APPENDIX B

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report: 50-313/90-45
50-368/90-45

Operating Licenses: DRP-51
NPF-6

Dockets: 50-313
50-368

Licensee: Entergy Operations, Inc.
Route 3, Box 137G
Russellville, Arkansas 72801

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

Inspection At: ANO, Russellville, Arkansas

Inspection Conducted: November 26-30, 1990, onsite and
December 3-6, 1990, in-office

Inspector: H. F. Bundy, Reactor Inspector, Test Programs Section, Division of Reactor Safety — Date 1/4/91

Accompanying Personnel: W. C. Lyon, Senior Reactor Engineer, NRR

Approved: W. C. Seidle, Chief, Test Programs Section Division of Reactor Safety — Date 1/7/91

Inspection Summary

Inspection Conducted November 26-30 and December 3-6, 1990 (Report 50-313/90-45; 50-368/90-45)

Areas Inspected: Routine, announced inspection of actions on previous inspection findings and programmed enhancements in response to Generic Letter (GL) 88-17, "Loss of Decay Heat Removal (DHR)."

Unit 1 Results: All followup items identified in Inspection Report 50-313/89-23, which involved the licensee's expeditious actions to prevent loss of DHR, were closed. With the exceptions discussed below, the

licensee's programmed enhancements satisfied the intent of GL 88-17. The level instrumentation appeared to have sufficient reliability and accuracy when temperature compensation was used. With the exceptions discussed below, the procedures appeared comprehensive and DHR performance monitoring appeared responsive to GL 88-17. Weaknesses in the program were identified by the inspectors as follows:

- Failure of the procedures to require logging of core exit thermocouple (CET) data at all times when on DHR with the reactor vessel (RV) head removed; this is discussed in paragraph 3.2.2.4 (Apparent Deviation 313/9045-01).

- The lack of anticipatory loss of DHR pump instrumentation, which is discussed in paragraph 3.2.1.3 (Inspector Followup Item 313/9045-02).

- Lack of procedures for containment control and fast containment closure to respond to a loss of DHR event in which reactor coolant is ejected from the reactor coolant system (RCS), which is discussed in paragraph 3.2.2.1 (Inspector Followup Item 313/9045-03).

- Weaknesses or omissions in the assumptions used to perform analyses completed pursuant to GL 88-17, which are discussed in paragraph 3.2.4 (Inspector Followup Item 313/9045-04).

No violations were identified.

Unit 2 Results: No inspection was performed for Unit 2.

DETAILS

1. PERSONS CONTACTED

Entergy Operations Incorporated

*N. S. Carns, Vice President Operations
*J. W. Yelverton, Director, Operations
*L. W. Humphrey, General Manager, Quality
*J. D. Vandergrift, Plant Manager, Unit 1
*R. A. Fenech, Plant Manager, Unit 2
*J. J. Fisicaro, Manager, Licensing
R. A. Sessoms, Plant Manager, Control
*C. P. Zimmerman, Operations Manager, Unit 1
*R. K. Edington, Operations Manager, Unit 2
*A. J. Wrape III, Design Manager, Electrical and Instrumentation and Control
R. N. Johannes, Project Manager, Outages (Unit 1)
M. R. Harris, Project Manager, Outages (Unit 2)
*R. J. King, Supervisor, Licensing
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*V. Bond, Electrical Engineer, Design Engineering
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*B. L. Garrison, Operations Specialist, Operations Standards
*D. W. Boyd, Licensing Specialist
J. Miller, Nuclear Engineer, Design Engineering
C. Taylor, Licensing Specialist
S. Bennett, Nuclear Safety and Licensing Specialist
C. Thompson, Shift Supervisor
T. Van Schank, Shift Supervisor

NRC

*C. C. Warren, Senior Resident Inspector
L. J. Smith, Resident Inspector

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

*Denotes those attending the exit meeting on November 30, 1990.

