# APPENDIX B

## U.S. NUCLEAR REGULATORY CUMMISSION REGION IV

NRC Inspection Report: 50-313/89-23 50-368/89-23 Operating Licenses: DRP-51 NPF-6

Dockets: 50-313 50-368

Licensee: Arkansas Power & Light Company (AP&L) P.O. Box 551 Little Rock, Arkansas 72203

Facility Name: Arkansas Nuclear One (ANO), Units 1 and 2

Inspection At: ANO, Russellville, Arkansas

Inspection Conducted: June 5-14, 1989

Inspectors:

189

. Bundy, Reactor Inspector, Test Programs Section, Division of Reactor Safety

V. Azua, Reactor Inspector, Test Programs

Section, Division of Reactor Safety

Accompanying Personnel:

W. C. Seidle, Chief, Test Programs Section Division of Reactor Safety, June 8-9, 1989

7/6/89

Approved:

Seidle, Chief, Test Programs Section Division of Reactor Safety

#### Inspection Summary

#### Inspection Conducted June 5-14, 1989 (Report 50-313/89-23; 50-368/89-23)

Areas Inspected: Routine, unannounced inspection of licensee actions to prevent and, if necessary, respond to loss of decay heat removal (DHR) as described in Generic Letter (GL) 88-17.

Unit 1 Results (Report 50-313/89-23): The licensee appeared to have implemented the recommendations for expeditious actions contained in GL 88-17 except for resolution of the issues concerning two reliable, independent reactor coolant system (RCS) level instruments and testing of the RCS level instruments. These issues are being tracked as Unresolved Items 313/8923-01 and -03.

The licensee's 90-day response to GL 85-17 (programmed enhancements) led the NRC inspector to believe that the licensee was taking credit for instruments sensing water level in the RCS "A" and "B" hot legs as the two independent RCS level instruments. The NRC inspector learned from internal memoranda, which were later substantiated by a letter from the licensee to the NRC, that the two independent RCS level instruments were considered to be the "B" loop wide and narrow range instruments. The licensee's failure to provide an accurate and complete 90-day response is an apparent violation of 10 CFR 50.9 (313/8923-04). A question concerning clarification of procedural requirements for the independent sources of RCS inventory makeup is being tracked as Unresolved Item 313/8923-02. The licensee committed, in the 90-day response to GL 88-17, to install variable setpoint alarms for low decay heat removal flow, high core exit temperature (CET) indications, and RCS low level in the spring 1990 outage. The licensee indicated that the design for these installations had not been completed. Other programmed enhancements appeared to have been implemented. Details concerning the items identified for NRC inspector followup are discussed in paragraph 2.1.

Unit 2 Results (Report 50-368/89-23): The licensee's expeditious actions pursuant to GL 88-17, as committed to in the 60-day response, appeared to have been implemented. The programmed enhancements committed to in the 90-day response appeared to have been completed with the following exceptions:

Design and installation of:

- o an alternate RCS level instrument
- ° a high CET alarm
- variable setpoint low DHR flow alarm

No violations or deviations were identified.

## DETAILS

#### 1.0 Persons Contacted

AP&L

\*N. S. Carns, Director, Nuclear Operations \*G. T. Jones, General Manager, Engineering E. Ewing, General Manager, Plant Support W. Perks, Training Manager \*R. Lane, Manager, ANO Engineering \*A. J. Wrage III, Manager, EIC Design Engineering D. Williams, Project Manager, Nuclear Industry Support \*J. D. Vandergrift, Operations Manager \*D. B. Lomax, Plant Licensing Supervisor E. Wentz, Operations Training Supervisor, Unit 1 \*A. B. McGregor, Superintendent, Engineering Services G. H. Kendrick, Superintendent, Instrumentation and Controls \*J. Taylor-Brown, Superintendent, Quality Control W. Cottingham, Supervisor, EIC Design Engineering \*C. P. Zimmerman, Operations Technical Supervisor, Unit 1 \*R. Thornton, Licensing \*G. R. D'Aunoy, Operations Technical Engineer, Unit 2 G. V. Woolf, Operations Technical Engineer, Unit 2

### NRC

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\*W. D. Johnson, Senior Resident Inspector \*R. Haag, Resident Inspector

The NRC inspectors also interviewed other licensee employees during the inspection.

