, additional piping replacement was performed to raise the total number of IGSCC Category A welds to 122.

Although not specifically stated, the piping replacement program during Refueling Outage No. 6 also apparently eliminated 4 welds (either from piping removal, redesign to decrease the number of welds, or replacement with carbon steel) since the total number of welds decreased by four (from 266 to 262).

2.3.3 Stress Improvement

According to CP&L Submittal No. 1, Induction Heating Stress Improvement (IHSI) was applied to 79 welds, 23 of which were cracked and were subsequently repaired with weld overlays. In addition, according to CP&L Submittal No. 2, ten welds were treated with the Mechanical Stress Improvement Process (MSIP), three of which were subsequently overlaid. Thus, Brunswick 1 presently contains a total of 62 IGSCC Category C welds (7 with MSIP and 55 with IHSI).

2.3.4 Weld Overlays

As indicated above, weld overlays were applied to several cracked welds, some of which had been previously treated with a stress improvement process. Standard weld overlays (per guidelines presented in NUREG 0313, Revision 2) were applied to a total of 46 welds which are classified as IGSCC Category E. In addition, according to CP&L Submittal No. 2, leak barrier overlays have also been applied to 10 welds (i.e., ten thermal sleeves), and these welds are classified as IGSCC Category F since the leak barrier weld overlays are intended only for temporary service.

Note that 22 corrosion susceptible welds still remain at Brunswick, although they have all been inspected as discussed below. These 22 welds are classified as IGSCC Category D. Brunswick 1 does not contain any IGSCC Category G welds.

2.3.5 Hydrogen Water Chemistry

According to CP&L Submittal No. 2, a Hydrogen Water Chemistry (HWC) system has been installed at Brunswick 1.

2.3.6 Previous Inspection Programs

CP&L Submittal No. 2 contains a list of welds that were inspected during Refueling Outages 4 through 6 (1985 through 1988). A comparable list is contained in CP&L Submittal No. 1. Concerning methods and personnel: CP&L Submittal No. 1, which was prepared prior to Refueling Outage No. 6, states that future inspections "will continue to be performed employing both equipment and personnel qualified in accordance with the most current NRC/EPRI BWROG coordination." The word "continue" implies that past inspections were similarly conducted; however, it is presumed that only those inspections performed during Refueling Outage No. 5 are so qualified since most of Refueling Outage No. 4 occurred prior to September, 1985 (the date of upgrading of the coordination plan referenced in NUREG 0313, Revision 2). Thus, credit should be granted towards the inspection program (in terms of compliance with NRC Staff guidelines as delineated by Generic Letter 88-01) for inspections conducted at Brunswick 1 during Refueling Outages Nos. 5 and 6, but not those conducted during Refueling Outage No. 4.

During refueling Outages No. 5 and 6, all IGSCC Category C, D, E, and F welds were inspected at least once. In addition 40 IGSCC Category A welds were inspected during those refueling outages. No flaws are reported in the CP&L Submittals except for flaws in the 46 IGSCC Category E welds, all of which were repaired with weld overlays as discussed above.

It should be noted that two welds classified as IGSCC Category C (i.e., 24A12 and 24B13) and seven welds classified as IGSCC Category D (i.e., 12ARA5, 12ARB5, 12ARD5, 12BRF5, 12BRG5, 12BRH5, and 12BRK5) are only partially inspectable. CP&L Submittal No. 2 explains the classifications of these despite

the lack of inspectability:

"As previously submitted to the Staff in CP&L's response to Generic Letter 88-01, there are nine welds in Unit 1 and seven welds in Unit 2 which had limited inspectability."

"Four of these welds (24A12 and 24B13 in both units) have severe inspection limitations. CP&L is currently pursuing alternate inspection techniques which will allow a complete inspection to be performed. If the alternate inspection techniques do not provide the required coverage, CP&L will consider other repair methods, one of which will require the addition of weld material (weld overlay) to provide a surface suitable for the UT inspection of the weld joints. These four welds were classified as IGSCC Category C welds because they have received stress improvement (IHSI), and have no known cracks, and are not made of resistant materials."

The remaining twelve welds are the same configuration. They are the recirculation system 12' pup piece to safe end welds. These welds have only recently become limited from an inspection standpoint because of the addition of a weld overlay on the adjacent (upstream) weld. The addition of the overlay on the adjacent weld has restricted the inspection to one side only, which is not in conformance with Section 5.2.1 of NUREG-0313, Revision 2. However, previous (pre-overlay) inspections were performed on these welds and were acceptable. These welds were classified as IGSCC Category D welds because they are not made with resistant material, and have not been given an SI treatment, but were previously inspected and found to be free of cracks. In addition, due to CP&L's

commitment to replace recirculation piping in Unit 1 in 1990, and in Unit 2 by 1991, all 12 of these welds will be replaced."

2.3.7 Evaluation of Previous Mitigating Actions and Previous Inspections

An extensive program has been conducted at Brunswick 1 following guidlines presented in Generic Letter 88-01 and NUREG 0313, Revision 2. That program consisted of piping replacement, solution heat treating, stress improvement, and weld overlays. The result is that only 22 welds at Brunswick 1 are unmitigated, susceptible welds (IGSCC Category D). The remaining welds consist of: 122 IGSCC Category A welds, 62 IGSCC Categgry C welds, 46 IGSCC Category E welds, and 10 IGSCC Category F welds. Brunswick 1 does not contain any IGSCC Category G welds.

Inspections performed at Brunswick during the last two refueling outages were conducted in conformance with the NRC Staff position in terms of schedules and methods and personnel.

Based on information supplied in the CP&L Submittals, the IGSCC classifications are correctly assigned to all of the welds in Brunswick except for welds 24A12 and 24B13 which did not receive complete inspections because of limited accessibility. Each of these welds was treated with IHSI, but such treatment must be followed by inspection to warrant a classificaiton as IGSCC Category C. Without such an inspection, they should be considered IGSCC Category G (see NUREG 0313, Revision 2, Section 5.3.1.7).

2.4 Current Plans for Mitigating Actions

2.4.1 Summary of CP&L's Plans

CP&L Submittal No. 1 contains a list of planned mitigating actions including replacement of remaining IGSCC Category G welds, application of MSIP to safe-end to nozzle welds (IGSCC Category D), and installation of HWC. These plans were completed during Refueling Outage No. 6. No additional plans were disclosed by CP&L except for: (1) replacement of the partially inaccessible welds in recirculation piping discussed in Section 2.3.6 of this report. (2) Inspections as discussed below

2.4.2 Evaluation and Recommendation

Since: (1) extensive mitigating actions have already been applied at Brunswick 1 (with the result that only 230 of the 262 welds within the scope of Generic Letter 88-01 have been replaced, stress improved, or repaired with standard weld overlays), (2) several additional welds are scheduled for replacement, (3) the use of Hydrogen Water Chemistry will be continued and evaluated, CP&L's current plan concerning mitigating treatments follows the guidelines of Generic Letter 88-01. Therefore, acceptance of CP&L's plan is recommended.