2. LICENSEE ACTIONS ON PREVIOUS INSPECTION FINDINGS (TI 2515/101)

(CLOSED) Unresolved Item (313/8923-01): "Establish that RCS Level Instruments are Independent and Sufficiently Accurate." The licensee responded to this issue by letter (Attachment, Document 1). Credit was taken for the "B" loop wide and narrow range level instruments. To ensure the common tap for the

wide and narrow range level instruments was not plugged, the licensee performed an accuracy comparability check between them and the Tygon tube during drain down of the reactor coolant system (RCS). All three indications were required to read within 6 inches of each other, and the most conservative reading on the safety parameter display system (SPDS) was used to establish reduced inventory level. The Tygon tube reading was logged every 15 minutes during draining. The wide range instrument was calibrated just prior to draining; this was to assure that the maximum error did not exceed 6.4 inches. The inspectors verified that current procedures incorporated these administrative requirements. Also, it was observed that the Tygon tube and wide range instrument were reading within 2 inches with RCS level just above reduced inventory. This item is considered closed.

(CLOSED) Unresolved Item (313/8923-03): "Resolve Test Requirements for RCS Level Instruments." The inspector observed that Procedure 1103.11 (Attachment, Document 2) Step 9.9.3, required Level Instruments LI-1195 and LI-1198 and the Tygon tube to be reading within 0.5 feet of each other prior to draining below 375 feet. This resolves the item and it is considered closed.

(CLOSED) Violation (313/8923-04): "Failure to Provide Complete and Accurate Information to the NRC." The inspector reviewed the licensee's letter (Attachment, Document 3), which provided the written response to this violation. The inspector discussed actions in this area with the cognizant nuclear safety and licensing specialist. Draft documents reviewed included the following:

- Training Program for Complete and Accurate Communications With the NRC and
- Station Directive No. A4.502, "Accuracy of Communications."

These documents appeared comprehensive and, when implemented, should improve the quality of communications to the NRC. In view of the fact that a similar issue was discussed during and subsequent to NRC Inspection Report 50-313/90-24; 50-368/90-24, implementation of the procedures and training will be tracked as part of the followup on the later issue (EA 90-175). This violation is considered closed.

3. PROGRAMMED ENHANCEMENTS IN RESPONSE TO GL 88-17 - LOSS OF DECAY HEAT REMOVAL (TI 2515/103)

3.1 GL 88-17 Recommendations and Inspection Scope

GL 88-17 provided recommended licensee actions to prevent and, if necessary, to respond to loss of DHR during operations with the RCS partially drained.

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.

NRC's review of the licensee's expeditious actions was documented in NRC Inspection Report 50-313/89-23; 50-368/89-23. The status of the licensee's programmed enhancements was also discussed. The purpose of this inspection was to follow up on the above NRC inspection report comments and concerns and ascertain completion of programmed enhancements. For the purpose of future reference, the programmed enhancement recommendations are briefly paraphrased below (to avoid confusion, the numbers are identical to similar items contained in GL 88-17):

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:

- Two independent RCS level indications;
- At least two independent temperature measurements representative of the core exit whenever the RV head is located on top of the RV;
- The capability of continuously monitoring DHR system performance whenever a DHR system is being used for cooling the RCS; and
- 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:

- 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;
- 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 should normally be provided by DHR systems; and

- o Administrative controls that support and supplement the procedures in the above items and all other actions identified in this communication, as appropriate.

(3) Equipment

- o Provide equipment of high reliability for cooling the RCS and avoiding loss of RCS cooling;
- o 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
- o 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)

Technical Specifications 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.

3.2 Licensee's Actions in Response to GL 88-17 Programmed Enhancement Recommendations - Unit 1

The inspectors' comments on the licensee's actions are provided below. The Attachment is a tabulation of related documents reviewed by the inspectors. When a document number is cited below, it will be the number assigned in the Attachment. In addition to reviewing the listed documents and interviewing appropriate personnel, the inspectors walked down installed equipment and instrumentation. In general, procedure revisions and instrumentation modification satisfactorily resolved inspector concerns and comments discussed in NRC Inspection Report 50-313/89-23 for Unit 1. No inspection of Unit 2 was performed. Although the licensee's actions were generally responsive to the GL 88-17 programmed enhancement recommendations, the following deficiencies were identified:

- Failure of the procedures to require logging of CET data at all possible times when on DHR with the RV head removed, which is discussed in paragraph 3.2.2.4 (Apparent Deviation 313/9045-01).