\*Denotes those attending the exit interview on June 9, 1989.

# 2.0 Licensee Actions to Prevent and Respond to Loss of DHR (TI 2515/101)

The purpose of this inspection was to verify licensee actions to prevent and, if necessary, to respond to loss of DHR during operations with the reactor coolant system (RCS) partially drained. Licensee actions were in response to recommendations contained in GL 88-17, "Loss of Decay Heat Removal." Recommendations were made by GL 88-17 in two categories:

- expeditious actions which should be implemented prior to operating in a reduced inventory condition, and
  - programmed enhancements which should be developed in parallel with the expeditious actions and may replace, supplement, or add to the expeditious actions.

For purposes of future reference, the recommendations are briefly paraphrased below (to avoid confusion, the numbers are identical to similar items contained in GL 88-17):

#### Expeditious Actions

- Discuss related events and lessons learned with appropriate plant personnel. Provide training shortly before entering a reduced inventory condition.
- (2) Implement procedures and administrative controls for containment closure in the event of loss of DHR event. This should be accomplished:
  - (a) prior to entering a reduced RCS inventory condition for Nuclear Steam Supply Systems (NSSSs) supplied by Combustion Engineering (CE) or Westinghouse; and
  - (b) prior to entering an RCS condition wherein the water level is lower than 4 inches below the top of the flow area of the hot legs at the junction of the hot legs to the reactor vessel (RV) for NSSSs supplied by Babcock and Wilcox (B&W), and should apply whenever operating in those conditions. If such procedures and administrative controls are not operational, then either do not enter the applicable condition or maintain a closed containment.
- (3) Provide at least two independent, continuous temperature indications that are representative of the core exit conditions whenever the RCS is in mid-loop condition and the RV head is located on top of the RV.
- (4) Provide at least two independent, continuous RCS water level indications whenever the RCS is in a reduced inventory condition. Indications should be periodically checked and recorded by an operator or automatically and continuously monitored and alarmed.
- (5) Implement procedures and administrative controls that generally avoid operations that deliberately or knowingly lead to perturbations to the RCS and/or to systems that are necessary to maintain the RCS in a stable and controlled condition while that RCS is in a reduced inventory condition. If avoidance of perturbations is impossible, compensatory measures should be taken.
- (6) Provide at least two available or operable means of adding inventory to the RCS that are in addition to pumps that are a part of the normal DHR systems.
- (7) For CE unit, implement procedures and administrative controls that reasonably assure that both hot legs are not blocked simultaneously by nozzle dams unless a vent path is provided that is large enough to prevent pressurization of the upper plenum of the RV.

## (8) Not applicable to ANO. (Applies to units with loop stop valves.)

#### Programmed Enhancements

(1) Instrumentation

Provide reliable indication of parameters that describe the state of the RCS and the performance of systems normally used to cool the RCS for both normal and accident conditions. At a minimum, provide the following in the control room (CR):

- (a) two independent RCS level indications;
- (b) at least two independent temperature measurements representative of the core exit whenever the RV head is located on top of the RV;
- (c) the capability of continuously monitoring DHR system performance whenever a DHR system is being used for cooling the RCS; and
- (d) visible and audible indications of abnormal conditions in temperature, level, and DHR performance.
- (2) Procedures

Develop and implement procedures that cover reduced inventory operation and that provide an adequate basis of entry into a reduced inventory condition. These include:

- (a) procedures that cover normal operation of the NSSS, the containment, and supporting systems under conditions for which cooling would normally be provided by DHR systems;
- (b) procedures that cover emergency, abnormal, off-normal, or the equivalent operation of the NSSS, the containment, and supporting systems if an off-normal condition occurs while operating under conditions for which cooling would normally be provided by DHR systems; and
- (c) administrative controls that support and supplement the procedures in items (a), (b), and all other actions identified in this communication, as appropriate.
- (3) Equipment
  - (a) provide equipment of high reliability for cooling the RCS and avoiding loss of RCS cooling;

- (b) maintain equipment available to mitigate loss of DHR or loss of RCS inventory should they occur including at least one high pressure injection pump and one other system, each sufficient to keep the core covered; and
- (c) provide adequate equipment for personnel communications involving activities related to the RCS or systems necessary to maintain the RCS in a stable and controlled condition.
- (4) Analyses

Conduct analyses to supplement existing information and develop a basis for procedures, instrumentation installation and response, and equipment/NSSS interactions and response.

