CP&L
A Progress Energy Company

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BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
DOCKET NOS. 50-325 AND 50-324/LICENSE NOS. DPR-71 AND DPR-62
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING REQUEST FOR LICENSE AMENDMENTS - FREQUENCY OF PERFORMANCE-BASED LEAKAGE RATE TESTING
(NRC TAC NOS. MB3470 AND MB3471)

Ladies and Gentlemen:

On November 26, 2001 (Serial: BSEP 01-0070), Carolina Power & Light (CP&L) Company submitted a license amendment application for the Brunswick Steam Electric Plant (BSEP), Units 1 and 2. The proposed license amendments revise Technical Specification 5.5.12, "Primary Containment Leakage Rate Testing Program," to incorporate a one-time exception to the 10-year frequency for performance-based Type A leakage rate tests. During a telephone conference call on January 24, 2002, the NRC requested information on CP&L's actions taken in response to three drywell liner defects identified during the Spring 1999, refueling outage for BSEP, Unit 2. In a subsequent telephone conference call on February 1, 2002, the NRC also requested information regarding the BSEP containment inspection program. The requested information is enclosed.

Please refer any questions regarding this submittal to Mr. Leonard R. Beller, Manager - Regulatory Affairs, at (910) 457-2073.

Sincerely,

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WRM/wrm

Enclosure: Response to Request for Additional Information (RAI)

John S. Keenan, having been first duly sworn, did depose and say that the information contained herein is true and correct to the best of his information, knowledge and belief; and the sources of his information are officers, employees, and agents of Carolina Power & Light Company.

Notary (Seal)

My commission expires: 8/29/04

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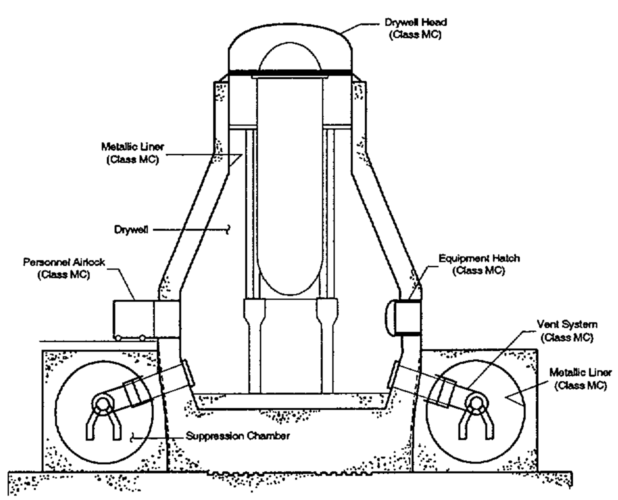
## Containment Description

BSEP Units 1 and 2 are BWR-4s with Mark I steel-lined, reinforced concrete primary containments (i.e., refer to Figure 1). The concrete primary containment is comprised of three major components: (1) Drywell, (2) Suppression Chamber, and (3) Vent System.

Figure 1



The Drywell is composed of a series of vertical right cylinders and truncated cones with inside diameters between approximately 65 feet to 36 feet. The overall height from the top of the foundation mat to the Drywell head flange is approximately 111 feet. The Drywell is sealed at the top with a steel pressure vessel head bolted to the reinforced liner plate extension that is in turn anchored to the reinforced concrete.

The Suppression Chamber (i.e., also referred to as the Torus) is a 16-sided steel liner, reinforced concrete pressure vessel in a shape of a torus. The Suppression Chamber is approximately 40 percent filled with water and encircles the lower portion of the Drywell structure.

The Vent System connects the Drywell and the Suppression Chamber. Eight circular vent lines (i.e., approximately 76 inches in diameter), equally spaced around the periphery of the Drywell, connect the Drywell to a vent ring header contained within the air space of the Suppression Chamber. Projecting downward from the vent ring header are 96 downcomer pipes that terminate below the water level in the Suppression Chamber. For clarification, only the eight vent lines are part of the primary containment leakage boundary.

Containment Inspection Program

In accordance with 10 CFR 50.55a(b)(2)(vi), CP&L prepared the Containment Inspection Program for the First Containment Inspection Interval to comply with the applicable requirements of the 1992 Edition with the 1992 Addenda of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, Subsection IWE and IWL. The scope of this program includes the inspection of components classified as Class MC and Class CC, subject to the limitation listed in paragraph (b)(2)(vi) and the applicable modifications listed in paragraph (b)(2)(viii) or (b)(2)(ix) of 10 CFR 50.55a.