- The lack of anticipatory loss of DHR pump instrumentation such as a low pump current alarm or acoustic monitoring, which is discussed in paragraph 3.2.1.3 (Inspector Followup Item 313/9045-02).

- The lack of procedures for containment control and fast containment closure in response to a loss of DHR event in which reactor coolant is ejected from the RCS, which is discussed in paragraph 3.2.2.1 (Inspector Followup Item 313/9045-03).

- Weaknesses or omissions in the assumptions used to perform the analyses completed pursuant to GL 88-17, which is discussed in paragraph 3.2.4 (Inspector Followup Item 313/9045-04).

Details of the inspectors' concerns and other comments on the licensee's actions in response to the programmed enhancement recommendations as committed to in Documents 1 and 4 are documented below.

3.2.1 Instrumentation

3.2.1.1 Level Instrumentation

Indications from two trains of level instrumentation were provided in the control room, although only one train was used under normal DHR system operation because the other was affected by decay heat removal system flow. The inspectors noted that both trains probably would provide information if there were no flow.

The remaining train consisted of wide range and narrow range indication. The lowest narrow range indication shared a pressure connection with the wide range indication, and hence did not provide full independence. The licensee also provided a Tygon tube inside containment and used both the control room and Tygon indications for independent verification.

Control board indications (in the control room) provided a rough indication of level, and the shutdown parameter display system provided both a rough indication and trending. A separate CRT displayed levels to fractions of a foot and provided trending information as well. Additional cross-checks of level could be obtained at some levels by other instrumentation.

Equipment inside containment, such as level transmitters, the Tygon tube, and instrumentation piping, showed evidence of professional installation with attention to such details as prevention of air bubbles or water slugs. Permanently installed stainless steel tubing was used for both transmitters and the Tygon tube, with Tygon used only in the vertical section from an elevation near the containment basemat. The licensee performed a walkdown of the level systems prior to using them to be sure no tubing was kinked and the valve lineups were correct. This was covered in Procedure 1103.11 (Document 2).

A permanently mounted scale was provided for the Tygon tube over the range of levels of most interest. Other scale indications were marked on the wall. The permanent scale used etched levels that were somewhat difficult to read, and it appeared that an ink marker had been used to enhance the print. This appeared to be effective. Portions of the tubing scale were blocked by several pipes, which probably would preclude a remote television observation in those areas. The inspectors were able to discern level behind the pipes by changing position. A flashlight may be necessary for some angles. Most of the tubing was readily accessible.

The inspectors were informed that an operator at the Tygon tubing was provided with a radio for communication with the control room during evolutions where level information was needed. Permanent communication stations were also close to the tubing observation locations. Procedures required such communication for some conditions.

The procedures required that the Tygon tubing be continuously observed during reactor coolant system draining and during reduced inventory operation. This was consistent with the inspectors' observations. The inspectors were in the control room when level was a few inches above reduced inventory operation, and were told that the operators were treating the condition as though the plant was at reduced inventory. The narrow range level indication was inoperative. Wide range was being followed in the control room and Tygon tube indication was being recorded every 15 minutes in the control room.

Use of the Tygon tube to supplement the wide and narrow range level indications appeared to be a suitable compensation for the lack of independence. The observed usage of the Tygon tube as a substitute for the narrow range indications while the latter was inoperative was consistent with the intent of GL 88-17, although this should not normally be used to enter a condition such as mid-loop.

The inspectors' observations of level instrumentation and usage were consistent with a finding that ANO meets the intent of GL 88-17 for level instrumentation.

3.2.1.2 Temperature

The normal operating practice appeared to have six incore instrumentation cables inserted into the reactor vessel whenever the reactor vessel (RV) head was on the vessel to monitor core exit temperatures. This was consistent with the GL 88-17 recommendation for temperature monitoring with the head on the vessel. This was adequately covered in Procedure 1015.002 (Document 7). Failure to routinely monitor core exit temperatures with the RV head removed is discussed in Section 3.2.2.4 below.

3.2.1.3 DHR System Monitoring

Generic Letter 88-17 states, "We expect each licensee to consider the individual plant configuration and instrumentation, and to provide sufficient information to the operators that an approaching malfunction is clearly

indicated." Further discussion is provided regarding what is and what is not representative of an approaching malfunction.

