UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W., SUITE 2900
ATLANTA, GEORGIA 30323-0199

Report Nos.: 50-325/96-06 and 50-324/96-06

Licensee: Carolina Power and Light Company
P. O. Box 1551
Raleigh, NC 27602

Docket Nos.: 50-325 and 50-324 License Nos.: DPR-71 and DPR-62

Facility Name: Brunswick 1 and 2

Inspection Conducted: March 26, 1996 - March 28, 1996

Inspector: _____ 4/5/96
J. J. Blake, Senior Project Manager, Maintenance Date Signed

Approved By: _____ 4/5/96
A. O. Christensen Chief Date Signed
Maintenance Branch
Division of Reactor Safety

SUMMARY

Scope:

This was a special, unannounced inspection of portions of the licensee's inservice inspection (ISI) program. The inspection included a review of completed inspection packages for piping welds, (including pipe support attachment welds) which had been surface or volumetrically inspected during the current outage; a review of the comparison of current ISI data with previous preservice inspection (PSI) or ISI records; an inspection of selected ultrasonic examination calibration blocks; and a review of the ISI records system.

Results:

The inspector found that the licensee had successfully kept track of the various changes to the ISI requirements for the Brunswick units and had factored the changes into the current ISI program as required updates to the baseline data for the systems. ISI records were found to be in compliance with NRC requirements.

Enclosure

4-24-96

9604180426 XA

REPORT DETAILS

1.0 Persons Contacted

Licensee Employees

E. Black, Level III Examiner, Nondestructive Examination
*W. Campbell, Vice President, Brunswick Nuclear Plant
*J. Crider, Engineering
*D. Estes, Supervisor, Quality Control
*G. Honma, Supervisor, Licensing
*J. Kinsey, Engineering Supervisor
J. Langdon, Supervisor, Nondestructive Examination
*W. Levis, Director, Site Operations
R. Lopriore, General Plant Manager
*B. Wilton, Engineering Supervisor, Reactor Support
*J. Yadusky, Engineering

Other licensee employees or contractors contacted included licensed reactor operators, auxiliary operators, craftsmen, technicians, and public safety officers, in addition to quality assurance, design, and engineering personnel.

NRC Personnel

C. Patterson, Senior Resident Inspector
*M. Janus, Resident Inspector
*E. Brown, Resident Inspector, Intern

*ATTENDED EXIT MEETING

Acronyms and initialisms used in the report are listed in the last paragraph.

2.0 Inservice Inspection - Unit 2 (IM 73753)

2.1 Background - Requirements

Inservice inspections (ISI) of Brunswick, Units 1 and 2, are conducted in accordance with the requirements of Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (the Code), 1980 Edition, with Addenda through Winter 1981 (80W81). The Code, which is required to be implemented by Federal Regulations (10CFR50.55a), requires that ISI inspections be conducted over a 10-year inspection interval, which is divided into three, 40-month inspection periods. The current 10-year inspection period for both units started on July 10, 1986, and was originally scheduled to complete on July 10, 1996. As allowed by the Code, on August 5, 1994, the licensee notified NRC of their intent to extend the second 10-year interval for both units to July 10, 1997; and on March 6, 1996, the licensee notified NRC of their intent to further extend the interval until May 10, 1998.

The 80W81 Edition of the Code specifies the type of examinations required, based on the type of weld, the Code classification, and the size of the piping involved. The type of examinations employed were volumetric examinations using ultrasonic test (UT) methods; surface examinations using either magnetic particle testing (MT) or liquid penetrant testing (PT) methods; and/or visual examination (VT) methods.

The inspector reviewed the final data packages for 109, ISI examinations of ASME Class 1 component support, piping, and pipe support attachment welds that were conducted during the current outage. The weld examination data packages were reviewed to determine if the tests conducted were proper for the particular component support, pipe size, and Code class. The data packages were also reviewed to determine if the ISI examiner(s) were appropriately qualified; that for UT examinations, the proper calibration block(s) were used; and that examination results were compared to the results of previous ISI or preservice inspection (PSI) examinations.

