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

March 13, 1990

Dockets Nos. 50-269, 50-270, 50-287

Mr. H. B. Tucker, Vice President
Nuclear Production Department
Duke Power Company
422 South Church Street
Charlotte, North Carolina 28242

Dear Mr. Tucker:

SUBJECT: PREVENTION OF BORIC ACID CORROSION AT OCONEE NUCLEAR STATION, (GENERIC LETTER 88-05) (TAC NOS. 68931, 68932, 68933)

The purpose of this letter is to advise you that our audit of your boric acid corrosion prevention program has resulted in an acceptable finding, and we now consider this issue to be closed.

On July 31 through August 2, 1989, the NRC staff and our consultant visited the Oconee Nuclear Station, Units 1, 2 and 3, to audit the program to prevent boric acid-related corrosion. The audit team included K. Parczewski (NRC), M. Schuster (Consultant, Brookhaven National Laboratory), and L. Wiens (NRC). Boric acid corrosion prevention requirements were described in Generic Letter 88-05 which was issued on March 17, 1988, and requested the implementation of such a program by all licensees of operating PWRs and holders of construction permits for PWRs. In your letters dated May 23 and August 31, 1988, you provided a description of, and a commitment to, a boric acid leakage monitoring and corrosion preventive program for Oconee.

A copy of the trip report covering the results of the audit which was prepared by our consultant, is enclosed. The staff has reviewed this report and agrees with its findings and the conclusion. Although it is recommended that a more formal method of identifying components prone to boric acid leakage and corrosion damage be implemented, we conclude that you have adequately implemented a program for monitoring small primary coolant leakage through carbon steel components caused by boric acid corrosion as described in your submittals dated May 23 and August 1, 1988, for the Oconee Station. The result of the Oconee audit will be used, along with audit results from other plants, in our overall determination of future actions to be taken regarding NRC's final resolution of this industry-wide generic issue.

MLA-4 DF01 1/1

Our review of this issue for the Oconee Nuclear Station, Units 1, 2 and 3, is closed.

Sincerely,

/s/

Leonard A. Wiens, Project Manager
Project Directorate II-3
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosure:
As stated

cc w/encl:
See next page

DISTRIBUTION
Docket File
NRC PDR
Local PDR
PDII-3 r/f
S. Varga 14-E-4
G. Lainas 14-H-3
D. Matthews
R. Ingram
L. Wiens
OGC (For inform. Only) 15-B-18
E. Jordan MNBB-3302
E. Rossi 11-E-4
K. Parczewski 8-H-7
D. DiIanni 3-H-15
M. Shymlock RII
ACRS (10) P-315
OCONEE FILE

OFC	LA:PDII-3	PM:PDII-3	D:PDII-3				
NAME	RIgram	LWiens:sw	DMatthews				
DATE	3/5/90	3/5/90	3/5/90				

OFFICIAL RECORD COPY
Document Name: LTR TUCKER 68931/2/3

Mr. H. B. Tucker
Duke Power Company

Oconee Nuclear Station
Units Nos. 1, 2 and 3

cc:
Mr. A. V. Carr, Esq.
Duke Power Company
P. O. Box 33189
422 South Church Street
Charlotte, North Carolina 28242

J. Michael McGarry, III, Esq.
Bishop, Cook, Purcell & Reynolds
1400 L Street, N.W.
Washington, D.C. 20005

Mr. Robert B. Borsum
Babcock & Wilcox
Nuclear Power Division
Suite 525
1700 Rockville Pike
Rockville, Maryland 20852

Manager, LIS
NUS Corporation
2536 Countryside Boulevard
Clearwater, Florida 34623-1693

Senior Resident Inspector
U.S. Nuclear Regulatory Commission
Route 2, Box 610
Seneca, South Carolina 29678

Regional Administrator, Region II
U.S. Nuclear Regulatory Commission
101 Marietta Street, N.W., Suite 2900
Atlanta, Georgia 30323

Mr. Heyward G. Shealy, Chief
Bureau of Radiological Health
South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Office of Intergovernmental Relations
116 West Jones Street
Raleigh, North Carolina 27603