The licensee had not provided information consistent with detection of an approaching malfunction and had not provided compensatory action to address this failure. For example, no DHR system pump motor current or noise monitoring was provided in the control room, as meaningful indications of system behavior. This issue will be tracked as Inspection Followup Item 313/9045-02 pending further analysis of this recommendation by the licensee as discussed during the exit meeting.

3.2.1.4 Visible and Audible Indications of Abnormal Conditions

The inspectors were informed that high and low DHR system flow rate alarms were to be provided and that the low flow rate alarm would have two settings which change depending upon conditions. A variable setpoint low level alarm was to be provided by the end of the current outage. A variable setpoint high temperature alarm was installed during this outage but it had not been declared operational. Procedure 1015.002 had been updated. The operators had it set to roughly 10°F above the existing temperature, a setting that should have eliminated false indications while providing an adequate margin under the existing operating condition (roughly 1°F/min adiabatic heatup rate) if the temperature began to increase.

An annunciator panel had been installed to visibly indicate malfunctions associated with DHR. This was not fully operational at the time of the inspection.

These indications and alarms are responsive to the Generic Letter recommendations, subject to the previous comments regarding instrumentation.

3.2.2 Procedures

A review of procedures and administrative controls was performed during this inspection. The following comments and observations were based upon items recognized during this procedure review. These comments are provided for the licensee's consideration. Because the licensee did not have time to respond to each comment while the inspectors were on site, licensee management was urged to evaluate the safety significance of each comment subsequent to this inspection. The licensee acknowledged the inspectors findings and agreed to take appropriate action. Inspector followup is planned for those items specifically designated and for selected other items listed below. The inspectors had no comments on other procedures reviewed.

3.2.2.1 Containment Closure

No containment closure procedures were provided. The inspectors were informed that these were to be prepared immediately following the present outage. Completion of these procedures will be tracked as Inspector Followup Item 313/9045-03.

Although procedures specific to GL 88-17 were not prepared, the inspectors did note signs of prudent operation regarding aspects of containment. For example, although RCS level was slightly above the ANO definition of reduced inventory operation (which is conservative in comparison to the NRC definition), there was a manned crane immediately outside the equipment hatch with the sole purpose of being available to assist in hatch closure should that be necessary. The inspectors were informed that time to close the equipment hatch has been timed by the licensee during an unannounced test. The licensee stated that attainment of a "no gaps" hatch closure condition had been confirmed by the test.

3.2.2.2 Operations Administrative Procedure 1015.03, Revision 14, "Operations Log Taking"

The inspectors found an over-reliance on the need to record data pertaining to Technical Specifications (TS), whereas other data that may also be important was essentially not addressed. For example, Item 6.3.7 states, "The Shift Supervisor must be notified of any instrument failure which prevents TS logging from being conducted." No such priority was assigned to something that may be critical for operation or may occur during an event. The procedure did not mention data that was required to be logged to meet procedures generated in response to a commitment to the NRC.

3.2.2.3 Abnormal Operating Procedure 1203.028, Revision 9, "Loss of Decay Heat Removal"

The licensee had taken prudent action for controlling plant status by determining and posting current time to core uncovery and anticipated heatup rate (assuming no water leaks from the system) during a loss of decay heat removal. This information was not used in the procedure, but it was part of the assessment of "immediate need" and the operators would probably place a high reliance on this information and such plant response as actual heatup rate for guiding their actions.

It is important that operators be able to deal with malfunctions without having to overly rely on accurate diagnosis. For example, the sub-procedure of "Loss of DH Flow Due to Vortexing" appeared to be unnecessarily restrictive. Historically, it has not always been evident that vortexing was the cause, a in level instrument malfunctions and failure to fully realize vortexing behavior. The other subtitles appeared more appropriate.

Numerous references were provided that a borated water storage tank (BWST) level greater than 21 feet was necessary for gravity feed. It was not clear if this was required because of a high elevation in the piping or if it was required only to obtain flow out of reactor coolant system openings. If the latter, then gravity feed may be effective for preventing core uncovery for an extended time at lower BWST levels. In addition, gravity feed may be useful in providing a head for venting and starting DHR pumps even if the BWST is almost empty. The licensee should evaluate the level requirement to determine if it is overly restrictive and possibly detrimental to safety.