2.5 Plans for Future Inspections

2.5.1 Summary of Inspection Schedule

CP&L Submittal No. 2 contains a list of past inspection schedules (on a weld-by-weld basis) for for the last three

refueling outages (nos. 4, 5, and 6 which occurred in 1985, 1987, and 1988, respectively) and planned schedules for future refueling outages through 1995 (Refueling Outages No. 7 through 10). Table 3 contains a summary of those schedules, showing the number of welds in each IGSCC category (as presently classified) conducted/scheduled during each of those refueling outages. Also included in Table 3 are requirements for welds of each IGSCC classification as detailed in Generic Letter 88-01 and NUREG 0313, Revision 2. Note that with the exception of the partially inaccessible welds discussed in Sections 2.3.6 and 2.5.2 of this report, CP&L's plans completely comply with the NRC Staff position, providing that credit is allowed for inspections conducted during Refueling Outages No. 5 and No. 6. As discussed in Section 2.3.6 of this report, such credit should be allowed.

2.5.2 Inaccessible Welds

As discussed in Section 2.3.6 of this report, two IGSCC welds classified as IGSCC Category C (24A12 and 24B13) should properly be classified as IGSCC Category G because they have severe inspection limitations, so they were not completely inspected following IHSI treatments. Plans for these welds are to either pursue alternate inspection techniques which will allow complete inspections to be performed, or apply weld overlays to provide surfaces suitable for UT inspections.

Also, as discussed in section 2.3.6 of this report, seven IGSCC Category D welds are partially inaccessible for inspection. CP&L plans to replace these welds during the next refueling outage scheduled for 1990.

Table 3

Summary of Inspection Schedules for Brunswick 1
for Refueling Outages 4 through 10

IGSCC Categ.	No. in Categ.	No. Inspected/Scheduled During Indicated R.O. Past 04	05	05	Future 07	08	09	10	Required by Generic Letter 88-01
A	122	26	9	31	5	7	9	4	25% every 10 years (at least 12% in 6 years)
B	0	-	-	-	-	-	-	-	50% every 10 years (at least 25% in 6 years)
C	62	62	59	16	14	11	11	10	All within the next 2 refueling cycles, then all every 10 years (at 50 % in 6 years)
D	22	0	20	7	16	6	3	6	All every 2 refueling cycles
E	46	45	39	28	22	24	22	24	50% next refueling cycle, then all every 2 refueling cycles
F	10	-	10	10	10	5	5	5	All every refueling outage
G	0	-	-	-	-	-	-	-	All next refueling cycle

Refueling Outage Dates are as follows:

R.O.#	Date	R.O.#	Date	R.O.#	Date
04	03/85-11/85	07	1990	09	1993
05	02/87-06/87	08	1992	10	1995
06	11/88-02/89				

2.5.3 Methods and Personnel

CP&L Submittal No. 1 states the following:

> "Ultrasonic examinations will continue to be performed employing both equipment and personnel qualified in accordance with the most current NRC/EPRI/BWROG coordination plan."

2.5.4 Sample Expansion

CP&L Submittal No. 1 states the following:

> "At the present time, CP&L plans to adhere to the provisions set forth in the Staff positions for flaws detected and determined to be caused by IGSCC. However, flaws initiated or caused by other mechanisms will be evaluated at that time as to determining the need for additional examinations within the provisions of Section XI of the ASME Code."

2.5.5 Evaluation and Recommendations

Since CP&L's inspection plans for accessible welds, including schedules, methods and personnel, and sample expansion comply with the NRC Staff positions on these items, acceptance of their plans is recommended. Acceptance of CP&L's plans for the seven partially inaccessible IGSCC Category D welds is also recommended since these welds are scheduled for replacement during the next refueling outage.

Plans to develop alternate inspection techniques or apply weld overlay built-ups to improve inspectability for the two welds that have severe inspection limitations (currently

classified as IGSCC Category C) should be pursued. However, since these welds should be properly classified as IGSCC Category G, either those plans should be advanced to the next refueling outage (scheduled for 1990) or interim plans should be developed to assure the integrity of those welds.

2.6 Changes in the Technical Specification Concerning ISI

2.6.1 CP&L's Position

CP&L Submittal No. 1 contains the following statement:

> "Generic Letter 88-01 provides guidance for a revision to the Technical Specification Surveillance Requirements to include a statement that the ISI program for piping covered by the scope of Generic Letter 88-01 will be in conformance with the Staff positions. Preparation of the documentation to affect this change in the Technical Specifications for both BSEP units is presently being performed. Enclosure 7 to this letter provides a preliminary draft of the proposed changes. Submittal of these changes is contingent on concurrence by the NRC Staff with the response provided in this letter. This will ensure that CP&L will be in conformance with the Staff positions as presented in Generic Letter 88-01 and NUREG 0313, Revision 2."

2.6.2 Evaluation and Recommendation

CP&L's position is in compliance with the NRC Staff position and they have submitted a preliminary draft of the change to the Technical Specification. Thus, acceptance of CP&L's position is recommended.

2.7 Confirmation of Leak Detection in the Technical Specification

2.7.1 CP&L's Position

Table 4, reproduced from CP&L Submittal No. 2, summarizes CP&L's position regarding requirements for leakage detection as delineated in Generic Letter 88-01.

In addition CP&L Submittal No. 1 contains the following comments pertaining to leakage requirements:

> "Currently the BSEP Technical Specifications require that plant shutdown be initiated for inspection and corrective action when any leakage detection indicates, within any period of 24 hours, an increase in unidentified leakage in excess of 2 gpm, or when total unidentified leakage attains a rate of 5 gpm as averaged over any 24 hour period."

> "Additionally, CP&L has committed via correspondence to the Staff to the following items: (1) For sump level monitoring systems with fixed measurement-interval methods, the level shall be monitored at 4 hour intervals or less. (2) At least one of the leakage measurement instruments associated with each sump shall be operable and the outage time for inoperable instruments shall be limited to 24 hours. Otherwise, an orderly shutdown will be immediately initiated."

> "Based upon the above requirements and commitments, CP&L actions pertaining to leakage detection are in conformance with the Staff's positions outlined in Generic Letter 88-01."

Table 4

Licensee Positions on Leakage Detection

Position	Already Contained in TS	TS will be Changed to Include	Alternate Position Proposed
1. Conforms with Position C of Regulatory Guide 1.45	yes	-	-
2. Plant shutdown should be initiated when:			
(a) within any period of 24 hours or less, an increase is indicated in the rate of unidentified leakage in excess of 2 gpm, or	yes	-	-
(b) the total unidentified leakage attains a rate of 5 gpm.	yes	-	-
3. Leakage monitored at four hour intervals or less.	-	-	yes[(a)]
4. Unidentified leakage includes all except:	yes	-	-
(a) leakage into closed systems, or			
(b) leakage into the containment atmosphere from sources that are located, do not interfere with monitoring systems, or not from throughwall crack.			
5. Provisions for shutdown within 24 hours due to inoperable measurement instruments in plants with Category D, E, F, or G welds.	yes	-	-

(a) The leakage monitoring is governed by BSEP/Vol. VII/OI-03.1 (Attachment 1, page 11 thru 17), which stipulates that leakage shall be monitored in approximately 4 hour intervals.