(5) Technical Specifications (TS)

TS, that restrict or limit the safety benefit of the actions identified in this letter, should be identified and appropriate changes should be submitted.

(6) RCS Perturbations

Reexamine Item (5) of expeditious actions and refine operations as necessary to reasonably minimize the likelihood of loss of DHR.

Comments on the licensees actions in response to GL 88-17 are provided for each unit below. Attachment 1 is a tabulation of documents reviewed by the NRC inspector which related to Unit 1. The asterisked documents also applied to Unit 2. Attachment 2 is a list of documents reviewed by the NRC inspector relative to Unit 2 actions only.

### 2.1 Unit 1

The NRC inspector reviewed lesson plans and class attendance records which indicated that training responsive to Expeditious Action (1) had been conducted. Simulator training on DHR abnormal operations had been conducted in late summer 1988. A considerable number of events and lessons learned were included in the lesson plans as well as revised operations procedures which were generally responsive to GL 88-17 expeditious actions. The NRC inspector noted that most of the training was conducted using procedures with numerous temporary changes. For example, OAP 1015.02, Revision 8 (Attachment 1, Document 16) had been inserted in the shift turnover book, but no formal training had been conducted. The NRC inspector noted no substantive differences between it and the earlier version with temporary changes.

The NRC inspector reviewed a lesson plan and attendance records for an expedited course covering the technical aspects of AP&L's 60-day response to GL 88-17. It was presented, in February 1989, to all operations and

maintenance personnel in anticipation of RCS draindown for steam generator tube plugging and/or reactor coolant pump seal work. It covered the salient points of GL 88-17. The basic format was incorporated into Course AA-21002-020 and included in the requalification training program. The same materia.s were also included in Course AA-51002-020 on May 23, 1989, and incorporated in the operator training program. The requirements of Expeditious Action (1) appear to have been satisfied.

With regard to Expeditious Action (2)(b), the licensee did not address implementation of procedures and administrative controls for containment closure in the event of loss of DHR. As an alternative, requirements were placed in OAP 1015.02 and (OP) 1103.11 (Attachment 1, Documents 16 and 17) to maintain RCS Level greater than or equal to 371 feet 2 inches. The licensee determined that this would be above the area which is 4 inches below the top of the flow area of the hot leg and, therefore, containment closure requirements would not apply. From a sketch supplied by the licensee, the NRC inspector calculated 4 inches below the top of the hot leg to be 370 feet 8 inches. As discussed below in an internal memorandum (Attachment 1. Document 9), the licensee established that the only reliable, continuous level indications are "B" hot leg wide and narrow range level instruments. The NRC inspector interpreted this memorandum to indicate that, under the most favorable conditions, the wide range instrument accuracy limitation is ±9 inches. Therefore, the licensee would have to rely on a single level instrument ("B" loop - narrow range) to preclude operation at a prohibited low level. This issue will be tracked as Unresolved Item 313/8923-01, pending further study by the licensee and review by the NRC.

With regard to Expeditious Action (3) and Programmed Enhancement (1)(b), Unit 1 has 32 bottom entry CETs. Procedure OAP 1015.02 required monitoring a CET from each train in a reduced inventory condition and recording the readings. Also, the inadequate core cooling (ICC) display on C19 as well as the safety parameter display system (SPDS) decay heat screen provided continuous monitoring.

With regard to Expeditious Action (5) and Programmed Enhancement (6), Attachment B in OAP 1015.02 provided a list of components which should not have been taken out-of-service in a reduced inventory mode. The procedure required that there be compensatory measures if one of these components was required to be out-of-service.