The ability to use steam generators for cooling without filling the RCS did not appear to be addressed. The usefulness of steam generators in preventing large quantities of steam from entering containment under some conditions did not appear to be recognized, and warnings regarding the hazard of steam ejection from openings in the RCS appeared to be inadequate. Discussions with operators provided the information that they would check for water in the containment sump before initiating recirculation via low pressure injection (LPI) pumps. No such caution had been provided at appropriate places in the procedures, although it was mentioned later (at the end of Section 1, Step 3.12.6, for example).

Section 3, Step 3.7.1.A stated, "Open PP-1403 downstream of CV-1404 (DH-1403), located in upper north piping penetration room"; Step 3.7.1.B, stated, "When decay heat suction pipe is full, close DH-1403." Valve PP-1403 had a threaded cap that would require one or two wrenches to remove. The licensee should ensure that this venting can be performed in a timely manner.

Section 3, Step 3.7.1.C references vents P-34A and P-34B. Unlike DH-1403, these valves were in closed pipes where the effectiveness of venting is more difficult to assess. Sight glasses were provided, but were dirty and difficult to use from a distance.

Section 3, Step 3.7 established a level that could be as low as 370.5 feet. Step 3.7.6 provided a flow rate of about 1500 gpm. This is on the vortex limit curve (See, for example, page 53 of 1104.04, Revision 47). Level instrument error could result in a level as low as about 370.0 feet, significantly below the vortex limit curve. Further, either condition was significantly inside the established region labeled as, "operation in these regions not allowed." According to some licensee representatives, operators would include instrument error in their responses, but interviews with operations personnel indicated that the operators would use actual readings in applying the procedures.

Section 4, "Loss of Service Water Flow," appeared to address only the service water aspects of the situation. If a heatup were in progress, for example, DHR system operation with the RCS at saturation temperature was not addressed. Vaporization in the pump suction piping or in the pump with accompanying loss of flow and net positive suction head (NPSH) limits should have been considered. If nozzle dams were installed or large vents were open, it would be unlikely that the temperature and pressure required for alternate cooling would be reached before loss of DHR systems, as a result of insufficient water in the RCS.

Section 7, "Loss of Both DH Systems, RCS Pressure Boundary Intact," appeared to be based upon the assumption that reflux cooling with boiling in the core would not be used. Reflux cooling may be useful for a loss of all AC power and, perhaps, for other conditions as well. Section 7 could also apply when incore instrumentation seals were "broken." If this was true, then the pressurization guidance may be incorrect since it could lead to significant RCS inventory loss.

Step 3.18.4 of Section 7 instructs the operator to run reactor coolant pumps (RCPs) to promote natural circulation. Guidance should have been provided with respect to incore instrumentation. For example, if maximum core temperature was 140°F, then RCP use may not be justified.

Section 8, "Loss of Both DH Systems, RCS Pressure Boundary Open," Step 3.6 references boiling. Guidance should have been provided regarding the control of water injection by using incore temperature indications to avoid wasting water from the borated water storage tank (BWST). Section 8, Step 3.10, also provided instructions for starting an idle LPI pump (both DHR systems lost) but no venting guidance was provided.

Attachment A to the procedure did not provide a range of expected flow rates, nor did it include a description of the several gravity flow paths that could have been used. The current instructions only address the use of LPI pumps. Alternatives such as HPI use and dependence of HPI pumps on LPI pumps should be addressed.