2.2 Comparison with Previous Examination Results.

While the Code states that ISI examinations should be compared to PSI inspection results, the inspector found a number of cases where there were no PSI records for the examinations conducted. In the cases where there were no PSI records, the results of the current inspections were compared to the results of previous ISI examinations, or the current examinations were considered to be the baseline examination for the particular weld. This was acceptable.

The reasons for there not being preservice examination records for some of the weld examinations were the result of 10CFR50 required changes to the ISI examination program. (The PSI was conducted in accordance with the 1970 Edition of the Code and Appendix I of the FSAR; ISIs during the first 10-year interval were originally conducted in accordance with (IAW) the 1974 Edition with Addenda through Summer 1975 (74S75) and later were conducted IAW the 1977 Edition with Addenda through Summer 1978 (77S78); and the ISI during the second 10-year interval has been conducted IAW the 80W81 Edition of the Code.) The PSI requirements and the 74S75 Edition of the Code did not require surface examinations on welds that were subjected to full-thickness volumetric examinations. The later Editions of the Code (77S78 and 80W81) changed the volumetric examination requirement from a full thickness examination to a volumetric examination of the inner 1/3 of the wall thickness supplemented with a surface examination for piping welds; the later editions also changed some welded support inspection requirements from volumetric to surface examinations. Because of these changes to the ISI requirements, MT and/or PT results for PSI or previous ISI inspections have not always been available for comparison.

The reason for conducting preservice or baseline examinations was that the original fabrication standards for welds had established NDE acceptance standards that allowed indications below an established size to be put into service. The preservice examination mapped these

indications so that future ISI examinations do not have to be evaluated for these previously accepted indications, provided that they do not exhibit growth. Without a preservice examination, every indication detected during ISI must be considered to be service-induced and evaluated against acceptance criteria in ASME Section XI.

For purposes of evaluating the service life of a component or weld, each inservice examination establishes a new baseline for which the next examination is to be compared. This is especially true as NDE methods evolve and improve.

As stated above, the technical reason for maintaining an accurate preservice record is so that indications accepted during construction don't have to be analyzed for acceptance each time they are found during ISI.

A sample of twelve weld examinations is shown in Table 1, "Class 1 Welds With No Preservice Examination Data." The table contains seven, 2-inch diameter pipe welds; three integrally welded supports; and two large diameter pipe welds. These welds are examples of welds which currently require surface examinations, which were not required by the Code of record during the preservice examination.

Table 1. **Class 1 Welds With No Preservice Examination Data**

Weld Description	ISI Rpt	Previous Data Compared to: (per ISI Data Sheet)	Comment: ISI Category Various ISI Codes and Applicable Inspection Requirements
1) 2B32F043A-2-SWH 2-inch diameter	**PT** R-071	First Surface ISI this outage, this is now the base-line	ISI Category B-J 1970: Exempted by size 74S75: B4.8 - Surface 77S78 & 80W81: B9.40 - Surface
2) 2B32F043A-2-SWK 2-inch diameter	**PT** R-072	First Surface ISI this outage, this is now the base-line	ISI Category B-J 1970: Exempted by size 74S75: B4.8 - Surface 77S78 & 80W81: B9.40 - Surface
3) 2B32F043A-2-SWB 2-inch diameter	**PT** R-069	PSI RPT 035360 (1986 ISI)	ISI Category B-J 1970: Exempted by size 74S75: B4.8 - Surface 77S78 & 80W81: B9.40 - Surface
4) 2B21704-2-FWRN8 2-inch diameter	**PT** R-021	B&R WELD DATA - original Field Weld data	ISI Category B-J 1970: Exempted by size 74S75: B4.8 - Surface 77S78 & 80W81: B9.40 - Surface

