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

April 13, 1989

Docket No. 50-368

Mr. T. Gene Campbell
Vice President, Nuclear
Operations
Arkansas Power & Light Company
P. O. Box 551
Little Rock, Arkansas 72203

Dear Mr. Campbell:

SUBJECT: PLANT-SPECIFIC BACKFIT FOR IMPROVED AUXILIARY FEEDWATER SYSTEM RELIABILITY AT ARKANSAS NUCLEAR ONE, UNIT 2 (ANO-2)

This letter requests that a plant-specific backfit be implemented as the final resolution of NRC Generic Issue (GI) 124, "Auxiliary Feedwater System Reliability," for ANO-2. Previous actions relative to this GI included a detailed NRC review group reliability assessment for each of seven plants with a two-train auxiliary feedwater (AFW) system, including ANO-2. A final report of the staff's conclusions concerning the ANO-2 AFW system reliability was transmitted to Arkansas Power & Light Company (AP&L) on June 14, 1988. This report stated that the level of AFW system reliability was not adequate on the basis of plant-specific data and existing compensatory decay heat features such as the method of feeding the steam generators with the condensate pumps following loss of both main feedwater pumps and both emergency feedwater (EFW) pumps. The transmittal letter requested AP&L's response to the findings and specific proposals to upgrade the AFW system reliability.

On September 2, 1988, you submitted a response to the assessment report. The response restated the AP&L position that the ANO-2 method of feeding the steam generators with condensate pumps was an acceptable alternate-secondary side decay heat removal method and satisfied the guidelines of SRP Section 10.4.9, and no upgrade to the existing AFW system was warranted. You also provided a detailed evaluation (modeling and fault tree analysis) of the ability of the condensate pump to perform the safety functions of the EFW pumps.

The NRR staff has fully evaluated your response and has not been persuaded to alter its determination that the two-pump AFW system at ANO-2 needs to be upgraded. I have therefore enclosed, as justification for backfit, an analysis for improvement of the ANO-2 AFW system. The analysis indicates that substantial improvement in plant safety can be achieved by providing an additional means of supplying water to the steam generators in the event of loss of both main feedwater pumps and both emergency feedwater pumps, such as by adding an additional startup feed pump.

You are therefore requested to implement improvements in the secondary decay heat removal capability for ANO-2 as resolution of GI 124 and to provide a schedule for completion of the recommended modifications within 60 days of

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receipt of this letter. If you choose to appeal this proposed backfit, the appeal should be addressed to the Director, Office of Nuclear Reactor Regulation.

If you have any questions regarding this letter, please contact Mr. C. Poslusny, Project Manager for the Arkansas Nuclear One, Unit 2, plant.

Sincerely,

/S/

Gary M. Holahan, Acting Director
Division of Reactor Projects - III,
IV, V and Special Projects
Office of Nuclear Reactor Regulation

Enclosure:
As stated

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Mr. T. Gene Campbell
Arkansas Power & Light Company

Arkansas Nuclear One, Unit 2

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Honorable William Abernathy
County Judge of Pope County
Pope County Courthouse
Russellville, Arkansas 72801

PLANT-SPECIFIC BACKFIT ANALYSIS
GENERIC ISSUE 124, AUXILIARY FEEDWATER SYSTEM RELIABILITY
ARKANSAS NUCLEAR ONE, UNIT 2

As a result of its review and resolution of the auxiliary feedwater system reliability in those plants with two-pump auxiliary feedwater systems (AFWSs) under Generic Issue (GI) 124, the staff has concluded that improvement in the secondary side decay heat removal capability is necessary at Arkansas Nuclear One, Unit 2 (ANO-2). The Standard Review Plan (SRP) Section 10.4.9 unavailability criterion of 10^{-4} to 10^{-5} per demand served as the goal for resolution of GI-124. The SRP criterion permits a greater AFWS unavailability if suitably reliable compensatory decay heat removal features are provided, and therefore the staff's review focused on this area. A suitably reliable compensatory feature is one that provides an alternative means of supplying water to the steam generators. However, such an alternative capability has not been demonstrated for ANO-2. This action is being taken at this time in order to avoid a repetition of the significant delay in achieving secondary decay heat removal improvements such as occurred before the Davis-Besse loss of all feedwater event.

It is the staff's judgment that a substantial safety improvement can be gained by providing additional means of decay heat removal through the steam generators. An additional compensatory feature of this type can provide as much as an order of magnitude decrease in the likelihood of a loss of all feedwater. The staff recognizes the existence and availability of other means of decay heat removal, such as the "feed-and-bleed" cooling mode and the use of condensate pumps. However, the use of the "feed-and-bleed" mode is appropriate only as a last resort in an emergency.

