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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO IMPLEMENTATION OF TMI ACTION ITEM II.K.3.5

"AUTOMATIC TRIP OF REACTOR COOLANT PUMPS"

(RESPONSE TO GENERIC LETTER NO. 86-06)

ARKANSAS POWER & LIGHT COMPANY

ARKANSAS NUCLEAR ONE, UNIT 2

DOCKET NO. 50-368

1.0 SUMMARY

In Generic Letter 86-06 (Ref. 1), we reported that the information provided by the CE Owners Group (CEOG) in support of alternative Reactor Coolant Pump (RCP) trip criteria was acceptable on a generic basis. The review noted that a number of considerations were assigned plant specific status. Accordingly, we requested that operating reactor licensees select and implement an appropriate RCP trip criterion based upon the CEOG methodology. This Safety Evaluation (SE) contains the staff's findings concerning this issue for Arkansas Power & Light Company's ANO-2.

Reference 1 required owners of CE Nuclear Steam Generating Systems to evaluate their plants with respect to RCP trip. The objectives was to demonstrate that their proposed RCP trip setpoints assure pump trip for small break LOCAs, and in addition to provide reasonable assurance that RCPs are not tripped unnecessarily during non-LOCA events. A number of plant specific items were identified which were to be considered by applicants and licensees, including the selected RCP trip parameter, instrumentation quality and redundancy, instrumentation uncertainty, possible adverse environments, calculational uncertainty, potential RCP and RCP associated problems, operator training, and operating procedures.

The licensee has addressed the Generic Letter (GL) 86-06 criteria and we have reviewed this information with assistance from consultants at EG&G. We find the material submitted by the licensee to be acceptable and find that the licensee has satisfied the requirements in regard to TMI Action Item II.K.3.5.

2.0 BACKGROUND

TMI Action Plan Item II.K.3.5 of NUREG-0737 required all licensees to consider other solutions to the small-break loss-of-coolant-accident (LOCA) problems since tripping the reactor coolant pumps (RCPs) was not considered the ideal solution. Automatic trip of the RCPs in the case of a small-break LOCA was recommended until a better solution was found. A summary of both the industry programs and the NRC programs concerning RCP trip is provided in Generic Letters 83-10a through f, which are included in the NRC report, SECY-82-475 (Ref. 2). SECY-82-475 also provided the NRC guidelines and criteria for the resolution of TMI Action Item II.K.3.5, "Automatic Trip of Reactor Coolant Pumps."

The CEOG proposes using a trip-two/leave-two (T2/L2) strategy. The T2/L2 trip strategy consists of tripping two RCPs, located in diametrically opposed coolant loops, very early in a transient on a low reactor coolant system (RCS) pressure signal independent of the nature of the event. The remaining two RCPs are tripped subsequently after trip setpoints indicating a LOCA are reached.

The licensee addressed this issue in Reference 3, 4, and 5, which we have reviewed with the assistance of EG&G consultants. Enclosure 3 is the technical evaluation report (TER) prepared by EG&G. We have reviewed their recommendations and concur that the licensee's submittal meets the requirement of Item II.K.3.5.3.0

EVALUATION

As discussed in detail in the TER, the licensee has satisfied the requirements of GL 86-06. The staff finds that Arkansas Power & Light Co. has complied with the requirements of Generic Letter 86-06 and that they have, therefore, met the requirements in regard to implementation of TMI Action Item II.K.3.5.

These requirements include:

A. Determination of RCP Trip Criteria
The first two RCPs are tripped if the pressurizer pressure falls below 1400 psia. The last two RCPs are tripped if the RCS subcooling margin falls below 30°F and the secondary system reactivity alarms do not actuate. This agrees with the approved CEOG guidelines and hence is acceptable.

B. Instrumentation Uncertainties for Normal and Adverse Environments
The licensee has demonstrated that the instrument uncertainties are conservatively bounded in the plant specific analyses. We conclude these uncertainties are acceptable.

C. Generic and Plant-Specific Analyses Uncertainties
The licensee has demonstrated that the results of the CEOG generic analyses are conservative for ANO-2. Therefore, we consider these acceptable.

D. Operator Training and Procedures
The licensee has provided operator training and procedures, which are consistent with the Generic Letter 86-06 guidelines. We, thus conclude, these are acceptable.

4.0 CONCLUSION

Each of the points identified in Reference 1 has been satisfactorily addressed by the licenseee. The staff finds the licensee treatment of RCP trip to be acceptable and the licensee has satisfied the requirements of TMI Action Item II.K.3.5.