Table 1. **Class 1 Welds With No Preservice Examination Data**

Weld Description	ISI Rpt	Previous Data Compared to: (per ISI Data Sheet)	Comment: ISI Category Various ISI Codes and Applicable Inspection Requirements
5) 2B21708-2-FW2 2-inch diameter	**PT** R-066	B&R WELD DATA - original Field Weld data	ISI Category B-J 1970: Exempted by size 74S75: B4.8 - Surface 77S78 & 80W81: B9.40 - Surface
6) 2B21709-2-FW3 2-inch diameter	**PT** R-019	B&R WELD DATA - original Field Weld data	ISI Category B-J 1970: Exempted by size 74S75: B4.8 - Surface 77S78 & 80W81: B9.40 - Surface
7) 2B21703-2-FW3 2-inch diameter	**PT** R-065	B&R WELD DATA - original Field Weld data	ISI Category B-J 1970: Exempted by size 74S75: B4.8 - Surface 77S78 & 80W81: B9.40 - Surface
8) 2E21FF-8-FW206 integrally welded support	**MT** R-016	PSI RPT 052350	ISI Category B-K-1 1970: 4.5 - Visual & Volumetric 74S75: B4.9 - Volumetric 77S78 & 80W81: B10.10 - Surface
9) 2B212-1-2-FWR3 12-inch diameter	**MT** R-055	PSI RPT 130434	ISI Category B-J 1970: 4.2 - Visual & Volumetric 74S75: B4.5 - Volumetric 77S78 & 80W81: B9.11 Vol & Surface
10) 2B32RECIRC-28-A-6HL-2 integrally welded support	**PT** R-068	ISI RPT 94-AHGE1 - surface exam done per modification package	ISI Category B-K-1 1970: 4.5 - Visual & Volumetric 74S75: B4.9 - Volumetric 77S78 & 80W81: B10.10 - Surface
11) 2B32RECIRC-28-A-6HL-1 integrally welded support	**PT** R-067	ISI RPT 94-AHGD1 - surface exam done per modification package	ISI Category B-K-1 1970: 4.5 - Visual & Volumetric 74S75: B4.9 - Volumetric 77S78 & 80W81: B10.10 - Surface
12) 2B21PS1D5-24-SWB 24-inch diameter	**MT** R-083	PSI RPT 130202	ISI Category B-J 1970: 4.2 - Visual & Volumetric 74S75: B4.5 - Volumetric 77S78 & 80W81: B9.11 Vol & Surface

The third column of Table 1 shows how the preservice or baseline data, that the ISI results were compared to, are recorded in the current ISI documentation records . As shown in the table, four of the welds were compared to original construction fabrication records; two of the welds were compared to plant modification fabrication records; four of the

welds were compared to previous ISI examinations which had been labelled as PSI records; and two of the welds were not compared to previous data as the licensee elected to use the current ISI records as the baseline examination for these welds. All four of these methods of establishing a baseline for ISI examinations, in lieu of preservice examinations, are acceptable.

The inspector concluded that the licensee has done a good job of keeping track of the various changes to the ISI requirements for the Brunswick units. The inspector determined that the licensee was in compliance with regulatory requirements, and no violations or deviations were identified.

2.3 Calibration Blocks

The inspector selected a sample of six calibration blocks, used during the current ISI examinations, for a review of the fabrication documentation and an inspection of the conditions of the blocks. The calibration blocks reviewed were as follows:

120B: Stainless Steel, 4-inch Diameter, 0.33-inch Thick. No side-drilled holes only axial and circumferential 10% notches.

14B: Carbon Steel, 10-inch Diameter, 0.70-inch Thick. Circumferential notches cut with ID notch directly below 1/4T side-drilled hole and the OD notch cut directly above the 3/4T side-drilled hole.

19B: Carbon Steel, 24-inch Diameter, 1.37-inch Thick. Circumferential notches cut directly above and below the 1/2T side-drilled hole.