With regard to Expeditious Action (6) and Programmed Enhancement (3), a memorandum referencing Calculation 89-1005-03 (Attachment 1, Documents 8 and 21) states that the reactor building (RB) spray pumps satisfy the second available means of adding inventory to the RCS. They were required to be operable in a reduced inventory condition together with high pressure injection (HPI) pumps by OAP 1015.02. OAP 1015.02 also specified the components in two of four DHR systems which must be operable. Various other equipment alignments for DHR were also specified by this procedure.

With regard to Programmed Enhancements (1)(c) and (d), the dedicated SPDS display for DHR system monitoring appeared to satisfy GL 88-17

recommendations. The licensee has implemented an SPDS DHR diagnostic display, which provides trends of DHR flow and DHR pump suction and discharge pressure. The low flow alarm setpoint was lowered to provide a meaningful alarm for all drained down conditions. There was also a DHR pump trip alarm. The licensee committed, in the 90-day response, to install variable setpoint alarms for low DHR flow, high CET indications, and low RCS level in the spring 1990 outage. Because no plans for the variable setpoint alarms were available, these items will be included in a future NRC inspection prior to closeout of Temporary Instruction (TI) 2515/101.

With regard to Programmed Enhancement (2), it appeared licensee procedures and administrative controls generally supported GL 88-17 changes which had been implemented. Some of the procedure changes were temporary and further procedure revision will be required. The HPI and RB spray pumps were included as a part of the lineups in OAP 1015.02; Procedure AOP 1203.28 (Attachment 1, Document 18) did not appear to support use of these pumps for inventory makeup. This discrepancy will be tracked as Unresolved Item 313/8923-02 pending further discussion between the licensee and NRC on procedural requirements for using independent inventory makeup pumps.

As discussed below, the licensee elected to use instruments having a common tap for the liquid leg as the two independent RCS level indicators. However, there were no test or surveillance procedures to assure valid level measurements by each instrument as discussed in Section 3.1.2.1 of Enclosure 2 to GL 88-17. As pointed out in the enclosure, there have been instances where difficulties with blockage of the liquid connection have invalidated level indications. Discussions with the licensee indicated that potential blockage of the tap had not been analyzed. The need for test procedures to assure that the RCS coolant level instruments will perform satisfactorily is an unresolved item (313/8923-03) pending further licensee clarification and NRC review.

With the exceptions discussed herein, it appeared that the licensee had performed appropriate analyses in accordance with Programmed Enhancement (4). Specifically, the NRC inspector reviewed the analyses for RCS pressurization and associated required makeup capability and times to boiling and core uncovery after loss of DHR (Attachment 1, Documents 8, 11, and 21).

The NRC inspector did not evaluate TS changes that might be required. The licensee indicated that TS change evaluation, for DHR considerations, is in progress. This item will be inspected during a future inspection prior to closure of TI 2515/101.

In attempting to establish the licensee's compliance with commitments made in the 60- and 90-day responses to GL 88-17 (Attachment 1, Documents 4 and 10, respectively) relative to Expeditious Action (4) and Programmed Enhancement (1)(a), the NRC inspector discovered contradictory statements. Specifically, in discussing "two independent continuous RCS water level indications," the following statement was made in the 60-day response: "ANO-1 presently has hot leg level indication for both RCS loops . . . ." Similarly, in discussing two reliable independent RCS level indications in the 90-day response, it was stated, "As described in our 60-day response, ANO-1 presently has two independent RCS level indications (Hot Leg Level Monitoring System)." Because of the reference back to the 60-day response, the MRC inspector assumed that the hot leg level monitors for the two loops constituted the two reliable, independent, continuous RCS water level indications. However, upon further research, the NRC inspector discovered the following statement in an internal memorandum (Attachment 1, Document 7) which was issued 6 weeks prior to the 90-day response:

"Two independent and continuous indications of RCS level must be maintained when RCS level is less than 375'. This will be satisfied by using the ICC level displays. The B Loop narrow range display and the B Loop wide range display should be used. The A Loop instruments have a flow induced error which causes them to read lower than actual and are therefore not reliable indications of actual level. They may however be useful for indicating trends. . . ."