5.0 REFERENCES

1. F. J. Miraglia, USNRC, letter to all applicants and licensees with CE designed Nuclear Steam Supply Systems (except Maine Yankee), "Implementation of TMI Action Item II.K.3.5, Automatic Trip of Reactor Coolant Pumps," Generic Letter 86-06, May 29, 1986.

2. W. J. Dircks, Executive Director for Operations, USNRC, "Staff Resolution of the Reactor Coolant Pump Trip Issue," SECY-82-475, NRC Accession Number 830603070, November 30, 1982.

3. J. T. Enos, AP&L, ltr to F. J. Miraglia, NRC, "Arkansas Nuclear One - Unit 2, Docket No. 50-368, License No. NPF-6, Implementation of TMI Action Item II.K.3.5, Automatic Trip of Reactor Coolant Pumps, Response to Generic Letter 86-06," 2CAN118608, November 24, 1986.

4. D. R. Howard, AP&L, ltr to U. S. Nuclear Regulatory Commission, Document Control Desk, "Arkansas Nuclear One - Unit 2, Docket No. 50-368, License No. NPF-6, Additional Information Response, RCP Trip Criteria (TAC No. 49676)," 2CAN068806, June 3, 1988.

5. J. R. Marshall, AP&L, ltr to Director of Nuclear Reactor Regulation, NRC, "Arkansas Nuclear One - Unit 2, Docket No. 50-368, License No. NPF-6, Reactor Coolant Pump Trip - Generic Letter 83-10," 2CAN9489409, April 20, 1984.

Principal contributor: S. Wu

Dated:

TECHNICAL EVALUATION REPORT
CONFORMANCE TO GENERIC LETTER 86-06
IMPLEMENTATION OF NUREG-0737, TMI ACTION ITEM II.K.3.5
ARKANSAS NUCLEAR ONE, UNIT 2
DOCKET NO. 50-368

1. INTRODUCTION

TMI Action Plan Item II.K.3.5 of NUREG-0737 requires all licensees to consider other solutions to small break loss-of-coolant accident (LOCA) problems because tripping the reactor coolant pumps (RCPs) was not considered to be the ideal solution. NRC report SECY-82-475[1] summarized the industry and NRC programs concerning RCP trip. In Generic Letter 86-06[2] the staff accepted the Combustion Engineering Owners Group (CEOG) trip-two/leave-two staggered RCP trip strategy.[3,4]

The CEOG developed a trip-two/leave-two (T2/L2) strategy as the basis for RCP trip. The T2/L2 strategy consists of tripping two RCPs, located in diametrically opposed coolant loops, early in a transient on a low reactor coolant system (RCS) pressure signal regardless of the nature of the event. The remaining two RCPs are later tripped if setpoints indicating a LOCA are reached. The goal of the T2/L2 trip strategy is to trip all four RCPs in the case of a small break LOCA but to have two or more RCPs operating for non-LOCA events. These would include steam line breaks, steam generator tube ruptures, or an anticipated operational occurrence.

The CEOG reports addressed the selection of trip parameters, evaluation of LOCA and non-LOCA events, evaluation of NRC criteria, justification of manual RCP trip, and instrumentation capabilities. The generic information presented by the CEOG, however, did not address plant specific concerns about instrumentation uncertainties, potential RCP problems, and operator training and procedures. This information, specifically identified in Generic Letter 86-06, was requested from each C-E licensee to enable the staff to assess implementation of the RCP trip criterion.

2. DISCUSSION

Arkansas Power & Light's (AP&L's) response to Generic Letter 86-06, Section IV, for Arkansas Nuclear One, Unit 2, (ANO-2) was provided in a letter dated November 24, 1986.[5] AP&L's response to a NRC request for additional information was contained in Reference 6. Additional information provided by AP&L in Reference 7 was also reviewed. These references were reviewed to verify AP&L provided the required information. This review found the licensee endorsed the CEOG reports and provided plant specific details, such as subcooling margin, emergency operating procedures, and instrument uncertainties. A summary of AP&L's response to Generic Letter (GL) 86-06 and EG&G Idaho's basis for acceptance is provided below.

2.1 GL 86-06, Item 1 - Reactor Coolant Pump Trip Criteria

The NRC requested the licensee to identify the instrumentation used to determine the RCP trip setpoints, including the degree of redundancy for each measurement needed for the criteria chosen.