2.7.2 Evaluation and Recommendation

Generic Letter 88-01 requires that the Technical Specification related to leakage detection will be in conformance with Position C of Regulatory guide 1.45 and the following NRC Staff positions: (1) Leakage limits. (2) Frequency of leakage monitoring. (3) Description of unidentified leakage. (4) Operability of monitoring instruments. According to the CP&L Submittals, the Brunswick 1 Technical Specification conforms with all of the above items except for Item 2 on frequency of leakage monitoring, so acceptance of CP&L's positions on items other than Item 2 is recommended. Although CP&L Submittal No. 1 contains a commitment to adhere to the requirement to monitor leakage at approximately four hour intervals, as required by the NRC Staff, CP&L Submittal No. 2 states that the commitment is contained in an alternate document rather than the Technical Specification. It is recommended, therefore, that the Brunswick 1 Technical Specification should be changed to incorporate the four hour requirement for monitoring leakage.

2.8 Plans for Notification of the NRC of Flaws

2.8.1 CP&L's Position

CP&L Submittal No. 1 states:

"Plans to notify the NRC of inspection results, evaluations, and actions to be taken regarding IGSCC related flaws will continue as they are presently formulated. Inspection plans will be submitted three months prior to the start of a refueling outage on either BSEP-1 or BSEP-2."

"Flaws or changes found in the condition of welds which do not meet ASME Code Section XI criteria will be reported in a Licensee Event Report (LER) within 30 days, if applicable, or through direct contact with the Staff in cases where a significant indication is detected as was done during the recently completed Refueling Outage 7 on BSEP-2 for the flaw found in the 12" reactor recirculation nozzle."

"The results of specific inspections and the scope of mitigation and/or repairs which are performed during the refueling outages will be submitted to the Staff prior to startup of the unit."

2.8.2 Evaluation and Recommendation

CP&L's position complies with the NRC Staff position, so acceptance of their position is recommended.

3. ALTERNATIVE POSITIONS

CP&L did not present any alternative positions to the NRC Staff positions as delineated in Generic Letter 88-01 except for that on frequency of leakage monitoring previously discussed (Section 2.7 of this report).

4. CONCLUSIONS AND RECOMMENDATIONS

The CP&L stated that they endorse all of the thirteen NRC Staff positions delineated in Generic Letter 88-01 (i.e., those pertaining to materials, processes, water chemistry, weld overlay, partial replacement, stress improvement of cracked weldments, clamping devices,

crack evaluation and repair criteria, inspection methods and personnel, inspection schedules, sample expansion, leak detection, and reporting requirements). They also stated that they applied provisions to their endorsement of the NRC Staff position on HWC, i.e., they wish to reserve judgment until HWC installed at Brunswick is fully evaluated. In addition, although they accept leakage requirements proposed in Generic Letter 88-01, they proposed that the governing document for one item (frequency of leakage measurements) be a document other than the Technical Specification.

Prior to operation and during several refueling outages, CP&L extensively applied piping replacement, solution heat treatments, and stress improvement treatments to piping/welds within the scope of Generic Letter 88-01 at Brunswick 1. In addition they applied standard weld overlays to 46 cracked welds and 10 leak barrier overlays to 10 welds. These actions followed the guidelines of Generic Letter 88-01. The result is that 122 of the 262 welds within the scope of Generic Letter 88-01 are IGSCC Category A, 62 welds are IGSCC Category C, 46 welds are IGSCC Category E, and 10 are IGSCC Category F. Twenty-two welds have not received any mitigating treatments, but since they have been inspected and found to be free of cracks, these 22 welds are classified as IGSCC Category D. Plans for future mitigation treatments include replacement of additional piping in the recirculation system (including seven welds that are currently partially inaccessible for inspection) and continued operation of the hydrogen water system to develop operating data.

CP&L provided an extensive list of inspections that have been performed during the last three refueling outages. Inspection schedules and inspection methods and personnel during at least the last two of those refueling outages were performed in accordance with NRC Staff guidelines (concerning both schedules and methods and personnel). An Inservice Inspection Program (ISI) has been developed for the future for Brunswick 1 which complies with the requirements of Generic Letter 88-01

pertaining to schedule, methods and personnel, sample expansion, and plans for reporting flaws. A list of welds that are included in the ISI program was supplied including weld numbers, configuration, mitigating treatments, and IGSCC classifications. The identities of the specific welds to be inspected during the next several refueling outages were also supplied.

Two welds were classified as IGSCC Category C which should have been classified as IGSCC Category G because inadequate accessibility prohibited complete inspections following IHSI treatments. CP&L plans to develop new inspection techniques or modify the welds to permit inspection in 1993. No plan for inspection of these welds during the next refueling outage has been advanced.

CP&L agreed to change the Technical Specification on ISI and submitted a preliminary copy of the proposed change with their original submittal (response to Generic Letter 88-01).

The Brunswick 1 Technical Specification pertaining to leakage detection is already in conformance with most aspects of the NRC Staff position (as delineated in Generic Letter 88-01) including conformance to Position C of Regulatory Guide 1.45, leakage limits, description of unidentified leakage, and operability of measurement instruments. CP&L has committed to follow NRC guidelines on frequency of leakage measurements, but they proposed that the controlling document should be another document rather than the Technical Specification (TS). This does not carry the same weight as a statement in the TS.

As a result of this technical evaluation, the following recommendations are made:

(1) Acceptance of CP&L's IGSCC classifications of all welds except for the two partially inaccessible welds currently classified as IGSCC Category C. CP&L should reclassify those two welds

as IGSCC Category G. CP&L should also either advance their plans concerning improvement of inspections or apply another method of assuring the integrity of those welds.

(2) Acceptance of CP&L's plan to replace the IGSCC Category D welds that have limitations on accessibility for inspection.

(3) Acceptance of CP&L's Inservice Inspection Program for accessible welds at Brunswick 1.

(4) Acceptance of CP&L's position concerning a change to the Technical Specification on ISI.

(5) Acceptance of CP&L's position concerning leakage detection at Brunswick 1 except for their position on frequency of leakage measurements. CP&L should add a statement to the TS on leakage to assure that leakage is monitored at approximately four hour intervals or less.

(6) Acceptance of the remaining portions of the CP&L Submittals.

5. REFERENCES

1. "Technical report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping," NUREG 0313, Revision 2, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, January, 1988.