17B: Carbon Steel, 18-inch Diameter, 1.22-inch Thick. Circumferential notches cut with ID notch directly below 1/8T side-drilled hole and the OD notch cut directly above the 3/8T side-drilled hole.

12B: Carbon Steel, 4-inch Diameter, 0.425-inch Thick. Circumferential notches at opposite end of block from side-drilled hole.

09BR: Stainless Steel, 28-inch Diameter, 1.2-inch Thick. Block large enough so that Circumferential notches were cut on opposite end of block from side-drilled holes.

The 1970 and 74S75 Editions of the Code required Volumetric ISI examinations of Piping and Integral Support Welds (e.g., Lugs). The volumetric examination was to include the full thickness of the weld and adjacent base material.

The later Editions of the Code, 77S78 and 80W81, changed the requirement for piping examinations by requiring the volumetric examination to focus on the inner 1/3 of the pipe wall thickness and adding a surface examination to look for indications initiating on the outside.

With the change in focus of the volumetric exam from the full cross-section of the weld to the inner 1/3 of the weld, looking for surface-connected indications, indicative of service-induced flaws, there also came a change in the method of calibration of the Ultrasonic Instruments. The standard calibration block had been one with a series of side-drilled holes at increasing depths, (e.g., 1/4T, 1/2T, 3/4T) with the instrument Distance Amplitude Correction (DAC) Curve established around the side-drilled hole that created the largest reflector. The change in focus made it important to be able to calibrate on a corner reflector on the inner surface of the pipe, so the calibration standard became a 5% or 10% through-wall notch machined in the calibration standard.

It is understood that ASME Section V pictures the calibration blocks with the ID and OD notches aligned even with the 1/2T side-drilled hole but removed beyond the bottom of the hole so that they are not in the same plane through the block. The Code only requires that the location of calibration reflectors "... shall not interfere with establishing the primary reference."

In the cases reviewed, the inspector noted that where the licensee had modified an existing side-drilled hole calibration block to include ID and OD notches. Care was taken to ensure that the angle-beam metal paths for half-skip and full-skip calibrations, using either the side-drilled holes or the ID and OD notches and 45-, 60-, and 70-degree angles, would in no way be obscured by the other standards.

During a review of the ISI data for the current weld examinations, the inspector noted that in cases where the calibration block notches were lined up with the side-drilled holes, the UT examiners had often included the reflections from notches as well as the holes in the generation of the DAC Curve. This inclusion of other know reference reflectors could be considered as an enhancement.

The Code has a number of criteria which must be met in order to create a calibration standard. These criteria include such things as the material form, composition, heat treatment, shape, thickness, etc. The change in focus of the volumetric (UT) examination only changed the calibration target from side-drilled holes to surface notches, with other criteria for the calibration blocks remaining constant. Because of the large investment in certified standard calibration blocks, most licensees chose to have sets of ID and OD notches machined on their existing side-drilled hole calibration blocks. While some blocks were large enough that the notches could be machined in an area away from the side-drilled holes, others had to be machined so that the notches were directly above, or below, a side-drilled hole in order to ensure that the notches did not interfere with the sound path for a side-drilled hole calibration or vice-versa.

The inspector determined that the licensee was in compliance with regulatory requirements, and no violations or deviations were identified.

2.4 PSI and ISI Records

The inspector reviewed the status of the PSI and ISI record systems at Brunswick. The inspector found that the official record copies in the licensee's vault are microfiche files. The licensee's ISI personnel have also retained the original hard-copies, for a vast majority of the records, in file cabinets and book cases in the NDE building. The NDE building was a locked stand-alone facility, inside the security fence, maintained by QC, which was also the storage facility for NDE calibration blocks and associated records. The QC supervisor with primary responsibility for the files in the NDE building was also responsible for retrieving needed files from the official microfiche records to support ISI examinations.

