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SUBJECT: Special rept:on 970421,RCS leak was detected on Oconee Unit 2.Leak was identified to be crack in weld for pipe to safe end connection at RCS nozzle for HPI Sys injection line.Root cause will be determined.Unit is at cold shutdown.JCO,encl.

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DUKE POWER

April 28, 1997

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

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
Justification for Continued Operation of
Oconee Units 1 and 3 Based on Oconee Unit 2
HPI Line Leak
NRC TAC No. M98454

On April 21, 1997, at approximately 2245 hours, a Reactor Coolant System (RCS) leak was detected on Oconee Unit 2. Subsequent investigations identified the leak to be a crack in the weld for the pipe to safe end connection at the RCS nozzle for the High Pressure Injection (HPI) System A1 injection line. Oconee Unit 2 is currently at cold shutdown conditions. Oconee Units 1 and 3 are currently operating at 100% full power.

As a result of the Unit 2 RCS leak, the two immediate concerns of Oconee Nuclear Station are to maintain Unit 2 in a safe condition while the cause of the leak is being investigated and to evaluate the potential for a similar failure mechanism to occur on Units 1 and 3. Duke Power has a formal process, referred to as the Failure Investigation Process (FIP), to methodically determine the root cause of an equipment failure. A FIP team was initiated on April 22, 1997, to determine the root cause of the crack in the Unit 2 A1 injection line weld.

Duke Power held conference calls with the staff on April 23, 1997, April 24, 1997, and April 25, 1997, to discuss the status of the ongoing investigation of the Unit 2 leak. During the April 25, 1997, conference call, Duke Power stated that it would submit a Justification for Continued Operation (JCO) of Oconee Units 1 and 3 by April 28, 1997. Attachment 1 to this submittal provides the staff with the status of the FIP team investigation as of April 28, 1997,

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and summarizes the current JCO of Oconee Units 1 and 3. Based on the information available at this time, Duke Power believes that the continued safe operation of Oconee Units 1 and 3 is justified. It should be recognized that this submittal documents the technical judgment of the Oconee staff as of April 28, 1997. A definitive cause for the leak on Unit 2 will not be possible until the subject piping is removed and examined in a metallurgical laboratory. Based on the current schedule, these laboratory results will not be available until May 1-2, 1997. As new information becomes available, Duke Power will continue to promptly communicate the status of the ongoing investigation to the staff.

Please address any questions to J. E. Burchfield, Jr. at (864) 885-3292.

Very Truly Yours,

Joe M Davis

for J. W. Hampton
Site Vice President

xc: L. A. Reyes, Region II
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M. A. Scott, Region II
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D. E. LaBarge, ONRR
Project Manager

Attachment 1

Oconee Units 1 and 3 Justification for Continued Operation

Background

On April 21, 1997, at 2245 hours, a Reactor Coolant System (RCS) leak was detected on Oconee Unit 2. The control room operator noted a level change in the Letdown Storage Tank (LDST) and Reactor Building air particulate monitor RIA-47 went into alarm. An RCS leakage calculation was performed and estimated a leak rate of 2.36 gpm. A Unit 2 Reactor Building entry was made and the leak was observed in the area of the 2A1 reactor coolant pump. Due to the location, nature of the leak, and the dose rates, the leaking component could not be positively identified. A power reduction on Oconee Unit 2 was initiated at 0352 hours on April 22, 1997. In accordance with 10CFR 50.72(b)(1)(i)(A), the NRC was notified of the Unit 2 shutdown at 0426 hours on April 22, 1997. The reactor was shutdown at 1448 hours on April 22, 1997. During the Unit 2 shutdown, an Unusual Event was declared at 1600 hours on April 22, 1997, because the RCS leak rate exceeded 10 gpm. The leak rate reached a maximum of approximately 12 gpm at 1750 hours on April 22, 1997. The Unusual Event was exited at 2032 hours on April 22, 1997, when the leak rate decreased to less than 10 gpm as the RCS was cooled and depressurized. Oconee Unit 2 is currently at cold shutdown conditions.

The leak has been identified as a crack in the weld for the pipe-to-safe end connection at the RCS nozzle for the High Pressure Injection (HPI) System A1 injection line. Duke Power has a formal process, referred to as the Failure Investigation Process (FIP), to methodically determine the root cause of equipment failures. A FIP team was assembled on April 22, 1997 to determine the root cause for this weld crack. The FIP team consists of both Duke Power and industry experts. In addition to the FIP team, a recovery team has been assembled to coordinate inspection and repair activities and minimize the time Unit 2 will be at reduced inventory conditions.