2. "Investigation and Evaluation of Stress-Corrosion Cracking in Piping of Light Water Reactor Plants," NUREG 0531, U. S. Nuclear Regulatory Commission, February, 1979.

3. "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping," Generic Letter 88-01, U.S. Nuclear Regulatory Commission, January 25, 1988.

FINAL

TECHNICAL EVALUATION REPORT ON RESPONSE FROM CAROLINA POWER AND LIGHT COMPANY TO GENERIC LETTER 88-01 PERTAINING TO THE BRUNSWICK STEAM ELECTRIC PLANT, UNIT 2

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ABSTRACT

This report contains an evaluation of the licensee (Carolina Power and Light Company) submittal for Brunswick Steam Electric Plant, Unit 2 which was submitted in response to the NRC Generic Letter 88-01 in which Carolina Power and Light was requested to: (1) Furnish their current plans relating to piping replacement and other measures to mitigate IGSCC, inspection, repair, and leakage detection. (2) Indicate whether they plan to follow the NRC Staff positions, or propose alternative measures. Carolina Power and Light Company's plans are evaluated in Section 2 of this report in terms of compliance to NRC Staff positions. Although Carolina Power and Light Company follows the NRC Staff guidelines pertaining to leakage detection including frequency of leakage monitoring, they proposed that the requirement for leakage monitoring be included in a document other than the Technical Specification. This alternative proposal is discussed in Section 2.7 of this report.

SUMMARY

The Licensee, Carolina Power and Light Company (CP&L), submitted a response to the NRC Generic Letter 88-01. CP&L's response pertaining to the austenitic stainless steel piping in the Brunswick Steam Electric Plant, Unit 2 (a BWR nuclear power plant) was evaluated in terms of: (1) Their previous and planned actions to mitigate IGSCC to provide assurance of continued long-term service. (2) Their Inservice Inspection (ISI) Program. (3) Their Technical Specifications pertaining to ISI and their plans to ensure that leakage detection will be in conformance with the NRC Staff position. (4) Their plans to notify the NRC of significant flaws identified (or changes in the condition of the welds previously known to be cracked) during inspection.

CP&L endorses all of the 13 NRC Staff positions which are outlined in Generic Letter 88-01; however, they attached a provision to that on Hydrogen Water Chemistry that they reserve judgment until operating data are available on the use of HWC at Brunswick 2. Also, they proposed that the control of the four-hour monitoring requirement for leakage be contained in an alternate document to the Technical Specification (TS).

Extensive mitigating actions have been performed at Brunswick 2 including piping replacement, solution heat treating, stress improvement (using both IHSI and MSIP), and application of weld overlays. Additional piping replacement is planned including 23 of 25 IGSCC Category G welds and additional recirculation system piping.

An ISI program proposed for Brunswick 2 conforms with the NRC Staff positions on schedule, methods and personnel, sample expansion, and reporting requirements. A list of welds to be inspected was provided, and a preliminary draft of a proposed change to the Technical Specification on ISI to conform with the NRC Staff position was submitted.

CONTENTS

1. INTRODUCTION

Intergranular stress corrosion cracking (IGSCC) near weldments in Boiling Water Reactor (BWR) piping has been occurring for almost 20 years. Substantial efforts in research and development have been sponsored by the BWR Owners Group for IGSCC Research, and the results of this program, along with other related work by vendors, consulting firms and confirmatory research sponsored by the NRC, have permitted the development of NRC Staff positions regarding the IGSCC problems. The technical basis for NRC Staff positions is detailed in Reference 1, and further background is provided in Reference 2.

The results of these research and development programs prompted the NRC to issue Generic Letter 88-01 (see Reference 3) requesting all licensees of BWR's and holders of construction permits to:

(1) Furnish their current plans relating to piping replacement, inspection, repair, and leakage detection.

(2) Indicate whether they:
   (a) Plan to follow the staff positions, or
   (b) Propose alternative measures.

Specifically, Generic Letter 88-01 stated that an acceptable licensee response would include the following items:

(1) Current plans regarding pipe replacement and/or other measures taken or to be taken to mitigate IGSCC and provide assurance of continued long-term piping integrity and reliability.

(2) An inservice inspection (ISI) program to be implemented at the next refueling outage for austenitic stainless steel piping.

(3) A change to the Technical Specifications to include a statement

in the section on ISI that the inservice inspection program for piping will be in conformance with the staff positions on schedule, methods and personnel.

(4) Confirmation of plans to ensure that the Technical Specification related to leakage detection will be in conformance with the Staff position on leak detection.

(5) Plans to notify the NRC, in accordance with 10CFR50.55a(o), of any flaws identified that do not meet IWB-3500 criteria of Section XI of the ASME Code for continued operation without evaluation, or a change found in the condition of the welds previously known to be cracked, and an evaluation of the flaws for continued used operation and/or repair plans.

This report contains a technical evaluation of the response which Carolina Power and Light Company (called CP&L in this report) submitted in response to the NRC Generic Letter 88-01 pertaining to the Brunswick Steam Electric Plant, Unit 2 (hereafter called either Brunswick 2 or BSEP 2).

2. EVALUATION OF RESPONSE TO GENERIC LETTER 88-01

This evaluation consisted of a review of the response to NRC Generic Letter 88-01 of January 25, 1988 by Carolina Power pertaining to Brunswick 2 to determine if their performance and plans are in conformance with the NRC Staff positions or if proposed alternatives are acceptable. Proposed inspection schedules and amendments to the Technical Specification were included in the review.

2.1 Documents Evaluated

Review was conducted on the information pertaining to Brunswick

2 provided by the Licensee in the following documents.

(1) "Response to Generic Letter 88-01 and IGSCC Inspection Plans - BSEP-1 Refueling Outage 6, Brunswick Steam Electric Plant, Units 1 and 2, Docket Nos. 50-325 and 50-324, License Nos. DPR-71 and DPR-62," Carolina Power & Light Company, P.O. Box 1551, Raleigh, NC 27602, July 18, 1988.

(2) "Response to Staff's Request for Additional Information Pertaining to Carolina Power & Light Company's Response to Generic Letter 88-01, Brunswick Steam Electric Plant, Units 1 and 2, Docket Nos. 50-325 and 50-324, License Nos. DPR-71 and DPR-62," Carolina Power & Light Company, P.O. Box 1551, Raleigh, NC 27602, July 29, 1989.

Hereafter, in this report, these documents will be referred to as CP&L Submittals No. 1 and No 2, respectively, and collectively as the CP&L Submittals.