As stated in paragraph 2.2, above, the reason for conducting preservice, or baseline, examinations was that the original fabrication standards for welds had NDE acceptance standards that allowed indications below an established size to be placed into service. The PSI mapped these indications so that future ISI examinations would not have to evaluate these previously accepted indications, provided that they do not exhibit growth. In the absence of PSI data, every indication detected during an ISI examination would have to be considered as service induced.

The inspector determined that the licensee was in compliance with regulatory requirements, and no violations or deviations were identified.

2.5 Previous NRC Inspections of the ISI Programs

NRC Inspection Report Nos. 50-325/86-09 and 50-324/86-10 documented the results of a Unit 2 ISI inspection conducted on March 17-21, 1986. As noted in the inspection report, the first 10-year inspection interval for Unit 2 was scheduled to conclude on July 10, 1986.

The report also noted that during the first 10-year inspection interval, there were three separate ASME Section XI Codes, of record, for inservice inspection.

- The unit started its first 10-year interval with the 1970 Edition of ASME Section XI; this edition of the code only required inservice inspections of primary system piping and components.

- A change to 10CFR50.55a required all licensees to up-grade their inservice inspection programs to include Class 2 and 3 piping and components by mandatory backfit to the 1974 Edition with Summer 1975 Addenda (74S75). The licensee changed to the 74S75 Edition prior to the second refueling of the first 40-month period.

- When the 1977 Edition with Summer 1978 Addenda (77S78) was approved and listed in 10CFR50.55a, the licensee requested allowance to change to that edition of the code for the final two 40-month periods of the first 10-year interval.

- A fourth change to the Section XI Code was made, as required by 10CFR50, for the start of the current, second 10-year interval. The current ISI Code is the 1980 Edition with the Winter 1981 Addenda, (80W81) as indicated in Paragraph 2.1, above.

The report issued a violation because the licensee had deferred a significant number of piping welds until the last outage of the ten-year interval instead of conducting a percentage of them during each forty-month period of the interval as required by Code. This deferral of the inspections until the end of the interval resulted in a significant number of weld surface examinations being required for the first time in the 1986 time period.

As a result of the violation, the licensee rewrote the ISI administrative procedures to preclude recurrence, and also looked closer at the criteria for sample selection. The close-out of the first ten-year interval in the final outage had resulted in sample selection by what was the easiest to reach while meeting the minimum requirements of the ASME Code. For the second ten-year interval, which is scheduled to conclude after the next refueling outage for each unit, the licensee re-selected the required sampled to balance the sample selection and focus of the higher stressed welds. The changes in the sample selection in the plan resulted in the need to continue to establish base-line surface examinations as new sample welds were brought into the program.

The significant number of welds that were ISI examined at the close of the first 10-year interval, and the change to the criteria for sample selection implemented at the start of the second 10-year interval, resulted in a large number of welds with baseline surface examinations in lieu of preservice examinations in 1986, and in most outages since then. This was an acceptable method of implementing new inspection methods as the requirements are changed to maintain compliance with 10 CFR 50.55a, Codes and Standards.

3.0 Exit Interview

The results of the inspection were discussed on March 28, 1996, with the members of the licensee's staff identified in paragraph 1.0. There were no proprietary items discussed during this inspection.

4.0 Acronyms and initialisms

ASME	American Society of Mechanical Engineers
DAC	Distance Amplitude Correction
ID	Inside Diameter
ISI	Inservice Inspection
MT	Magnetic Particle Test
NDE	Nondestructive Examination
OD	Outside Diameter
PSI	Preservice Inspection
PT	Liquid Penetrant Test
T	Thickness
the Code	ASME Boiler and Pressure Vessel Code Section XI
UT	Ultrasonic Test
VT	Visual Examination
74S75	1974 Edition with Addenda through Summer 1975
77S78	1977 Edition with Addenda through Summer 1978
80W81	1980 Edition with Addenda through Winter 1981