County Supervisor of Oconee County
Walhalla, South Carolina 29621

Mr. Paul Guill
Duke Power Company
Post Office Box 33189
422 South Church Street
Charlotte, North Carolina 28242

Mr. Alan R. Herdt, Chief
Project Branch #3
U.S. Nuclear Regulatory Commission
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

Ms. Karen E. Long
Assistant Attorney General
N. C. Department of Justice
P.O. Box 629
Raleigh, North Carolina 27602

BORIC ACID PREVENTION

Trip Report

FIN A-3871   TASK ASSIGNMENT NO. 4

A. Introduction

On July 31 - August 2, 1989, a USNRC audit team visited the Oconee Nuclear Power Station Units 1, 2, 3. The team was comprised of Messrs. K. Parczewski, and L. Wiens of the USNRC and Mr. M. Schuster of Brookhaven National Laboratory (BNL).

The purpose of the plant visit was to audit the licensee implemented program for prevention of carbon steel corrosion by boric acid in the reactor pressure boundary of the plant.

This verification of program implementation took the form of an audit of the Units' written procedures, interviews with plant staff personnel and verifying that the techniques used by the utility were proper and performed by adequately trained/certified personnel.

The guidelines for the audit fell into four broad areas of concern which should encompass the utilities' elicited responses to NRC Generic Letter 88-05.

B. Determination of the principal locations where leaks of primary coolant below the specification limits could cause degradation of the reactor pressure boundary components.

The licensee in its response to Generic Letter 88-05 dated August 1, 1988 indicates the primary method used to locate boric acid leaks will be the operator surveillances. The operator surveillances will be evaluated by the individual stations and where it is deemed necessary a review of containment systems will be conducted to ensure that all potential leak locations have been identified. To date the licensee has completed a review of all systems and compiled a list of those systems fabricated from low alloy carbon steel materials where boric acid leakage may cause damage. No emphasis on specific components is placed during operator surveillance, but rather a thorough inspection of all components and areas is required of operations personnel during surveillance walk downs.

Station technical specifications provide the guidelines, actions and requirements when total and unidentified reactor coolant leakage exceeds required values. Technical specification 3.1.6 provides the following in addition to other requirements:

(1) "3.1.6 Leakage

Specification

3.1.6.1 If the total reactor coolant leakage rate exceeds 10 gpm, the reactor shall be shutdown within 24 hours of detection.

3.1.6.2 If unidentified reactor coolant leakage (excluding normal evaporative losses) exceeds 1 gpm or if any reactor coolant leakage is evaluated as unsafe, the reactor shall be shutdown within 24 hours of detection."

(2) "Bases

Every reasonable effort will be made to reduce reactor coolant leakage including evaporative losses (which may be on the order of .5 gpm) to the lowest possible rate and at least below 1 gpm in order to prevent a large leak from masking the presence of a smaller leak. Water inventory balances, radiation monitoring equipment, boric acid crystalline deposits, and physical inspections can disclose reactor coolant leaks. Any leak of radioactive fluid, whether from the reactor coolant system primary boundary or not can be a serious problem with respect to in-plant radioactivity contamination and cleanup or it could develop into a still more serious problem; and therefore, first indications of such leakage will be followed up as soon as practicable."

(3) "If leakage is to the reactor building it may be identified by one or more of the following methods:

a. The reactor building air particulate monitor is sensitive to low leak rates. The rates of reactor coolant leakage to which the instrument is sensitive are .10 gpm to greater than 30 gpm, assuming corrosion product activity and no fuel cladding leakage. Under these conditions, an increase in coolant leakage of 1 gpm is detectable within 10 minutes after it occurs.

b. The iodine monitor, gaseous monitor and area monitor are not as sensitive to corrosion product activity. It is calculated that the iodine monitor is sensitive to an 8 gpm leak and the gaseous monitor is sensitive to a 230 gpm leak based on the presence of tramp uranium (no fission products from tramp uranium are assumed to be present). However, any fission products in the coolant will make these monitors more sensitive to coolant leakage.