Two factors form the basis for the staff's conclusion that the "feed-and-bleed" mode entails great uncertainty as a decay heat removal feature at ANO-2. The first factor is the operator's inherent reluctance to initiate "feed-and-bleed" given the consequences of this action, as observed during the Davis-Besse loss of all feedwater event. "Feed-and-bleed" cooling intentionally releases substantial amounts of reactor coolant into the containment. Plant restart following "feed-and-bleed" cooling will be delayed because of (1) a potentially lengthy cleanup period, and (2) the necessity to correct those secondary heat sink deficiencies that required the use of the "feed-and-bleed" mode. The

second factor is the basic pressurized-water reactor (PWR) primary system design, which is not intended for direct decay heat removal at high pressure. The staff recognizes that ANO-2 has a unique "bleed" capability that permits rapid primary system depressurization to the high pressure safety injection pump discharge pressure through a 3-inch vent path. However, even with this capability, the "feed-and-bleed" mode must be initiated in a timely manner before steam generator dryout in order to be an effective means of decay heat removal before the core is uncovered. These factors preclude consideration of the "feed-and-bleed" mode as a reliable compensatory decay heat removal feature.

The use of a condensate pump for decay heat removal through the steam generators in the event of a loss of all main and auxiliary feedwater avoids the difficulties noted for initiation of the "feed-and-bleed" mode, but does not represent an adequate compensatory feature as claimed by the ANO-2 licensee. The staff has for some time recognized the explicit use of condensate pumps as an emergency source of water for the steam generators. All plants have the capability of employing a condensate pump to supply water flow to the steam generators once the secondary side pressure has been reduced sufficiently below the pump shutoff head. Although the staff notes that ANO-2 condensate pumps have a marginally higher discharge pressure than other plants, as shown by the licensee, an action to depressurize the secondary side must still be taken. Therefore, the ANO-2 capability in this regard is similar to that of other PWR plants.

To supplement the above qualitative evaluation, the staff performed a quantitative value impact assessment of the proposed action. This assessment used the licensee's estimate of AFW system unavailability per demand and site-specific data to determine the person-rem release resulting from a postulated core melt and containment failure caused by a loss of decay heat removal. The assessment was based on an assumed range of success between 10 and 90 percent for the "feed-and-bleed" mode. The frequency of extended loss of secondary heat sink in the value impact assessment assumes credit for condensate pump availability. The results indicated that considering only $1000/person-rem for the proposed

improvement in decay heat removal capability, the proposed action is cost-effective when a 10 percent success rate for the "feed-and-bleed" mode is assumed. The proposed action is only marginally cost effective when a 90 percent success rate for the "feed-and-bleed" mode is assumed. However, when considering the uncertainty in the use of the "feed-and-bleed" mode and other factors in the cost of recovery following its use (i.e., cleanup of the containment and cost of replacement power while the plant is down following the loss of all feedwater event), a substantially greater expenditure can be justified.

For the reasons indicated above, the staff proposes the identified plant-specific backfit. The licensee is requested to implement improvement in the ANO-2 secondary decay heat removal capability and propose a schedule for completion of the necessary modifications. The following section addresses information required for a backfit analysis formatted in accordance with NRC Manual Chapter 0514.

MC 0514 BACKFIT ANALYSIS INFORMATION

The following discussion supports the regulatory analysis of the proposed plant specific backfit and addresses the specific areas of consideration in the staff's guidelines, in accordance with NRC MC 0514.

a. The objective of the proposed backfit is to improve secondary side decay heat removal reliability for Arkansas Nuclear One, Unit 2 (ANO-2) by providing an additional means of delivering water to the steam generators following transient and accident conditions. Installation of a nonsafety-related startup feedwater pump or an additional auxiliary feedwater pump are suitable alternatives to satisfy this proposed action. Such a modification would provide substantial safety improvement by decreasing the likelihood of a loss of all feedwater by as much as one order of magnitude, and would significantly reduce reliance on the "feed-and-bleed" mode and the use of condensate pumps (which are part of the feedwater system) to prevent core damage from loss of all feedwater events.

b. The licensee would be required to install an additional nonsafety-related pump and its associated piping and power supplies. Much of the required installation work could be achieved while the plant is at power. However, interconnection of the new pump to the water source (e.g., condensate storage tank) and existing auxiliary feedwater system piping would require plant shutdown such as a refueling outage because such activity could leave the AFW system inoperable. An appropriate schedule to deal with this concern should be developed by the licensee.