2.2 Review of CP&L's Responses to Staff Positions and Implementation of Those Positions.

Generic Letter 88-01 outlines thirteen NRC Staff positions pertaining to (1) materials, (2) processes, (3) water chemistry, (4) weld overlay, (5) partial replacement, (6) stress improvement of cracked weldments, (7) clamping devices, (8) crack evaluation and repair criteria, (9) inspection methods and personnel, (10) inspection schedules, (11) sample expansion, (12) leak detection, and (13) reporting requirements. Generic Letter 88-01 states that the licensee should indicate in their submittal whether they endorse these NRC Staff positions or propose alternative positions. CP&L Submittal No. 1 did not specifically state acceptance or rejection of most of the thirteen NRC Staff positions, but the CP&L positions

on several of the thirteen items were implied in discussions in CP&L Submittal No. 1, and additional information was provided in CP&L Submittal No. 2. These positions are presented in Table 1.

Note that CP&L indicated endorsement of all thirteen NRC Staff positions, although they applied provisions to one, i.e., that pertaining to Hydrogen Water Chemistry (HWC). Concerning HWC, installation of HWC system for both Brunswick 1 and 2 is currently in progress, but CP&L reserves judgment on this Staff position until it has been fully developed. Concerning leakage detection, although CP&L endorses the NRC Staff position, as discussed in Section 2.7 of this report, requirements for frequency of leakage monitoring comply with the NRC Staff position, but they are not contained in the Technical Specification. Rather they are contained in an alternate document.

2.3 Review of Previous Mitigating Actions Classification of Welds, and Previous Inspections

2.3.1 Summary of Previous Mitigating Actions and IGSCC Classifications of Welds

According to CP&L Submittal No. 1, CP&L replaced portions of the austenitic stainless steel primary coolant piping in Brunswick, Unit 2. Other mitigating actions included the application of either (or both) SI and weld overlays to several welds.

CP&L Submittal No. 2 contains additional information concerning mitigating treatments at Brunswick 2. That information is quoted below:

"Partial replacement of susceptible piping systems with

Table 1

Summary of CP&L's Responses to Staff Positions

Staff Position	CP&L Accepts NRC Staff Position	CP&L Has/Will Applied In Past	CP&L Has/Will Consider for Future Use
1. Materials	yes	yes[a]	yes[a]
2. Processes	yes	yes[b]	yes
3. Water Chemistry	yes[c]	yes[c]	yes[c]
4. Weld Overlay	yes	yes	possible
5. Partial Replacement	yes	yes	yes
6. Stress Improvement of Cracked Weldments	yes	yes	yes
7. Clamping Devices	yes	yes	possible
8. Crack Evaluation and Repair Criteria	yes	yes	yes
9. Inspection Method and Personnel	yes	yes	yes
10. Inspection Schedule	yes	yes	yes
11. Sample Expansion	yes	yes	yes
12. Leak Detection	yes	yes	yes
13. Reporting Requirements	yes	yes	yes

(a) CP&L redefined the susceptible weld population after issuance of NUREG 0313, Rev. 2 and thereby increased the susceptible weld population.

(b) CP&L has applied SHT and SI but not HSW.

(c) CP&L is currently installing Hydrogen Injection System for BSEP Units 1 and 2. They reserve judgement on this item until it has been fully developed.

carbon steel material or resistant stainless steel materials."

"Stress improvement of selected weldments, using both the Induction Heating Stress Improvement Process, and Mechanical Stress Improvement Process."

"Weld overlay reinforcement to repair flaws detected in reactor recirculation system welds."

Based on NUREG 0313, Revision 2, CP&L determined that the susceptible weld population at Brunswick 2 consists of 264 welds. This number includes 85 welds in the non-code classified, non-safety related portion of the RWCU system, so that prior to the issuance of NUREG 0313, Revision 2, CP&L included only 180 welds in the susceptible population in Brunswick 2.

A summary of classifications of welds by IGSCC Categories and of previous actions taken to mitigate IGSCC for Brunswick 2 is shown in Table 2 of this report. This table, a review of which provides easy visualization of the reasons for CP&L's classifications (with certain exceptions noted below), was generated from a comprehensive table contained in CP&L Submittal No. 2. The CP&L table contains a weld-by-weld list which provides the identification, system, configuration, diameter, material, and mitigating treatment(s) for each weld.

The mitigating treatments are discussed in greater detail in the following sections.

Table 2

Summary of IGSCC Classifications and
Mitigating Treatments at Brunswick 2

IGSCC	No. of	No. with	Number with Indicated Treatment				
Categ	Welds	Res. Matl.	SHT	MSIP	IHSI	SI+O.L.	O.L.
A	100	92	8				
B	0						
C	70			13	57		
D	26						
E	41					8	33
F	2			2			
G	25	see note (a)					
Totals	264	92	8	15	57	8	33

(a) The table of welds in CP&L Submittal No. 2 shows 23 of the IGSCC Category G welds (all in the RWCU) have resistant material (316L base metal and 308L weld metal), but those listings must be erroneous since CP&L Submittal No. 1 states that those welds contain non-resistant material and are scheduled for replacement.

2.3.2 Partial Replacement and Solution Heat Treating

Ninety-two welds were replaced using corrosion resistant, low-carbon stainless steel. Systems that were replaced included the reactor recirculation discharge valve bypass lines and a portion of the RWCU system. These welds are correctly classified as IGSCC Category A welds. The core spray piping was replaced with carbon steel, and the core

spray safe-ends were replaced with Inconel Alloy 600. No core spray welds are currently listed in the weld population.

Eight welds were solution heat treated, according to the CP&L Submittals and these welds are classified as IGSCC Category A welds.

The table in CP&L Submittal shows 23 of the IGSCC Category G welds (all in the RWCU) have resistant material (Type 316L base metal and Type 308L weld metal), but those listings must be erroneous since CP&L Submittal No. 1 states that those welds contain non-resistant material and are scheduled for replacement.

2.3.3 Stress Improvement

According to CP&L Submittal No. 1, Induction Heating Stress Improvement (IHSI)) was performed on 65 welds in the reactor recirculation system during Refueling Outage 6 in 1986. In addition 15 Inconel buttered safe-end to nozzle welds were treated with the Mechanical Stress Improvement Process (MSIP). Subsequently, weld overlays were applied to eignt of the IHSI-treated welds to repair flaws. Small axial indications were also found in two of the MSIP-treated welds, but these welds were judged satisfactory for temporary service without repair and were classified as IGSCC Category F welds. The 70 uncracked, stress-improved welds were classified as IGSCC Category C welds.

2.3.4 Weld Overlays

As indicated above, weld overlays were applied to eight cracked welds which had been treated with a stress improvement process. In addition, weld overlays were applied to 33 other cracked

welds (for a total of 41 weld overlays). CP&L Submittal No. 1 states that four of the overlays were designed overlays and 37 are standard overlays. These 41 welds are classified as IGSCC Category E welds.

2.3.5 Hydrogen Water Chemistry

According to CP&L Submittal No. 2, a Hydrogen Water Chemistry (HWC) system has been installed at Brunswick 2.