Status of FIP Team Investigation

The FIP team is performing a comprehensive analysis to determine the root cause of the Unit 2 HPI System A1 injection line crack. Potential root causes for the 2A1 injection line crack that are being investigated include the following:

- Vibration from equipment, flow, or different modes of RCS and HPI System operation.

- Workmanship, weld material, weld configuration, weld process and pipe alignment associated with the original design.

- Review of existing analyses reflecting modifications to the Unit 2 HPI System injection lines.

- Miscellaneous loads from stratification, thermal interferences, all operating modes (thermal), transients, (water hammer and thermal), modification loads, and overpressure.

- Material degradation due to embrittlement, stress corrosion cracking, chemical attack, and erosion.

- Operating history including work order history, thermal sleeve work, shock (hit), operations history (overpressure and transientes).

- Snubbers and other pipe supports.

The status of the FIP team investigation as of April 28, 1997, is provided below. The team identified the cracked weld as weld #44 on isometric drawing #39, Unit 2 system 51A (HPI). This weld is the pipe to safe end connection at the 2A1 HPI nozzle.

On April 24, 1997, a Reactor building entry was made by FIP team members to obtain as found data on the piping configuration. This entry also captured data associated with a recent modification to the HPI System injection lines (NSM-22975). This modification replaced the stop-check valve on each of the four HPI System injection lines with a check valve and an isolation valve. The modification has been implemented on Oconee Units 2 and 3 and is scheduled to be implemented on Oconee Unit 1 during its next refueling outage. This review was conducted because the weld failure occurred on the HPI System injection line modified during the previous refueling outage. During this review, the field inspection noted structural restraint 51A-0-1479A-H1A was not positioned as indicated by modification documentation. Preliminary analysis by the FIP team indicates this mispositioned structural restraint did not

induce unacceptable stresses to the piping system. Oconee has entered this issue into its formal corrective action program and is in the process of determining the cause and implementing appropriate corrective actions for the mispositioned restraint.

Post modification vibration test data from NSM-22975 (Unit 2) and NSM-32975 (Unit 3) and reactor coolant pump 2A1 vibration data were collected for analysis. In addition, the FIP team conducted vibration modal tests for all four HPI injection lines on Unit 2 to obtain additional vibration data.

On April 25, 1997, the FIP team reviewed non-destructive examination (NDE) records for this weld. The weld had NDE radiographic testing (RT) performed in June 1973 (original fabrication test). Two subsequent RT exams near this weld were performed in response to augmented thermal sleeve inspections resulting from the Crystal River 3 event. Although not an objective of these inspections, overlap of the affected weld was obtained with adequate resolution. In all three RTs, a linear indication (probable machining mark) is noted. These three RTs were approved by a Level III inspector at the time of the inspections and were considered acceptable. An additional review was performed by a Level III NDE inspector on April 25, 1997, and concluded the linear indication was acceptable with potential for further technical review.

Weld records for the Unit 1 and Unit 3 HPI injection nozzles were also reviewed. All eight nozzles were acceptable using the most recent weld RT data. The augmented thermal sleeve RT inspections for Units 1 and 3 were also reviewed to determine if, like Unit 2, they overlapped the affected weld. Unfortunately, the augmented thermal sleeve RTs did not provide the overlap and resolution necessary to accurately read the subject welds. The ISI history for the pipe to safe end welds and safe end examinations are provided in Table 1.

Current analysis of existing vibration data (FIP obtained and historical data) indicates that vibration can not be the single initiator of this event. However, it may have contributed to the increased leak rate during the incident.

The potential for an over pressurization event causing the crack has been investigated and it has been determined that over pressurization was highly unlikely because the pipe rupture is circumferential (over pressurization usually results in longitudinal failures).

On April 26, 1997, ultrasonic tests (UTs) were performed on the 2A2, 2B1 and 2B2 pipe-to-safe end welds and produced acceptable results. The Unit 2 A1 injection nozzle was not UT tested because of the cleaning requirements for performing UT testing and a concern that the failure would be disturbed, making laboratory analysis more difficult. NDE penetrant test (PT) examinations of the Unit 2 HPI injection lines results are acceptable. These tests were performed and evaluated on April 26-27, 1997.