c. Implementation of this proposed backfit is consistent with existing staff guidelines for AFW system reliability contained in the Standard Review Plan (SRP) Section 10.4.9. Nearly all other operating pressurized water reactors (PWRs) satisfy the SRP AFW reliability criterion and provide three pumps for delivery of water to the steam generators following feedwater transients. The proposed additional pump contributes minimal complexity to plant design or operation since it is intended for use only during upset conditions and is manually initiated. The additional pump may in fact improve overall plant safety if the licensee chooses to use it for normal plant startup and shutdown because reliance on the existing safety-related AFW pumps for this purpose would no longer be necessary. Some additional operational complexity would be imposed by the need to perform periodic tests and surveillance on the third pump's availability. Installation of the pump could be in areas of the plant which do not contain safety-related equipment, and therefore, it should not impact plant safety functions.

d. The proposed backfit is final and provides the final resolution of issues involving AFW and secondary decay heat removal reliability under GI 124.

e. Implementation of the proposed backfit provides significant benefit by reducing the risk to the public from accidental offsite releases of

radioactive materials resulting from core damage events caused by loss of the heat sink. Based on an estimated cost of $2 million for a third startup feedwater pump, and assuming the licensee's estimate of AFW system unavailability per demand, the proposed backfit satisfies the $1000/person-rem guideline and is, therefore, cost effective when a 10 percent success rate for the "feed-and-bleed" mode is assumed. Even with an increased "feed-and-bleed" success rate, other costs resulting from its use such as the cost of cleaning up containment and the cost of replacement power while the plant is shutdown following a loss of all feedwater event will justify a substantially greater expenditure in secondary decay heat removal capability. Overall, the proposed backfit provides approximately one order of magnitude reduction in the probability of a loss of all feedwater event and its associated risk.

The proposed modification would affect the secondary side of the plant and, therefore, its installation would be in areas not expected to contain radiological contamination. Therefore, there should be no radiological exposure to facility employees either during the installation process or during periodic testing and operation over the lifetime of the plant.

For the most part, the installation of the modification could be completed while the plant is operating. Some portions of the installation would result in inoperability of the auxiliary feedwater system and should, therefore, be accomplished during plant shutdown. However, this installation would not increase plant downtime as it could be completed during a scheduled refueling outage. The staff estimates the total installation cost of the proposed modification to be approximately $2 million for a startup feedwater pump or comparable modification. Some continuing cost of periodic testing and maintenance would also result. The cost of this is estimated at $1 million over the plant lifetime.

The proposed backfit results in minimal resource burden on the NRC staff because a license amendment to cover its implementation would not be

necessary (see item i below). Some staff resources would be required for the staff to meet with the licensee as necessary to discuss details of the installation and to perform the post-implementation inspection.

f. Operating events continue to point out the need for reliable secondary decay heat removal capability. Continuing problems with turbine driven auxiliary feedwater (AFW) pumps indicate that improvements in secondary decay heat removal reliability are necessary at plants with two pump AFW systems. The proposed backfit will provide the necessary improvement.

g. The need for the proposed backfit was originally identified by the NRC Office of Research (RES) before transfer of GI 124 to NRR for resolution. The Committee to Review Generic Requirements (CRGR) and the Executive Director for Operations (EDO) also have been informed of the proposed action.

h. Although while no specific implementation schedule has been identified, the staff expects the licensee to act promptly to perform the necessary engineering, design procurement, installation and testing to incorporate the modification in secondary side decay heat removal capability into the plant. Most of the installation can be completed while the plant is operating with the interconnections to existing piping and power supplies made during a subsequent scheduled refueling outage. The staff estimates that final implementation including procedure development and training could be completed within two refueling outages from the date of this letter.

i. The staff will meet with the licensee when appropriate to discuss details of the licensees proposed modification. However, a license amendment may not be necessary to incorporate the proposed change as it can be implemented under 10 CFR 50.59 as not being an unreviewed safety question and based on the fact that no technical specification change may be required. A post-implementation inspection will be performed by the NRC staff.

j. The issue of improved secondary side decay heat removal reliability is of major importance because of the significance of loss of feedwater events to the risk of core melt. The implementation schedule mentioned in item h. above is consistent with its importance when compared to other activities involving plant safety.

k. The proposed plant-specific backfit is a result of resolution of Generic Issue 124. All other PWR licensees have demonstrated sufficiently reliable auxiliary feedwater systems and secondary decay heat removal capability in accordance with the guidelines of SRP Section 10.4.9 to resolve the concern.