3.2.2.4 Operations Administrative Procedure 1015.002, Revision 11, "DHR and LTOP System Control"

An inconsistency involving a commitment contained in a letter (0CAN078903, dated July 6, 1989 - Document 1) was identified. The second paragraph on page 4 of the letter contained the following statement: "The ANO-1 procedure governing DHR and low temperature over pressure (LTOP) system control has been revised to require operator logging of independent core exit thermocouples (CETs) once per hour when the RCS level is below 390 feet." Revision 8 of this procedure, which was in effect when the letter was issued, conservatively complied with this statement in that it required logging CET data anytime the RCS level was less than 400 feet. However, Step 5.5a of the current revision exempts logging CET data if the RV head was removed. Attachment B to this procedure included a list of equipment required in the reduced inventory mode (less that 375 feet RCS level). Item 22 exempts having CETs for temperature indication and alarm when the RV head was removed. At the time of the inspection, the plant was on DHR at the 376.5 feet RCS level with the RV head removed, but the inspectors observed that no CET data was being logged nor did the capability exist. No licensee communication could be found that changed or clarified the commitment to log CET data whenever RCS level was below 390 feet, and, therefore, the operating practice and procedural exemption from logging CET data is an apparent deviation from the above commitment (313/9045-01). The safety basis for the inspectors' concern is that the CETs would provide the only valid temperature indication for the reactor core upon loss of DHR flow (whether the RV head is on or removed).

A licensee representative stated that it was their policy to have CETs available when actually operating in reduced inventory, notwithstanding the exemption allowed by the procedure. He went on to state that he believed CETs were not required with the RV head removed, because they were exempted in the GL 88-17 recommendation. The inspectors referred the licensee to the guidance contained in Enclosure 2 to GL 88-17. In Section 3.1.2.2 of this guidance, it

is suggested that the licensee investigate ways to provide temperature indication with the RV head removed. The licensee's statement in their July 6, 1989, letter was understood to mean that this guidance had been followed and that CET data was available with the RV head removed.

In reviewing the accuracy calculation for Level Transmitter LT-1198, the inspectors noted that the accuracy limitation (6.4 inches) assumed in the procedure was based on having the CETs in service. Without the CETs in service, the worst-case accuracy would be 7.3 inches as stated in Document 10.

3.2.3 Equipment

As discussed in NRC Inspection Report 50-313/89-23, the licensee's equipment availability appeared adequate to meet the intent of GL 88-17. The licensee processed a TS change (Document 11) to allow the use of HPI for emergency RCS makeup during DHR operations.

3.2.4 Analyses

The inspectors performed a partial review of the analyses and interviewed the cognizant design engineers that performed the calculations. The inspectors did not find sufficient analyses or consideration of the following areas:

3.2.4.1 Water Carry-Out During Boiling

Although analyses were conducted to determine heatup rates and time to core uncovery due to evaporation, the inspectors found no consideration for the loss of water as a result of high velocity steam flow through representative vent paths. Such effects can significantly reduce time to core uncovery for some vent paths. This would be significant if the vent were through the pressurizer and may be significant for other vent paths.

3.2.4.2 Pressurizer Water Holdup

The pressurizer surge pipe configuration and size will effectively trap any water entering the pressurizer and will prevent it from reentering the hot leg under many conditions. A small fraction of the steam generated during boiling is sufficient to exceed countercurrent flow limits irrespective of the pipe configuration. The pipe configuration will prevent water from flowing from the pressurizer to the hot leg whenever hot leg pressure is equal to or greater than pressurizer pressure (when pressure is determined at the hot leg level). This introduces the possibility that the core could be uncovered and damage could occur with a large inventory of water in the pressurizer. No evidence was found that these effects were evaluated.

3.2.4.3 Level Variation Within the Reactor Coolant System

Flow and temperature have been shown to have a significant influence on level with respect to location in the reactor coolant system. It was not clear that these were properly considered in evaluating level instrument readings in terms

of level needed for DHR pump operation or for purposes of determining entry into (or operation in) such conditions as reduced inventory, mid-loop, or the 4-inch criterion used for containment closure actions.

3.2.4.4 DHR Pump Suction Pipe

The DHR pump suction pipe has an elevated section that may introduce problems if the RCS contains saturated water or if a large amount of air has been trapped in the elevated section. No analysis of this behavior was found.

3.2.4.5 Vent Adequacy

No consideration of time required to vent high points was found. Such information is useful for providing operator guidance, particularly when reaction is necessary in a short time. Pressure buildup of less than 1 psi can have a significant effect upon RCS behavior during shutdown operations. Little evidence, in the licensee's analysis, was found to support an appreciation of the potential impact of inadequate venting. The licensee was referred to NRC Information Notice 89-67, "Loss of Residual Heat Removal Caused by Accumulator Nitrogen Injection," for further discussion of potential venting problems.