2.3.6 Previous Inspection Programs

CP&L Submittal No. 2 contains a list of welds that were inspected during Refueling Outages 5 through 7 (1984 through 1988). A similar list is contained in CP&L Submittal No. 1. Concerning methods and personnel: CP&L Submittal No. 1 states that future inspections "will continue to be performed employing both equipment and personnel qualified in accordance with the most current NRC/EPRI BWROG coordination." The word "continue" implies that past inspections were similarly conducted; however, it is presumed that only those inspections performed during Refueling Outages No. 6 and No. 7 are so qualified since Refueling Outage No. 5 occurred prior to September, 1985 (the date of upgrading of the coordination plan referenced in NUREG 0313, Revision 2). Thus, credit should be granted towards the inspection program (in terms of compliance with NRC Staff guidelines as delineated by Generic Letter 88-01) for inspections conducted at Brunswick 2 during Refueling Outages Nos. 6 and 7, but not those conducted during Refueling Outage No. 5.

During refueling Outages No. 6 and 7, all except for four of the IGSCC Category C, D, E, and F welds were inspected at least once. In addition 25 IGSCC Category A welds were

inspected (one of which was inspected twice) during those refueling outages. No flaws are reported in the CP&L Submittals except for flaws in the 41 IGSCC Category E welds (all of which were repaired with weld overlays as discussed above) and the two IGSCC Category F welds.

It should be noted that two welds classified as IGSCC Category C (i.e., 24A12 and 24B13) and five welds classified as IGSCC Category D (i.e., 12ARC4A, 12ARE4A, 12BRF4A, 12BRG4A, and 12BRH4A) are only partially inspectable. CP&L Submittal No. 2 explains the classifications of these despite the lack of inspectability:

> "As previously submitted to the Staff in CP&L's response to Generic Letter 88-01, there are nine welds in Unit 1 and seven welds in Unit 2 which had limited inspectability."
>
> "Four of these welds (24A12 and 24B13 in both units) have severe inspection limitations. CP&L is currently pursuing alternate inspection techniques which will allow a complete inspection to be performed. If the alternate inspection techniques do not provide the required coverage, CP&L will consider other repair methods, one of which will require the addition of weld material (weld overlay) to provide a surface suitable for the UT inspection of the weld joints. These four welds were classified as IGSCC Category C welds because they have received stress improvement (IHSI), and have no known cracks, and are not made of resistant materials."

The remaining twelve welds are the same configuration. They are the recirculation system 12' pup piece to safe end welds. These welds have only recently become limited

from an inspection standpoint because of the addition of a weld overlay on the adjacent (upstream) weld. The addition of the overlay on the adjacent weld has restricted the inspection to one side only, which is not in conformance with Section 5.2.1 of NUREG-0313, Revision 2. However, previous (pre-overlay) inspections were performed on these welds and were acceptable. These welds were classified as IGSCC Category D welds because they are not made with resistant material, and have not been given an SI treatment, but were previously inspected and found to be free of cracks. In addition, due to CP&L's commitment to replace recirculation piping in Unit 1 in 1990, and in Unit 2 by 1991, all 12 of these welds will be replaced."

2.3.7 Evaluation of Previous Mitigating Actions and Previous Inspections

An extensive program has been conducted at Brunswick 2 following guidelines presented in Generic Letter 88-01 and NUREG 0313, Revision 2. That program consisted of piping replacement, solution heat treating, stress improvement, and weld overlays. The result is that all except 51 welds (of a total of 264) at Brunswick 2 are unmitigated, susceptible welds (26 IGSCC Category D and 26 IGSCC Category G). The remaining welds consist of: 100 IGSCC Category A welds, 70 IGSCC Category C welds, 41 IGSCC Category E welds, and 2 IGSCC Category F welds.

Inspections performed at Brunswick 2 during the last two refueling outages were conducted in conformance with the NRC Staff position in terms of schedules and methods and personnel.

Based on information supplied in the CP&L Submittals, the

IGSCC classifications are correctly assigned to most of the welds in Brunswick 2. However, welds 24A12 and 24B13 did not receive complete inspections because of limited accessibility. Each of these welds was treated with IHSI, but such treatment must be followed by inspection to warrant a classification as IGSCC Category C. Without such an inspection, they should be considered IGSCC Category G (see NUREG 0313, Revision 2, Section 5.3.1.7). In addition, some question exists concerning whether four of the IGSCC Category D welds were inspected; however, as discussed in Section 2.5, those four welds are scheduled for inspection during the next refueling outage (scheduled for August, 1989).

2.4 Current Plans for Mitigating Actions

2.4.1 CP&L's Plans for Future Actions

CP&L Submittal No. 1 contains the following plans for future mitigating actions:

> "Replacement: The remaining susceptible portions of the RWCU system will be replaced using a low carbon wrought austenitic stainless steel material, per NUREG-0313, Revision 2."
>
> "Repairs: Based upon the results of examinations, welds found to be unacceptable for continued operation will be repaired by either a weld overlay or a piplock."

CP&L Submittal No. 1 also states that the replacement of the IGSCC Category G welds in the RWCU will occur during Refueling Outage No. 8 (scheduled for August, 1989).

In addition to the above, CP&L Submittal No. 2 states the following concerning the five IGSCC Category D welds (described in Section 2.3.6) which became partially inaccessible subsequent to previous inspections:

> "... These welds were classified as IGSCC Category D welds because they are not made with resistant materials, and have not been given an SI treatment, but were previously inspected and found to be free of cracks. In addition, due to CP&L's commitment to replace recirculation piping ... all of these welds will be replaced."

In addition to the above actions, CP&L plans to operate the Hydrogen Water Chemistry system that was scheduled for completion in 1988.

2.4.2 Evaluation and Recommendation

Since (1) extensive mitigating actions have already been applied at Brunswick 2 (with the result that 230 of the 262 welds within the scope of Generic Letter 88-01 have been replaced, stress improved, or repaired with standard weld overlays), (2) additional recirculation piping is scheduled for replacement, (3) the remaining unmitigated welds in the RWCU are scheduled for replacement, (3) operation of the Hydrogen Water Chemistry system should further reduce the occurance of IGSCC, CP&L's plan concerning mitigating treatments follows the guidelines of Generic Letter 88-01. Therefore, acceptance of CP&L's plan is recommended.

2.5 Plans for Future Inspections

2.5.1 Summary of Inspection Schedule

CP&L Submittal No. 2 contains a list of past inspection schedules (on a weld-by-weld basis) for for the last three refueling outages (nos. 5, 6, and 7 which occurred in 1984, 1986, and 1988, respectively) and planned schedules for future refueling outages through 1995 (Refueling Outages No. 8 through 11). Table 3 contains a summary of those schedules, showing the number of welds in each IGSCC category (as presently classified) conducted/scheduled during each of those refueling outages. Also included in Table 3 are requirements for welds of each IGSCC classification as detailed in Generic Letter 88-01 and NUREG 0313, Revision 2. Note that with the exception of the partially inaccessible welds discussed in Sections 2.3.6 and 2.5.2 of this report, CP&L's plans completely comply with the NRC Staff position, providing that credit is allowed for inspections conducted during Refueling Outages No. 6 and No. 7. As discussed in Section 2.3.6 of this report, such credit should be allowed.