c. In addition to the radiation monitors, leakage is also monitored by a level indicator in the reactor building normal sump. Changes in normal sump level may be indicative of leakage from any of the systems located inside the reactor building such as reactor coolant system, low pressure service water system, component cooling system and steam and feedwater lines or condensation of humidity within the reactor building atmosphere. The sump capacity is 15 gallons per inch of height and each graduation on the level indicates 1/2 inch of sump height. This indicator is capable of detecting changes on the order of 7.5 gallons of leakage into the sump. A 1 gpm leak would therefore be detectable within less than 10 minutes.

d. Total reactor coolant system leakage rate is periodically determined by comparing indications of reactor power, coolant temperature, pressurizer water level and letdown storage tank level over a time interval. All of these indications are recorded. Since the pressurizer level is maintained essentially constant by the pressurizer level controller, any coolant leakage is replaced by coolant from the letdown storage tank resulting in a tank level decrease. The letdown storage tank capacity is 31 gallons per inch of height and each graduation on the level recorder represents 1 inch of tank height. This inventory monitoring method is capable of detecting changes on the order of 31 gallons. A 1 gpm leak would therefore be detectable within approximately one half hour.

As described above, in addition to direct observation, the means of detecting reactor coolant leakage are based on 2 different principles, i.e., activity, sump level and reactor constant inventory measurements. Two systems of different principles provide, therefore, diversified ways of detecting leakage to the reactor building."

Inspection frequency is provided by the Operations Management Procedure 1-6 titled "Operating Status Reviews and Housekeeping Tour" and Maintenance Directive 5.3.7, sections:

"OMP 1-6

3.2 Monthly the Operation Engineers Staff will inspect the following areas associated with their unit.

A) Turbine Building
B) Control Rooms
C) Transformer Yards
D) Block Houses (Units 2 and 3 only)
E) Equipment Rooms
F) Yard Areas West of Auxiliary Building
G) Yard Area South of Turbine Building (Unit 3 only)

3.5 Operational status tours of the reactor buildings will be performed at hot shutdown conditions on unit shutdowns and startups. This tour will be performed by Operations Engineers staff and/or Unit Supervisors in conjunction with Maintenance Group Coordinators and/or Maintenance Group Shift Supervisors.

MP 5.3.7

5.1 During any reactor shutdown the Unit Operating Manager is contacted to determine if a hot shutdown tour will be performed."

- The licensee is in compliance with the intent of Generic Letter 88-05. The utilities ongoing evaluation of operation surveillances, industry experience and identification of potential leak locations should provide identification of those locations where conditions exist that could cause high concentrations of boric acid on pressure boundary surfaces.

C. <u>Procedures for locating small coolant leaks</u>

Procedures currently in use at the Oconee NPS provide the following and are as follows:

(1) Maintenance Directive 5.3.7

"Conducting and Documenting Reactor Building Boron Inspections

1.0 <u>Procedure</u>

This directive provides direction to Maintenance Engineering on:

a) When to perform a reactor building inspection for corrosion due to boric acid

b) How to perform this inspection

c) Action to take when evidence of corrosion is found

d) How to document the inspection results and action taken.

2.0 <u>Responsibility</u>

The Maintenance Engineering Manager is responsible for performance of the boric acid corrosion inspection and evaluation.

3.0 <u>Scope</u>

This program applies to all boric acid leaks in the reactor building, however the following items are excluded from being documented as part of this program since their inspection and documentation are already covered under other programs.

a) Leaks around the reactor vessel head and CRDM flanges

b) Leaks around reactor coolant pumps

c) Leaks on the OTSG"

(2) Operations Management Procedure 1-6

"Operating Status Reviews and Housekeeping Tours

1.0 <u>Purpose</u>

The purpose of this OMP is to:

1) provide problem identification and response forms to assure timely follow-up action on unacceptable housekeeping conditions.

2) insure a review of outstanding work requests to assure timely and appropriate action is taken on equipment problems."

(3) Procedure Process Record PT/1/B/700/01

Title "Cleanliness Verification"

"12.0 <u>Procedure</u>

12.1 Inspect areas listed on Enclosure 13.1 (Plant Inspection Checklist) and 13.2 (Quarterly Plant Inspection Checklist) if applicable for but not limited to the following:

- Existing, developing, or potential leakage from system valves, piping, pumps, and other leakage sources.
- Inspections should also include monitoring for boric acid build-up especially those on surfaces of carbon steel. Boric acid build-up should be identified by W.O. for timely repair and on Enclosure 13.3 for routine cleanup until repairs can be performed."