The First Containment Inspection Interval for BSEP, Units 1 and 2, became effective on May 11, 1998, and will end on May 10, 2008. In accordance with IWE-2412 of the ASME Code, the First Containment Inspection Interval is divided into three successive Inspection Periods as determined by calendar years of plant service. The First, Second, and Third Inspection Periods are three (3), four (4), and three (3) years in length, respectively. The start and end dates for the three Inspection Periods are as follows:

| | |
|---|---|
| First Inspection Period: | May 11, 1998 to May 10, 2001 |
| Second Inspection Period: | May 11, 2001 to May 10, 2005 |
| Third Inspection Period: | May 11, 2005 to May 10, 2008 |

Extent of the Subsection IWE Examinations

The examinations required by Subsection IWE for the First Inspection Period have been completed on both units. In summary, a general visual examination (i.e., Examination

Category E-A, Item E1.11) was performed on the accessible surface area of primary containment in accordance with plant procedure 0PT-20.5.1, "Primary Containment Inspection."

In accordance with IWE-1220(b) of the ASME Code, Section XI, embedded or inaccessible portions of the containment vessel, parts, and appurtenances that met the requirements of the original Construction Code are exempt from examination. With exception of the surface areas listed below, the three major components of primary containment are accessible for examination:

- The exterior surfaces of the metallic liner backed up by reinforced concrete.
- The interior surfaces of the lower portion of the Drywell embedded in concrete (i.e., below the base mat).
- The surface areas of the metallic liner covered by leak channels, structural shapes, or weld pads.

Excluding the inaccessible areas discussed above, the examinations of the Drywell included one hundred percent of the accessible surface areas. The inaccessible portions of the Drywell are estimated to represent less than 10 percent of the Drywell's leakage boundary.

For the Suppression Chamber and Vent System, the examinations included 100 percent of the accessible surface above the water line. For the Suppression Chamber, the accessible surface area above the water line represents greater than 50 percent of the entire leakage boundary. For the Vent System, only the lower portion of the 96 downcomers is submerged.

Surface areas that are submerged or insulated are not required to be examined during the First and Second Inspection Period, as allowed by Examination Category E-A (i.e., Note 3). The areas that are necessary to meet the requirements of IWE-1231(a)(4) (i.e., submerged and insulated areas discussed above) will be examined during the Third Inspection Period.

Defect Description

The three defects in the Unit 2 Drywell, at approximately the 18 foot, 56 foot, and 70 foot elevations, were identified during the performance of a general visual examination in accordance with 0PT-20.5.1. The purpose of this procedure is to perform a visual examination to assess the general condition of the containment and to detect evidence of degradation that may affect structural integrity or leak tightness. This procedure is used to satisfy the applicable requirements of the ASME, Section XI, Subsections IWE and IWL.

The three defects were identified during the Spring 1999, refueling outage (i.e., B214R1). The applicable requirements of Subsection IWE were being implemented for the first time during this outage.

The defects on the Drywell liner plate at approximately the 18 foot and 70 foot elevations were initially identified as blistering of the coated surface. The procedure requires the IWE examiner

to record and investigate blistering that is greater than standard number 6 (i.e., medium) as specified in American Society of testing and Materials (ASTM) Standard D 714-87, "Standard Test Method for Evaluating Degree of Blistering of Paint." If the blistering exceeds this threshold, the procedure requires the IWE examiner to select at least two areas that represent the most severe degradation in that area, remove and clean the degraded products, and perform a visual examination of the non-coated surface for evidence of degradation.

The blistering at these elevations exceeded the threshold for blistering. As such, the examiner investigated these areas. After removal of the corrosion products at the 18 foot elevation, an approximately 5/16 inch diameter cylindrical through-wall defect was identified. In addition to the initial visual examination, ultrasonic thickness readings were taken immediately adjacent to the defect. Nominal material thickness readings were obtained, except for one subsurface indication. The subsurface indication was connected to the through-wall defect and was approximately 1/4 inch wide. The reduced thickness of this indication was approximately 1/8 inch on the backside of the liner plate. The nominal thickness of the liner plate at this location is 5/16 of an inch.