This information was confirmed in a second internal memorandum issued 2 weeks later (Attachment 1, Document 9).

During followup with the licensee, it was confirmed that it was their present intent to consider the "B" loop narrow range display and the "B" loop wide range display to be the two independent RCS water level indications. This was formally confirmed by a letter to the NRC (Attachment 1, Document 12). The NRC inspector noted that readings for "B" RCS level only are required by OAP 1015.02. The information concerning the two independent RCS level indications, provided in the 90-day response, was considered by the NRC inspector to be incomplete and inaccurate regarding which level indications were to be used and, therefore, is an apparent violation of 10 CFR 50.9 (313/8923-04).

Further study of licensee memoranda, by the NRC inspector, led to the conclusion that "B" loop wide and narrow range level instruments may not constitute reliable, independent instruments within the intent of GL 88-17 because of suspected inaccuracy of the wide range instrument as discussed above. An internal memorandum (Attachment 1, Document 3) contains the following statement:

"Also the wide range ICC level transmitter errors will preclude the use of these instruments to assess level requirements."

A later memorandum (Attachment 1, Document 5) raises further questions concerning the adequacy of wide and narrow range level instrumentation by the following statement:

"In reviewing the six programmed enhancements recommended in GL 88-17 it appears that the following additional improvements should be provided: . . .

- "- A second level transmitter with equivalent capabilities as the B loop narrow range transmitter.
- "- Improve the reliability of the hot leg level transmitters. (May require a means to maintain reference legs filled and investigate transmitter failures.)"

The NRC inspector did not locate engineering dispositions to these suggestions. The RCS water level instrument independency and reliability issues will be tracked in conjunction with Unresolved Item 313/8923-01 discussed above.

## 2.2 Unit 2

The licensee's intended actions in response to GL 88-17, as contained in the 60- and 90-day responses (Attachment 1, Documents 4 and 10), were found to be adequate with respect to Unit 2.

To ascertain completion of the expeditious actions tabulated above, the NRC inspector reviewed the documents listed in Attachment 2. The licensee appeared to have implemented all expeditious actions as stated in the 60-day response.

V.th regard to programmed enhancements as stated in the 90-day response, the licensee's procedures and programs generally appeared sufficient. However, it was observed that the licensee was taking credit for a tygon tube system as the second method of RCS level indication. As stated in GL 88-17, the tygon tube system is only acceptable in the short-term. The licensee committed to install an alternate RCS level indication system no later than the 1991 (2R8) refueling outage.

There were no violations or deviations relating to Unit 2 identified.

#### 3.0 Exit Interview

The NRC inspectors met with the licensee representatives denoted in paragraph 1.0 on June 9, 1989, and summarized the scope and preliminary findings of this inspection. Also, the Region IV Chief, Test Programs Section, and other Region IV Reactor Safety Division inspectors discussed with the AP&L General Manager - Plant Support, Region IV concerns involving the accuracy of the wide range RCS level indication during a telephone conversation on June 14, 1989. The licensee did not identify, as proprietary, any of the materials provided to, or reviewed by, the NRC inspectors during this inspection.

#### ATTACHMENT 1

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#### UNIT 1 RELATED LOCUMENTS REVIEWED