(4) Procedure Process Record PT/0/B/700/01A

Title "Fuel Handling Cleanliness Verification"

"12.0 <u>Procedure</u>

12.1 Inspect areas listed on Enclosure 13.1 (Plant Inspection Checklist) for but not limited to the following:

- Inspections should also include monitoring for boric acid build-up especially those on surfaces of carbon steel. Boric acid build-up should be identified by W.O. for timely repair and on Enclosure 13.2 for routine cleanup until repairs can be performed."

(5) Quality Control Procedure

QA QC PM Procedure No. QCL-15

"5.2

e) At locations where leakages are normally expected and collected (e.g., valve stems, pump seals), the examination shall verify that the leakage collection system is operative.

f) During the examination, particular attention shall be given to detect evidence of boric acid residues on the components or their insulation. In the event boric acid residues are detected, the insulation shall be removed, to the extent necessary, to determine the source of the residue and possible resulting corrosion. Any corrosion shall be documented. Nuclear Production or Design Engineering shall evaluate these conditions for corrective action.

5.3 Corrective Action

If leakage (other than normal controlled leakages) is detected during the performance of the examination, the source of leakage shall be located and documented. Sources of leakage shall be identified to Nuclear Production for corrective action. The detection of boric acid residues shall require the location of the leakage source be determined. Any resulting corrosion shall be documented and evaluated to determine the need for repair or replacement."

Leak tests are also performed at each outage in accordance with ASME Section XI requirements.

Inspector qualifications for four inspectors were verified during the audit and found acceptable:

A.E. Bagwel	VT-2
L.E. Carlisle	VT-2
T.J. McAule	VT-2
R. Rogers	VT-2

Operations Training Records 87-10 and 88-31 were reviewed and are acceptable with the exception there is no provision to provide this training to new operations personnel.

- Procedures reviewed met the intent of Generic Letter 88-05.

D. <u>Procedures for evaluating boric acid induced corrosion of carbon steel components in the reactor pressure boundary</u>.

The maintenance work request is the primary method utilized to document boric acid leakage. The maintenance engineering manager is responsible for performance of the boric acid corrosion inspection and evaluation as provided in Maintenance Directive 5.3.7. The engineer is required by Maintenance Directive 5.3.7 to:

"5.5 Additional inspections, if required, shall be completed prior to a reactor building wash down or unit restart. These inspections should include all carbon steel exposed to boron. A determination will be made as to whether piping under boron coated insulation may have also been in contact with boric acid.

NOTE: It may be necessary to remove some boron crystals and/or insulation to perform an adequate inspection. Health Physics shall be consulted prior to disturbing the boron.

NOTE: If unit restart is being held awaiting completion of these inspections, it will be necessary to perform a preliminary evaluation of the inspection results before notifying the Outage Manager that restart may begin.

5.8 The engineer will document all inspections and evaluations with a memorandum to file, file numbers OS-208.32 and OS-259.40 will be used. This memorandum will contain the following:

a) Results of all inspections

b) List of all work requests written as a result of these inspections.

c) Status of each work request (complete, hold for parts, scheduled for refueling outage, etc.).

d) Identification of any components that may need to be monitored in the future."

Additional examples of instruction are provided in the:

(1) Operations Management Procedure 1-6

"4.0 Documentation and Handling

4.1 Discrepancies found by the Operations Engineers staff and discrepancies noted on Enclosure 13.2 of PTs/1, 2 and 3/B/700/01 will be compiled by the Operations Engineers staff and listed on Enclosure 5.1.

4.1.4 Components identified as having boron accumulations should be scheduled for repair as soon as possible. If repair cannot be scheduled in a short period of time, the Operations Engineers staff will complete Enclosure 5.5 (Boron Crystal Removal Request) and forward to the Contract Services Coordinator for cleanup."