The failed weld specimen was removed and shipped to a metallurgical laboratory in Lynchburg, VA on April 28, 1997. Extensive laboratory analyses are planned to determine the root cause of the failure. Preliminary results from the laboratory analysis should begin to become available by April 30, 1997. At this time, failure analysis efforts are focusing on the potential for material failure as a result of thermal cycling. This effort, combined with the information from the laboratory analysis, should provide a more definitive cause for the failure by May 2, 1997.

Oconee has determined that the safe end and thermal sleeve for the 2A1 nozzle will need to be replaced. Current plans are to replace the safe end and thermal sleeve later this week. These components will also be shipped to Lynchburg, VA for metallurgical tests.

In addition, NDE RT examinations are being completed on the three remaining Unit 2 HPI nozzles while the system is drained to remove the failed specimen. A primary objective of performing the RT examinations is to obtain additional data to assist in further evaluating the potential for any flaws in the HPI nozzles of the currently operating units.

Oconee Units 1 and 3 JCO

At this time there is no data that indicates flaws may exist in the Unit 1 and Unit 3 HPI nozzles. Previous inspection data for Oconee Units 1 and 3 have been carefully examined and no questionable NDE indications were identified.

As a result of the Unit 2 RCS leak, compensatory actions have been implemented by Operations to assure that the potential for similar RCS leakage on Oconee Units 1 and 3 is carefully monitored. These actions are documented on Operations turnover sheets and are discussed during shift turnover meetings. Operations has been instructed to take conservative actions if a leak develops on Oconee Units 1 or

3. Any confirmed RCS leak greater than 1 gpm in the Reactor Building will be treated as a non-isolable leak and the reactor will be promptly shut down.

Since thermal stresses may be a contributor to the weld crack on the HPI 2A1 injection line, Operations has been instructed to minimize the potential for thermal stresses on the normal injection lines for Units 1 and 3. Normal makeup through each injection line is approximately 15-20 gpm and is more than adequate to prevent excessive thermal gradients in the injection nozzles. The FIP team reviewed data taken in 1990 which indicates that undesirable thermal gradients may occur in the injection nozzles under certain conditions with makeup flow isolated. Thus, until the data can be further analyzed, Operations has been conservatively instructed not to isolate normal makeup except for emergency conditions.

Operations has the ability to detect RCS leakage using several methods. These methods include:

- The Reactor Building air particulate monitor which is sensitive to low leakage rates. The rates of RCS leakage to which the instrument is sensitive are 0.1 gpm to greater than 30 gpm, assuming corrosion product activity and no fuel cladding leakage.

- Leakage is monitored by a level indicator in the reactor building normal sump. Changes in the normal sump level can indicate leakage from the RC system. The sump capacity is 15 gallons per inch of height and each graduation on the level indicates 0.5 inches of sump height. Thus, this indicator is capable of detecting changes on the order of 7.5 gallons of leakage into the sump. A 1 gpm leak can be detected within less than 10 minutes.

- Total RCS leakage is determined by indications of reactor power, coolant temperature, pressurizer water level and letdown storage tank level. All of these indications are recorded. Leakage calculations are performed once per shift. As an interim measure until the root cause of the Unit 2 HPI line weld crack can be determined, Operations will be performing leakage calculations twice per shift.

- Since pressurizer level is held constant, leakage is replaced to the RCS from the letdown storage tank resulting in decreased letdown storage tank level. A 1 gpm leak can be detected within one half hour using

letdown storage tank inventory monitoring. The need to carefully monitor LDST level for indications of potential RCS leakage has been stressed to the operators.

All of the above leakage indications were effective during the Unit 2 event and are operable on Units 1 and 3.

The small break LOCA break spectrum for Oconee includes an HPI line break. This break would result in a 0.025 ft^2 small break LOCA and is successfully mitigated by the HPI System. Since the HPI System is required to mitigate this event, maintenance on this system is being restricted until the root cause of the Unit 2 crack is determined.

Conclusions

Oconee is aggressively investigating the root cause of the crack in the HPI System 2A1 injection line. At this time, based on an engineering review of the data that has been collected, it is Oconee's position that the continued safe opration of Oconee Units 1 and 3 is justified. Compensatory actions have been implemented by Oconee Operations to carefully monitor the potential for leakage on Units 1 and 3. In addition, compensatory actions have been implemented to minimize the potential for thermal transients on the HPI nozzles and to restrict maintenance on the HPI System until the root cause of the Unit 2 HPI line weld crack can be determined.