- \*1. Memorandum LIC-118-49, Licensing to Distribution, "Action Assignments from November 23, 1988 Meeting on GL 88-17 Response," dated November 30, 1988
- \*2. Memorandum LIC-128-18, Licensing to Distribution, "December 14, 1988 Meeting on GL 88-17," dated December 19, 1988
- \*3. Memorandum ANO-88-2-00942, Operations to Licensing, "ANO Action Assignments from November 23, 1988 Meeting on GL 88-17 Response," dated December 29, 1988
- \*4. Letter OCANO18901, AP&L to NRC, "GL 88-17 (Loss of DHR) 60-day Response," dated January 5, 1989
- Memorandum ANO-89-00477, Operations to Licensing, "ANO Action Assignments from November 23, 1988 Meeting on GL 88-17 Response," dated January 12, 1989
- Memorandum ANO-89-01361, Unit 1 Operations to Work Control Center, "Decay Heat Removal Equipment List," dated February 1, 1989
- Memorandum ANO-89-01364, Unit 1 Operations Superintendent to Shift Supervisors, "DHR Operations During Draindown Operations," dated February 1, 1989
- Memorandum ANO-89-01491, Unit 1 Operations Superintendent to File, "RCS Makeup Capability Using Reactor Building Spray Pumps," dated February 1, 1989
- Memorandum EIC-89-061, Engineering to Unit 1 Operations, "GL 88-17 Instrument Loop Error Calculations for ANO-1 Hotleg Level Instruments," dated February 14, 1989
- \*10. Letter OCAN038908, AP&L to NRC, "GL 88-17 90-day Response," dated March 14, 1989
- Memorandum, Engineering to ANO Unit 1 Operations, "ANO-1 Times to Boiling and Core Uncovery After Loss of DHR," dated June 5, 1989 at Little Rock
- 12. Letter 1CAN068907, AP&L to NRC, "Clarification of GL 88-17 Response Regarding Independent RCS Level Instrumentation," dated June 12, 1989
- Memorandum RER-89-00194, "Schedule for Training on DHR System as Required by GL 88-17"
- 14. Simulator Practice Guide, "DHR Abnormal Operations"
- 15. Case Study INPO 88-018, "Material for a Case Study on Loss of Decay Heat Removal," dated September 1988

- Operations Administrative Procedure (OAP) 1015.02, Revision 8, "DHR and LTOP System Control," Approved May 10, 1989
- RCS Operating Procedure (OP) 1103.11, Revision 9, imporary Change 3, "Draining and Nitrogen Blanketing of the RCS," Approved May 17, 1989
- Abnormal Operating Procedure (AOP) 1203.28, Revision 5, "Loss of Decay Heat Removal System," Approved October 13, 1988
- 19. AOP 1203.121, Revision 25, "Annunciator K10 Corrective Action (B-2)"
- AOP 1203.12J, Revision 25, "Annunciator K11 Corrective Action (A-1, A-3, C-3, F-7)
- Calculation 89-1005-03, "ANO-1 Loss-of-DHR RCS Pressurization Estimates," Approved February 4, 1989
- 22. Response to L82-1246, Unit 1 Operations
- 23. Lesson Plan, Course AA-51002-020, "DHR," dated May 23, 1989

\*Documents which also relate to ANO, Unit 2.

### ATTACHMENT 2

### UNIT 2 RELATED DOCUMENTS REVIEWED

- Mechanical Maintenance Procedure 2402.026, Revision 6, "Unit II Equipment Hatch Opening, Closing, and Maintenance," dated April 28, 1989
- Maintenance Administrative Procedure 1025.003, Revision 29, "Conduct of Maintenance," dated April 22, 1989
- Abnormal Operating Procedures (AOP) 2203.12G, Revision 15, "Annunciator 2KO7 Corrective Action," dated January 27, 1988
- AOP 2203.29, Revision 2, "Loss of Flow or Inventory While on Shutdown Cooling," draft
- 5. AOP 2203.22, Revision 2, "Loss of Service Water," dated August 21, 1987
- Reactor Coolant System Operating Procedure 2103.11, Revision 11, "Draining the RCS," dated April 19, 1989
- Operations Administrative Procedure 1015.08, Revision 2, "Unit 2 Shutdown Cooling System Maintenance Control," dated November 28, 1983
- Unit II Simulator Exercise Guide AA52011-010, Revision 0, "Shutdown Cooling Operations (Steady State)," dated May 26, 1987
- Unit II Simulator Malfunction Scenario 13, Revision 0, "A. LPSI Pump Failure B. SDC System Leak C. Loss of Service Water to SDC Heat Exchanger," dated July 23, 1987
- Plant Operations Procedure 2102.10, Revision 20, "Plant Shutdown and Cooldown," dated May 26, 1989
- Training Course AA22002-54/AA52002-042, "Shutdown Cooling Concerns," dated February 22, 1989
- Memorandum ANO-88-2-00887, Operations Manager to Supervisor Technical Operations, "ANO Unit 2 Loss of Shutdown Cooling Necessary Actions," dated November 29, 1988