(2) Procedure Process Record MP/0/A/1200/07

Title "Valves-Dresser Pressurizer Relief-Removal and Replacement"

"11.1.7 Inspect the valve for damage due to borated water, by performing the following:

A. Inspect exterior condition of valve for damage due to leakage of borated water.

B. IF evidence of leakage to adjacent components is found, inspect components.

C. IF damage to components is found, contact Supervisor or Accountable Engineer or both for further instructions."

The Nuclear Maintenance Database provides tracking for work orders. These work orders are reviewed for component trending periodically by the Maintenance Engineer Manager.

- Procedures reviewed provided assurance the licensee meets the intent of Generic Letter 88-05.

E. Corrective actions taken by the licensee to prevent recurrence of similar types of corrosion.

The licensee in its response to Generic Letter 88-05 provided the following:

"As a result of the engineering evaluations corrective actions (repairs) will be initiated through the present work request system. Work requests will be evaluated for trends to reduce the probability of boric acid leaks where they may cause corrosion damage to components.

The Operating Experience program currently in place initiates a documented review of significant operating events including significant boric acid leakage. This review includes a detailed engineering evaluation and trending of similar events. As a result of this program and lessons learned from industry Duke has implemented corrective actions in an effort to con-trol boric acid corrosion. Some examples are: 1) upgrading of steam gen-erator manway installation procedures which address tensioning, lubricants, gaskets and gasket surface preparation, stud materials, and stud coating, 2) extensive upgrades and comprehensive inspections of reactor coolant pumps at each outage with detailed inspections and evaluation for possible damage if boric acid build-up is present, and 3) enhanced valve inspection and maintenance programs."

- The licensee corrective actions were reviewed and found in compliance with the intent of Generic Letter 88-05.

A plant tour with systems inspections for boric acid leaks was completed by the team. The results of the inspections were as follows:

(1) Reactor building spray pump "2B" - suction side flange and swagelok connection leaks observed, work request #056216A had been generated.

(2) Low pressure injection pump "2B" - a flange leak was observed, work request #056216A had been generated.

(3) Low pressure injection pump "1B" - suction side swagelok fitting and seal leaks observed, no work request had been generated.

(4) Reactor building spray 1BS-16 - flange leak observed, work request #15059C had been generated.

(5) Reactor building spray pump "1B" - boric acid residue observed on 1LWP-377, no work request had been generated.

(6) Boric acid chemical addition mix tank room #1 & #2 - no leaks were observed.

(7) Boric acid chemical addition mix tank room #3 - no leaks were observed.

(8) Reactor building spray pump "3A" - instrument root valve to 3P6-252 and discharge flange leaks observed, work request #093075C had been generated.

(9) Low pressure injection pump "3A" - casing line fitting leak, no work request had been generated -- pump discharge flange leak, work request #21976C had been generated -- component 3BS-3 packing leak observed, work request #639626C had been generated.

(10) Unit #3 decay heat cooler room - component 3LP-11 packing leak observed, no work request had been generated.

(11) Unit #3 spent fuel cooler room - valve 3SF-6 leak observed, work request #50772I had been generated -- spent fuel cooling pump "3A" flange leak observed -- BWST #3 recirculation pump - flange leak observed, work request #22863C had been generated.

(12) Unit #3 seal supply filter room - high pressure injection system - no leaks were observed.

(13) Unit #2 control rod drive filter room - high pressure injection system - no leaks were observed.

(14) Unit #2 east penetration room - high pressure injection system - a flange leak was observed on the flow transmitter near component 2FT-159. A plastic protective enclosure had been built to contain the leak. No work request had been generated. The licensee is not in compliance with the work request program requirement to properly tag the leak and generate the work request. The conditions were brought to the licensee's attention.

(15) Unit #3 spent fuel pool - spent fuel pool vacuum pump - no leaks were observed.

- Review of walkdown work request showed no outstanding or backlogged work request. It appears work request repairs are being completed in a timely manner.

F. Conclusions

(1) Review of appropriate documentation, corrective actions, procedures and information provided by cognizant licensee personnel in general

provided verification the licensee's program meets the intent of generic letter 88-05.

(2) The utility current component boric acid leak trending program, evaluation of work request and identifying those components where boric acid leaks may cause damage to the components needs to be more formalized. The current program did not appear to provide a formal method of identifying components prone to boric acid leakage and possible corrosion damage.