The surface diameter of the corrosion deposit associated with the defect at the 70 foot elevation was approximately 1/4 inch. Upon removal of corrosion products, the through-wall defect tapered down to approximately 1/8-inch diameter in the bottom of the pit. Ultrasonic thickness readings were also taken adjacent to the defect. Nominal material thickness readings were obtained. This area, which was located approximately 1 inch below the pit, was approximately 1/8 inch wide and 1/16 inch deep on the backside of the liner plate. The nominal thickness of the liner plate at this location is 5/16 of an inch.

Both of the above defects were removed and the examination of this excavated area revealed no evidence of degradation to the subsurface concrete or evidence of staining adjacent to the defect. The excavated areas were enlarged to allow access for the weld repair and the installation of a metal backing bar to support the weld repair. Prior to the installation of the backing bar, the IWL Responsible Engineer examined the exposed concrete surfaces. This examination revealed corrosion products on the surface of the concrete that were dry and powdered. No indication of moisture was present.

A small amount of concrete was removed to permit the installation of the metal backing bar. The examination of this excavated area revealed no evidence of degradation to the subsurface concrete or evidence of staining adjacent to the defect.

The root cause of the degradation mechanism for the defects at the 18 foot and 70 foot elevations was pitting corrosion. Pitting corrosion is defined as a localized corrosive attack, where the corrosion site is relatively small compared to the overall surface exposed to an electrolyte, or conductive liquid. Based on the examinations of the defects and exposed concrete surfaces, the pitting corrosion initiated on the coated surface of the liner plate due to a break in the protective

coating film. The pitting corrosion propagated though the liner plate due to the presence of moisture, chloride ions, and oxygen that localized the attack through galvanic action.

The initial examination of the defect at approximately the 56 foot elevation was a cluster of indications with presence of corrosion staining. Additionally, the IWE examiner identified a pronounced bulge in the liner plate at the exact location of these indications.

As instructed by the procedure, the IWE examiner removed the blisters and corrosion products. The visual examination revealed shallow subsurface corrosion in the liner plate. Again, ultrasonic thickness readings were taken adjacent to the degraded area. The thickness reading adjacent to the degraded areas averaged approximated 0.100 inches. The nominal thickness of the liner plate at this location is 5/16 of an inch.

Two small sections of the liner plate were removed to permit a visual examination. This visual examination revealed a deposit of corrosion product. As such, a section of the liner plate approximately 7 inches tall by 10 inches wide was removed. The removal of this section of plate revealed a corrosion deposit that was bright red in the location of the initial indications. Further excavation revealed cloth material from a work glove. After cleaning of the area, an examination of the concrete was performed by the IWL Responsible Engineer. This examination revealed no evidence of degradation to the concrete or evidence of staining adjacent to the excavated area.

The root cause of the defects at the 56 foot elevation was general corrosion from the concrete side on the liner plate. The corrosion was caused by the presence of a void in the concrete containing cloth debris. The void provided a collection point for oxygen and the cloth debris acted as a wick to collect moisture. The liner plate corroded, from the backside, in the presence of moisture and oxygen. Once the corrosion penetrated the liner plate, the corrosion accelerated due to a new source of moisture.

Defect Repair

The three defects were repaired in accordance with the ASME Code, Section XI, 1992 Edition, with 1992 Addenda. The repaired areas were examined in accordance with the applicable Construction Code and Design Specification. Once completed, the areas were re-examined, in accordance with Subsection IWE, to re-establish a baseline.

Leakage Test

As required by IWA-4720, the three repairs to the leakage boundary were to be tested in accordance with IWE-5000. Paragraph IWE-5221 required a pneumatic leakage test to be performed on each of these repairs in accordance with the provision of 10 CFR 50, Appendix J.

Currently, and during the First Inspection Period, BSEP is committed to the applicable requirements of 10 CFR 50, Appendix J, Option B. Specific guidance on the implementation of

an Option B, performance-base leakage test program is provided in NRC Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program." With some limitations, this Regulatory Guide endorses the use of NEI 94-01, "Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J."

Requirements governing repairs to primary containment are outlined in Section 9.2.4 of NEI 94-01 document. Section 9.2.4 states "Repairs and modifications that affect the containment leakage integrity require leakage rate testing (i.e., Type A testing or local leakage rate testing) prior to returning the containment to operation."

Since the three repairs were limited to the leakage barrier (i.e., the liner plate) and the reinforced concrete structure was not affected, a local leakage rate test was performed as allowed by Appendix J, Option B. CP&L considers the performance of the local leakage rate tests a superior test method when compared to a Type A test.