3.2.4.6 Gravity Feed

Some consideration of gravity addition of water to the RCS from the BWST was found. However, this was incomplete. Further information was needed to cover such areas as adequacy with respect to level in the BWST and interaction of flow rate with such parameters as vent behavior, water buildup in components, decay heat generation rate, flow path, and the amount of air in the systems of interest. This was particularly important because of the established usefulness of gravity feed in recovering DHR pumps that may become air or vapor bound, and because of the significant extension in core cooling that is possible with a loss of all AC power.

3.2.4.7 Incore Instrument Flow Path

The identified loss of RV water flow path via incore instrument piping was not evaluated. The inspectors noted that this potential event had not been previously identified at ANO. Also, no evidence was found that a comprehensive evaluation of the RCS and DHR system had been performed to identify such potential loss of coolant paths.

3.2.4.8 Potential Impact of Core Boiling On the Containment Environment

No analysis of the effect of steam loss from the RCS was found insofar as personnel actions inside containment were concerned.

3.2.4.9 Summary of Analyses

The above findings regarding the licensee's analyses are based on a sampling of this area. Licensee engineering personnel were referred to Section 8 and

Appendix G of NUREG-1410, "Loss of Vital AC Power and the Residual Heat Removal System During Mid-Loop Operations at Vogtle Unit 1 on March 20, 1990," for additional information that may be of benefit in evaluating the effectiveness of this program. The licensee indicated that it would evaluate the impact of inspector concerns on the subject analyses. Completion of the evaluations in paragraph 3.2.4 will be tracked as an Inspector Followup Item (313/9045-04).

3.2.5 TS Changes

As discussed above, a change to allow HPI for emergency makeup when in the DHR mode had been processed and appropriate procedure changes had been made. Also, a plant design change was being processed to allow operator override of the DHR automatic closure interlock under certain operating conditions. The inspectors were informed that a TS change was being developed to support this design change.

3.2.6 RCS Perturbations

Through review of the procedures listed in the Attachment and interviews with plant personnel, the inspectors ascertained that appropriate precautions had been taken to avoid RCS perturbations during reduced inventory operations.

3.2.7 Other Comments

During the interviews, inspectors found that the licensee's practice is to off-load the core during refueling outages, to provide a window for maintenance work. Although the inspectors did not examine the work that was typically performed during this window, it was noted that off-loading the core did eliminate concerns with decay heat removal arising from activities within the containment.

No violations were identified. One apparent deviation is discussed in Sections 3.2.1 and 3.2.2 above.

4. EXIT MEETING

The inspectors met with the licensee representatives denoted in paragraph 1 on November 30, 1990, and summarized the scope and preliminary findings of this inspection. No further safety concerns were identified during the in-office inspection which continued through December 6, 1990. The licensee did not identify, as proprietary, any of the materials provided to, or reviewed by, the NRC inspectors during this inspection.

ATTACHMENT

DOCUMENTS REVIEWED

1. LETTER OCAN078903, AP&L to NRC, "Response to Additional Questions Regarding Implementation of GL 88-17," dated July 6, 1989

2. Procedure 1103.11, Revision 13, "Draining and N_2 Blanketing of the RCS"

3. Letter OCAN088908, AP&L to NRC, "Response to Inspection Report 50-313/89-23 and 50-368/89-23," dated August 7, 1989

4. Letter OCAN038908, AP&L to NRC, "GL 88-17 (Loss of DHR) 90-Day Response," dated March 14, 1989

5. Procedure 1015.03, Revision 14, "Operations Log Taking"

6. Procedure 1203.028, Revision 9, "Loss of DHR"

7. Procedure 1015.002, Revision 11, "DHR and LTOP System Control"

8. Procedure 1015.12, Revision 0, "Operations Performance Monitoring System"

9. Design Change Package 89-1044, Revision 3, "Generic Letter 88-17, "Loss of Decay Heat Annunciation"

10. Calculation 89E-0004-01, Revision 1, "RCS Hotleg Level Error Associated with LT-1195 and LT-1198 in DHR Mode"

11. Letter, NRC to Entergy Operations, Inc. "Issuance of Amendment No. 138 to Facility Operating License No. DPR-51-ANO-1"