As the investigation of the HPI System 2A1 injection line weld crack continues, new information will be immediately evaluated with respect to its impact on the continued safe operation of Oconee Units 1 and 3. The Unit 2 outage is being managed to minimize the amount of time at reduced inventory conditions. Definitive information related to the root cause of the crack will not be available until the failure analyses are completed at the metallurgical laboratory. Oconee management will continue to communicate findings from the ongoing investigation to the staff in a timely manner.

Table 1

ISI HISTORY-PIPE TO SAFE END WELDS & SAFE END EXAMINATIONS

UNIT 1-1A1 **WELD 1-51A-11-94**

SAFE END 1PDA1-47
AUGMENTED EXAMS PERFORMED- HPI SAFE END EXAMINATIONS (85-20)
RFO 9 UT & RT PERFORMED 3/6/86
RFO 11 UT & RT PERFORMED 1/18/89

1A2 **WELD 1-51A-11-85A**
CATEGORY B-J NOMINAL PIPE SIZE < 4 IN.
RFO 13 PT PERFORMED 08/06/91

SAFE END 1PDA2-47
AUGMENTED EXAMS - HPI SAFE END EXAMINATIONS (85-20)
RFO 9 UT & RT PERFORMED 3/6/86
RFO 11 UT & RT PERFORMED 1/18/89

1B1 **WELD 1-51A-11-89**
AUGMENTED EXAMS -THERMAL STRESS PIPING (88-08)
RFO 11 UT PERFORMED 01/13/89
RFO 13 UT PERFORMED 08/21/91
CATEGORY B-J NOMINAL PIPE SIZE < 4 IN.
RFO 12 PT PERFORMED 05/03/90

SAFE END 1PDB1-47
AUGMENTED EXAMS - HPI SAFE END EXAMINATIONS (85-20)
RFO 9 UT & RT PERFORMED 02/26/86
RFO 11 UT & RT PERFORMED 01/22/89

1B2 **WELD 1-51A-11-87**
AUGMENTED EXAMS -THERMAL STRESS PIPING (88-08)
RFO 11 UT PERFORMED 02/02/89
RFO 13 UT PERFORMED 08/21/91
RFO 16 UT PERFORMED 11/08/95

CATEGORY B-J NOMINAL PIPE SIZE < 4 IN.
RFO 12 PT PERFORMED 05/03/90

SAFE END 1PDB2-47
AUGMENTED EXAMS - HPI SAFE END EXAMINATIONS (85-20)
RFO 9 RT PERFORMED 02/26/86
RFO 11 RT PERFORMED 01/22/89

UNIT 2-2A1 **WELD 2-51A-39-44**
CATEGORY B-J NOMINAL PIPE SIZE < 4 IN.
RFO 11 PT PERFORMED 09/20/90

SAFE END 2PDA1-47
AUGMENTED EXAMS - HPI SAFE END EXAMINATIONS (85-20)
RFO 7 UT & RT PERFORMED 03/03/85
RFO 8 UT & RT PERFORMED 09/04/86
RFO 9 UT & RT PERFORMED 02/17/88
RFO 10 UT & RT PERFORMED 06/01/89
RFO 15 UT & RT PERFORMED 04/12/96

2A2 **WELD 2-51A-39-87B**

SAFE END 2PDA2-47
AUGMENTED EXAMS - HPI SAFE END EXAMINATIONS (85-20)
RFO 8 UT & RT PERFORMED 09/04/86
RFO 10 UT & RT PERFORMED 06/01/89
RFO 15 UT & RT PERFORMED 04/12/96

2B1 **WELD 2-51A-39-90C**
AUGMENTED EXAMS -THERMAL STRESS PIPING (88-08)
RFO 10 UT PERFORMED 06/13/89
RFO 12 UT PERFORMED 02/03/92
RFO 15 UT PERFORMED 04/11/96

CATEGORY B-J NOMINAL PIPE SIZE < 4 IN.
RFO 11 PT PERFORMED 09/20/90

WELD 2-51A-39-90B
AUGMENTED EXAMS -THERMAL STRESS PIPING (88-08)
RFO 10 UT PERFORMED 06/13/89
RFO 12 UT PERFORMED 02/03/92
RFO 15 UT PERFORMED 04/11/96