2.5.2 Inaccessible Welds

As discussed in Section 2.3.6 of this report, two IGSCC welds classified as IGSCC Category C (24A12 and 24B13) should properly be classified as IGSCC Category G because they have severe inspection limitations, so they were not completely inspected following IHSI treatments. Plans for these welds are to either pursue alternate inspection techniques which will allow complete inspections to be performed, or apply weld overlays to provide surfaces suitable for UT inspections. Inspections of these welds are scheduled for Refueling Outage No. 8 (the next refueling outage).

Table 3

Summary of Inspection Schedules for Brunswick 2
for Refueling Outages 5 through 11 (1984 through 1995)

IGSCC Categ.	No. in Categ.	No. Inspected/Scheduled During Indicated R.O. Past 05	Past 06	Past 07	Future 08	Future 09	Future 10	Future 11	Required by Generic Letter 88-01
A	100	7	23	3	4	3	5	5	25% every 10 years (at least 12% in 6 years)
B	0	-	-	-	-	-	-	-	50% every 10 years (at least 25% in 6 years)
C	70	58	63	41	36	16	11	13	All within the next 2 refueling cycles, then all every 10 years (at 50 % in 6 years)
D	25(a)	2	22	15	21	11	13	13	All every 2 refueling cycles
E	41	41	41	23	20	21	20	21	50% next refueling cycle, then all every 2 refueling cycles
F	2	2	2	2	2	2	2	1	All every refueling outage
G	25(b)	0	0	0	2	1	1	1	All next refueling cycle

(a) Four welds classified as IGSCC Category D have not been inspected during period shown. These welds are scheduled for inspection during R.O.#8.

(b) The 23 IGSCC Category G welds not scheduled for inspection are scheduled for replacement during R.O.#8. The other two IGSCC Category G welds will be inspected during R.O.#8, reclassified, and thereafter inspected as IGSCC Category D.

Refueling Outage Dates are as follows:

R.O.#	Date	R.O.#	Date	R.O.#	Date
05	03/84-10/84	08	08/89-11/89	10	1993
06	11/85-06/86	09	1992	11	1995
07	01/88-04/88				

Also, as discussed in section 2.3.6 of this report, five IGSCC Category D welds are partially inaccessible for inspection. As described in section 2.4, CP&L plans to replace these welds.

2.5.3 Methods and Personnel

CP&L Submittal No. 1 states the following:

> "Ultrasonic examinations will continue to be performed employing both equipment and personnel qualified in accordance with the most current NRC/EPRI/BWROG coordination plan."

2.5.4 Sample Expansion

CP&L Submittal No. 1 states the following:

> "At the present time, CP&L plans to adhere to the provisions set forth in the Staff positions for flaws detected and determined to be caused by IGSCC. However, flaws initiated or caused by other mechanisms will be evaluated at that time as to determining the need for additional examinations within the provisions of Section XI of the ASME Code."

2.5.5 Evaluation and Recommendations

Since CP&L's inspection plans for accessible welds, including schedules, methods and personnel, and sample expansion comply with the NRC Staff positions on these items, acceptance of their plans is recommended. Acceptance of CP&L's plans for the five partially inaccessible IGSCC Category D welds is also recommended since these welds are scheduled for

replacement during the next refueling outage.

Plans to develop alternate inspection techniques or apply weld overlay built-ups to improve inspectability for the two welds that have severe inspection limitations (24A12 and 24B13) should be pursued since they will, if successful, eliminate current inspection limitations. Thus, acceptance of CP&L's plans concerning these welds is recommended.

2.6 Changes in the Technical Specification Concerning ISI

2.6.1 CP&L's Position

CP&L Submittal No. 1 contains the following statement:

> "Generic Letter 88-01 provides guidance for a revision to the Technical Specification Surveillance Requirements to include a statement that the ISI program for piping covered by the scope of Generic Letter 88-01 will be in conformance with the Staff positions. Preparation of the documentation to affect this change in the Technical Specifications for both BSEP units is presently being performed. Enclosure 7 to this letter provides a preliminary draft of the proposed changes. Submittal of these changes is contingent on concurrence by the NRC Staff with the response provided in this letter. This will ensure that CP&L will be in conformance with the Staff positions as presented in Generic Letter 88-01 and NUREG 0313, Revision 2."

2.6.2 Evaluation and Recommendation

CP&L's position is in compliance with the NRC Staff position

and they have submitted a preliminary draft of the change to the Technical Specification. Thus, acceptance of CP&L's position is recommended.

2.7 Confirmation of Leak Detection in the Technical Specification

2.7.1 CP&L's Position

Table 4, reproduced from CP&L Submittal No. 2, summarizes CP&L's position regarding requirements for leakage detection as delineated in Generic Letter 88-01.

In addition CP&L Submittal No. 1 contains the following comments pertaining to leakage requirements:

> "Currently the BSEP Technical Specifications require that plant shutdown be initiated for inspection and corrective action when any leakage detection indicates, within any period of 24 hours, an increase in unidentified leakage in excess of 2 gpm, or when total unidentified leakage attains a rate of 5 gpm as averaged over any 24 hour period."
>
> "Additionally, CP&L has committed via correspondence to the Staff to the following items: (1) For sump level monitoring systems with fixed measurement-interval methods, the level shall be monitored at 4 hour intervals or less. (2) At least one of the leakage measurement instruments associated with each sump shall be operable and the outage time for inoperable instruments shall be limited to 24 hours. Otherwise, an orderly shutdown will be immediately initiated."

Table 4

Licensee Positions on Leakage Detection

Position	Already Contained in TS	TS will be Changed to Include	Alternate Position Proposed
1. Conforms with Position C of Regulatory Guide 1.45	yes	-	-
2. Plant shutdown should be initiated when:			
(a) within any period of 24 hours or less, an increase is indicated in the rate of unidentified leakage in excess of 2 gpm, or	yes	-	-
(b) the total unidentified leakage attains a rate of 5 gpm.	yes	-	-
3. Leakage monitored at four hour intervals or less.	-	-	yes[(a)]
4. Unidentified leakage includes all except:	yes	-	-
(a) leakage into closed systems, or			
(b) leakage into the containment atmosphere from sources that are located, do not interfere with monitoring systems, or not from throughwall crack.			
5. Provisions for shutdown within 24 hours due to inoperable measurement instruments in plants with Category D, E, F, or G welds.	yes	-	-

(a) The leakage monitoring is governed by BSEP/Vol. VII/OI-03.1 (Attachment 1, page 11 thru 17), which stipulates that leakage shall be monitored in approximately 4 hour intervals.

"Based upon the above requirements and commitments, CP&L actions pertaining to leakage detection are in conformance with the Staff's positions outlined in Generic Letter 88-01."