For demonstrating the adequacy of the repairs to these three defects, the local leakage rate test provided a superior test method since the Type A test would pressurize the entire leakage boundary. The acceptable criteria for the Type A test would have allow a specified amount of leakage so long as the acceptance criterion was not exceeded. As such, the leak tightness of the repaired areas could have not been verified by the Type A test. The backside of these repaired areas is embedded in concrete and not accessible during the performance of the Type A test to verify no leakage.

The performance of the local leakage rate test allowed CP&L to confirm the repaired areas were leak tight. As shown in Table 1, no leakage was observed during the post-repair test. As such, this type of leakage test was a superior method for verifying the effectiveness of the repairs. During the performance of these tests, the visual examination required by IWE-5240 was also performed.

Table 1 provides the leakage values obtained during the pre-repair and post-repair leakage rate tests. To understand the effect of the three defects, a pre-repair leakage test was performed. The pre-repair leakage value for the defect at the 18 foot elevation was obtained after excavating and, as such, the actual pre-repair leakage value was altered.

The pre-test leakage values for the defects at the 56 foot and 70 foot elevations are more indicative of accurate as-found leakage values. Minimal corrosion products were removed from the defects prior to performing these pre-repair leakage tests.

Table 1

| | Pre-Repair | Post-Repair |
|---|---|---|
| Defect at 18 foot elevation | 150 scfh | 0 scfh |
| Defect at 56 foot elevation | 12 scfh | 0 scfh |
| Defect at 70 foot elevation | 3.39 scfh | 0 scfh |

Additional Actions Taken

As a good engineering practice, the effectiveness of the IWE examinations to detect corrosion was re-validated. This action was performed by the on-site Material/Coating Engineer and a qualified IWE examiner. They performed an independent examination of sample areas in locations most susceptible to corrosion damage. The examination was completed and no additional degradation was identified.

In addition, ultrasonic thickness readings were taken at the other bulged areas identified during the IWE examination. No reduction of nominal wall thickness was found. This action ensured no similar condition to the one identified at 56 foot elevation existed. The bulged areas were also inspected by the IWE Responsible Engineer (i.e., Civil Design Group) and evaluated as having no adverse impact to the liner.

Procedure 0PT-20.5.1 was also revised to record and investigate any coating distress (e.g., undercutting, break in coating film) that may allow moisture to collect under the coating. This revision also included requirements to take thickness readings on any new bulged areas identified as well as to changes to any existing bulged areas.

Impact Of Not Performing A Type A Test

CP&L considers the performance of a visual examination, in accordance with procedure 0PT-20.5.1, a superior and proven method for identifying degradation to the portion of the liner backed up by reinforced concrete when compared to a Type A test. Because of the corrosion products in the defect area and the reinforcing concrete, leakage past the defects at the 18 foot and 70 foot elevations during a Type A test could be masked.

Although the actual length of time required for these defects to penetrate the liner plate is difficult to estimate, it is possible they were present during the last Type A test performed in 1993 and their associated leakage masked. 10 CFR Part 50 was not revised until September 9, 1996, to incorporate the requirements of Subsections IWE and IWL of the ASME Code relative for containment inspections. Based on our inspection experience, CP&L believes the IWE

inspections will identify containment defects that otherwise could be masked during performance of a Type A test.

The corrosion behind the liner at the 56 foot elevation was present during previous Type A tests. This condition had been occurring since the initial placement of the concrete. Because of the corrosion products backed against the concrete and surface area, the Type A test pressure was most likely not great enough to initiate a through-wall defect. As such, a visual examination is a better and proven method for detection of this type of degradation.

With defects initiating from the backside of the liner plate, bulged areas would be observed prior to the defect going through-wall. The budged area would be caused by the corrosion products forcing the separation of the liner from the concrete. For this reason, the procedural requirement to take and record thickness readings is a better method for finding this type of liner degradation.

In conclusion, the implementation of the IWE examinations played a key role in identifying and correcting the three identified defects. Based on the experienced gained through the 1999 visual examinations, and the subsequent enhancements to BSEP's procedure governing visual inspection of the containment liner, CP&L believes the visual examinations will continue to ensure the timely identification of containment degradation, if present, and provide assurance of the integrity of the primary containment during the period between performances of Type A tests.