(3) Although there were some areas of prior leakage (dry residue) which did not have work orders generated, it is felt that, in general, the walk down system for the Oconee Units is adequate.

These conclusions were discussed with utility personnel at the exit critique.

G. Document Review

Procedure Process Records

(1) Valve-Globe-Disassembly, Repair and Assembly MP/0/A/1200/02A

(2) Pump-Bingham-Reactor Coolant-Closure Stud-Removal, Installation MP/2&3/A/1310/22

(3) Crom-Flanges-Visual Inspection MP/0/A/1200/02

(4) Valves-Gate-Disassembly-Reassembly MP/0/A/1200/02

(5) Valve-Anchor Darling-Pressure Seal, Tilting, Disc, Check-Disassembly, Repair and Reassembly MP/0/A/1200/65

(6) Valve-Borg Warner-Swing Check-Gasket Type and Pressure Seal-Disassembly, Repair and Reassembly MP/0/A/1200/95

(7) Valve-Aloyco-"y" Type-Globe Disassembly, Repair, and Reassembly MP/0/A/1200/46

(8) Valve-Grinnell-Diaphragm-Handwheel Operated-Disassembly and Reassembly MP/0/A/1200/09

(9) Valves-Dresser-Pressurizer Relief-Removal and Replacement MP/0/A/1200/07

(10) OMP 3-1 Operating Experience Review

(11) Oconee Safety Review Group Report #SOER 84-5, INPO MA.2-1

(12) Boric Acid Corrosion of Carbon Steel RCS Components File OS-20-E

(13) Conducting and Documenting Reactor Building Boron Inspections Maintenance Directive 5.3.7

(14) Operations Management Procedure 1-6

(15) Problem Investigation Process Procedure

(16) Technical Specification Section 3.1.6.1 through 3.1.6.10

(17) Training Package 87-10

(18) Training Package 88-31

(19) Training Package 87-40

(20) Memorandum to File, Dated July 10, 1989, File #OS-208.32, 259.40

(21) Intra Station Letter, Dated June 16, 1989, Boric Acid Corrosion Concern

(22) Enclosure 5.5 Shift Turnover Checklist

(23) Procedure Process Record ID No. PT/1/B/700/01

(24) Procedure Process Record ID No. PT/0/B/700/01A

(25) Procedure Process Record ID No. PT/0/A/200/46

(26) Memorandum to File, Dated August 31, 1988, File #OS-208.32, 259.40

(27) Memorandum to File, Dated March 6, 1989, File #OS-208.32, 259.40

(28) Memorandum to File, Dated February 20, 1989, File #OS-208.32, 259.40

(29) Operations Attendance Training Records File #87-10, 87-40, 88-31

(30) Work Request 52370I through 52374I and 52409I Inspection Data Sheets

H. Personnel Interviewed

The following personnel were contacted during the site visit:

E. LeGette
B. Millsaps
B. Carney
N. Clarkson
B. Fostor
D. Sweigart
V. Dixon
J. Warren

The following personnel were present at the entrance meeting:

L. Wiens	NRC/NRR/PDII-3
P. Skinner	DPC/Senior Resident Inspector
K. Parczewski	NRC/NRR/DEST
M. Schuster	BNL
E. LeGette	ONS/Compliance
B. Millsaps	ONS/Maintenance
B. Carney	ONS/Maintenance Engr.
N. Clarkson	ONS/OPS
D. Deathevarge	ONS/OPS
D. Sweigart	ONS/OPS

The following personnel were present at the exit critique:

L. Wiens	NRC/NRR/PDII-3
P. Skinner	DPC/Senior Resident Inspector
L. Wert	DPC/Resident Inspector
K. Parczewski	NRC/NRR/DEST
M. Schuster	BNL
E. LeGette	ONS/Compliance
N. Clarkson	ONS/OPS
B. Millsaps	ONS/Maintenance Engr.
B. Carney	ONS/Maintenance Engr.
B. Fostor	ONS/Maintenance
D. Sweigart	ONS/OPS
T. Curtis	ONS/Compliance