2.7.2 Evaluation and Recommendation

Generic Letter 88-01 requires that the Technical Specification related to leakage detection will be in conformance with Position C of Regulatory guide 1.45 and the following NRC Staff positions: (1) Leakage limits. (2) Frequency of leakage monitoring. (3) Description of unidentified leakage. (4) Operability of monitoring instruments. According to the CP&L Submittals, the Brunswick 2 Technical Specification conforms with all of the above items except for Item 2 on frequency of leakage monitoring, so acceptance of CP&L's positions on items other than Item 2 is recommended. Although CP&L Submittal No. 1 contains a commitment to adhere to the requirement to monitor leakage at approximately four hour intervals, as required by the NRC Staff, CP&L Submittal No. 2 states that the commitment is contained in an alternate document rather than the Technical Specification. It is recommended, therefore, that the Brunswick 2 Technical Specification should be changed to incorporate the four hour requirement for monitoring leakage.

2.8 Plans for Notification of the NRC of Flaws

2.8.1 CP&L's Position

CP&L Submittal No. 1 states:

"Plans to notify the NRC of inspection results,

evaluations, and actions to be taken regarding IGSCC related flaws will continue as they are presently formulated. Inspection plans will be submitted three months prior to the start of a refueling outage on either BSEP-1 or BSEP-2."

"Flaws or changes found in the condition of welds which do not meet ASME Code Section XI criteria will be reported in a Licensee Event Report (LER) within 30 days, if applicable, or through direct contact with the Staff in cases where a significant indication is detected as was done during the recently completed Refueling Outage 7 on BSEP-2 for the flaw found in the 12" reactor recirculation nozzle."

"The results of specific inspections and the scope of mitigation and/or repairs which are performed during the refueling outages will be submitted to the Staff prior to startup of the unit."

2.8.2 Evaluation and Recommendation

CP&L's position complies with the NRC Staff position, so acceptance of their position is recommended.

3. ALTERNATIVE POSITIONS

CP&L did not present any alternative positions to the NRC Staff positions as delineated in Generic Letter 88-01 except for that on frequency of leakage monitoring previously discussed (Section 2.7 of this report).

4. CONCLUSIONS AND RECOMMENDATIONS

CP&L stated that they endorse all of the thirteen NRC Staff positions delineated in Generic Letter 88-01 (i.e., those pertaining to materials, processes, water chemistry, weld overlay, partial replacement, stress improvement of cracked weldments, clamping devices, crack evaluation and repair criteria, inspection methods and personnel, inspection schedules, sample expansion, leak detection, and reporting requirements). They also stated that they applied provisions to their endorsement of the NRC Staff position on HWC, i.e., they wish to reserve judgment until HWC installed at Brunswick is fully evaluated. In addition, although they accept leakage requirements proposed in Generic Letter 88-01, they proposed that the governing document for one item (frequency of leakage measurements) be a document other than the Technical Specification.

Prior to operation and during several refueling outages, CP&L extensively applied piping replacement, solution heat treatments, and stress improvement treatments to piping/welds within the scope of Generic Letter 88-01 at Brunswick 2. In addition they applied weld overlays to 41 cracked welds, and they applied MSIP to two welds containing small axial indications. These actions followed the guidelines of Generic Letter 88-01. The result is that 100 of the 264 welds within the scope of Generic Letter 88-01 are IGSCC Category A, 70 welds are IGSCC Category C, 41 welds are IGSCC Category E, and 2 welds are IGSCC Category F. Fifty-one welds have not received any mitigating treatments. Twenty-six of these welds have been inspected, found to be free of cracks, and classified as IGSCC Category D welds. Twenty-three of the remaining 25 welds (classified as IGSCC Category G welds) are contained in the RWCU and are scheduled for replacement. Other plans for future mitigation treatments include replacement of additional replacement of piping in the recirculation system (including five welds that are currently partially inaccessible for inspection), performance of repairs as needed using overlays or pipelock, and

operation of the hydrogen water chemistry system.

CP&L provided an extensive list of inspections that have been performed during the last three refueling outages. Inspection schedules and inspection methods and personnel during the last two of those refueling outages were performed in accordance with NRC Staff guidelines (concerning both schedules and methods and personnel). An Inservice Inspection Program (ISI) has been developed for the future for Brunswick 2 which complies with the requirements of Generic Letter 88-01 pertaining to schedule, methods and personnel, sample expansion, and plans for reporting flaws. A list of welds that are included in the ISI program was supplied including weld numbers, configuration, mitigating treatments, and IGSCC classifications. The identities of the specific welds to be inspected during the next several refueling outages were also supplied.

Two welds were classified as IGSCC Category C which should have been classified as IGSCC Category G because inadequate accessibility prohibited complete inspections following IHSI treatments. CP&L plans to develop new inspection techniques or modify the welds to permit inspection. These welds are scheduled for inspection in 1989.

CP&L agreed to change the Technical Specification on ISI and submitted a preliminary copy of the proposed change with their original submittal (response to Generic Letter 88-01).

The Brunswick 2 Technical Specification pertaining to leakage detection is already in conformance with most aspects of the NRC Staff position (as delineated in Generic Letter 88-01) including conformance to Position C of Regulatory Guide 1.45, leakage limits, description of unidentified leakage, and operability of measurement instruments. CP&L has committed to follow NRC guidelines on frequency of leakage measurements, but they proposed that the controlling document should be another document rather than the Technical Specification (TS).

This does not carry the same weight as a statement in the TS.

As a result of this technical evaluation, the following recommendations are made:

(1) Acceptance of CP&L's IGSCC classifications of all welds except for the two partially inaccessible welds currently classified as IGSCC Category C. CP&L should reclassify those two welds as IGSCC Category G. However, acceptance of CP&L's plans for inspections of these welds (including their plans to either modify inspection techniques or provide weld overlays to enhance inspectability) is recommended.

(2) Acceptance of CP&L's plan's for additional mitigating actions including replacement of additional recirculation system piping and RWCU piping.

(3) Acceptance of CP&L's Inservice Inspection Program for accessible welds at Brunswick 2.

(4) Acceptance of CP&L's position concerning a change to the Technical Specification on ISI.

(5) Acceptance of CP&L's position concerning leakage detection at Brunswick 2 except for their position on frequency of leakage measurements. CP&L should add a statement to the TS on leakage to assure that leakage is monitored at approximately four hour intervals or less.

(6) Acceptance of the remaining portions of the CP&L Submittals.

5. REFERENCES

1. "Technical report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping," NUREG 0313, Revision 2, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, January, 1988.

2. "Investigation and Evaluation of Stress-Corrosion Cracking in Piping of Light Water Reactor Plants," NUREG 0531, U. S. Nuclear Regulatory Commission, February, 1979.

3. "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping," Generic Letter 88-01, U.S. Nuclear Regulatory Commission, January 25, 1988.