SAFE END 2PDB1-47
AUGMENTED EXAMS- HPI SAFE END EXAMINATIONS (85-20)
RFO 7 RT PERFORMED 03/04/85
RFO 8 RT PERFORMED 08/26/86
RFO 9 RT PERFORMED 02/17/88
RFO 10 RT PERFORMED 06/05/89
RFO 15 RT PERFORMED 04/12/96

2B2 **WELD 2-51A-39-92A**
AUGMENTED EXAMS -THERMAL STRESS PIPING (88-08)
RFO 10 UT PERFORMED 06/13/89
RFO 12 UT PERFORMED 02/03/92
RF0 15 UT PERFORMED 04/30/96

CATEGORY B-J NOMINAL PIPE SIZE < 4 IN.
RFO 12 PT PERFORMED 01/15/92

Table 1 (Continued)

WELD 2-51A-39-92B
AUGMENTED EXAMS -THERMAL STRESS PIPING (88-08)
RFO 10 UT PERFORMED 06/13/89
RFO 12 UT PERFORMED 02/03/92
RFO 15 UT PERFORMED 04/30/96

SAFE END 2PDB2-47
AUGMENTED EXAMS- HPI SAFE END EXAMINATIONS (85-20)
RFO 8 UT & RT PERFORMED 09/04/86
RFO 10 UT & RT PERFORMED 06/01/89
RFO 15 UT & RT PERFORMED 04/12/96

UNIT 3-3A1 **WELD 3-51A-63-40**
CATEGORY B-J NOMINAL PIPE SIZE < 4 IN.
RFO 13 PT PERFORMED 08/01/92

SAFE END 3PDA1-47
AUGMENTED EXAMS- HPI SAFE END EXAMINATIONS (85-20)
RFO 8 UT & RT PERFORMED 09/12/85
RFO 9 UT & RT PERFORMED 02/26/87
RFO 10 UT & RT PERFORMED 09/09/88
RFO 11 UT & RT PERFORMED 12/06/89
RFO 16 UT & RT PERFORMED 11/19/96

3A2 **WELD 3-51A-64-24A**
CATEGORY B-J NOMINAL PIPE SIZE < 4 IN.
RFO 13 PT PERFORMED 09/17/92

SAFE END 3PDA2-47
AUGMENTED EXAMS- HPI SAFE END EXAMINATIONS (85-20)
RFO 9 UT & RT PERFORMED 01/27/87
RFO 11 UT & RT PERFORMED 11/26/89
RFO 16 UT & RT PERFORMED 11/19/96

3B1 **WELD 3-51A-61-44A**
AUGMENTED EXAMS -THERMAL STRESS PIPING (88-08)
RFO 11 UT PERFORMED 11/17/89
RFO 13 UT PERFORMED 08/08/92
RFO 15 UT PERFORMED 06/21/95

CATEGORY B-J NOMINAL PIPE SIZE < 4 IN.
RFO 12 PT PERFORMED 02/20/91

SAFE END 3PDB1-47
AUGMENTED EXAMS- HPI SAFE END EXAMINATIONS (85-20)
RFO 8 RT PERFORMED 08/26/85
RFO 9 RT PERFORMED 02/09/87
RFO 10 RT PERFORMED 09/05/88
RFO 11 RT PERFORMED 11/26/89
RFO 16 RT PERFORMED 11/19/96

3B2 **WELD 3-51A-62-26**

AUGMENTED EXAMS-THERMAL STRESS PIPING (88-08)
- RFO 11 UT PERFORMED 11/16/89
- RFO 13 UT PERFORMED 08/08/92
- RFO 15 UT PERFORMED 06/21/95

CATEGORY B-J NOMINAL PIPE SIZE < 4 IN.
- RFO 11 PT PERFORMED 11/15/89

SAFE END 3PDB2-47

AUGMENTED EXAMS -HPI SAFE END EXAMINATIONS (85-20)
- RFO 8 RT PERFORMED 08/26/85
- RFO 9 RT PERFORMED 02/09/87
- RFO 10 RT PERFORMED 09/05/88
- RFO 11 RT PERFORMED 11/26/89
- RFO 16 RT PERFORMED 11/19/96