Response for ANO-2:

The first two RCPs are tripped if the pressurizer pressure falls below 1400 psia. The last two RCPs are tripped if the RCS subcooling margin falls below 30°F and the secondary system reactivity alarms do not actuate.

RCS wide range pressure is available from four loops of instrumentation. This information is also used in the reactor protection system (RPS) and the engineered safety features actuation system (ESFAS) and is environmentally and seismically qualified. RCS wide range pressure is also available from the safety parameter display system (SPDS). Secondary system reactivity can be determined due to high radiation alarms from the condenser offgas radiation monitor, two steam generator sample cooler radiation monitors, two main steam line radiation monitors, or two secondary radiation recorders. In addition, steam generator sample reactivity is available on a more delayed basis. Subcooled margin is available from the SPDS, the plant computer, and from the RCS pressure and temperature (in

conjunction with steam tables). The primary indication of subcooled margin, however, is two subcooled margin monitors. The subcooled margin monitors were installed to meet the requirements of NUREG-0737, Item II.F.2, and are environmentally qualified.

EG&G Idaho evaluation:

The licensee identified the pump trip criterion and setpoints for ANO-2. The setpoints discussed above (the first two pumps are tripped at a primary pressure of 1400 psia and and the second two pumps are tripped if the subcooled margin drops below 30°F and there is no secondary radiation alarm) are based on the CEOG analyses. The licensee also identified the instrumentation needed to implement the chosen pump trip criterion. Adequate redundancy is available for this instrumentation. The response to Item 1 is acceptable.

2.2 GL 86-06, Item 2 - Instrumentation and Environment

The NRC requested the licensee to identify instrumentation uncertainties, adverse containment conditions, and the effects of localized factors (such as fluid jets or pipe whips) on instrument reliability.

Response for ANO-2:

For the small break LOCA analyses (0.1 to 0.02 ft^2 breaks) where tripping the second set of pumps was required to prevent fuel clad temperatures from exceeding licensing limits, AP&L noted that the criterion for tripping the second set of pumps is reached in a maximum of 94 s. In addition, the emergency operating procedures (EOPs) direct the operators to check the RCP trip criterion as one of the first steps after a reactor trip. Therefore, not only will the trip criterion be reached in a short period of time, but the need to trip the second set of pumps will be noticed by the operators in this short time period as well. In this short time period, containment environmental conditions for this range of small breaks will be only slightly more adverse than normal. Thus, normal instrument uncertainties can be used in determining the setpoints for the RCP trip criterion.

For the pressure measurement, an uncertainty of ±56 psi was used based on a 1980 analysis by C-E. Subcooling margin uncertainty varies with system pressure. In CEN-268, it was noted that the low pressure setpoint for tripping the first set of pumps (assumed to be 1300 psia) and the subcooled margin setpoint were reached nearly simultaneously. At 1300 psia, the uncertainty in the subcooled margin is 18°F.

AP&L's setpoints of 1400 psia to trip the first set of pumps and subcooled margin less than 30°F for tripping the second two pumps considered these uncertainties. The pressure setpoint included a margin of 80 psi above the C-E recommended setpoint of 1320 psia for ANO-2. The subcooled margin setpoint of 30°F included a margin of 12°F above the 18°F error identified by AP&L.

The pressure transmitters of interest are mounted on the outside of the secondary shield wall in containment. Thus, they are not in an area subject to pipe whip or fluid jets. The same pressure measurements are input to the subcooled margin monitors. Temperature input from the hot legs to the subcooling margin monitors comes from two channels in each of two hot legs. The hot legs are sufficiently separated so that local conditions cannot affect the temperature measurements in both hot legs simultaneously.

EG&G Idaho evaluation:

For the small breaks where tripping the second set of pumps is required to maintain fuel clad temperatures below licensing limits, the licensee demonstrated that the criterion for tripping the second set of pumps is reached quickly enough that containment conditions would not be significantly different from normal conditions. Therefore, normal uncertainties were used. This approach was reviewed and found acceptable. The uncertainties identified, ±56 psi for pressure and 18°F for subcooled margin, were considered by the licensee in determining the setpoints used in ANO-2. The pressure setpoint for tripping the first set of pumps, 1400 psia, accommodates an uncertainty of 80 psi based on the recommended setpoint of 1320 psia for ANO-2 in CEN-268. The subcooled margin setpoint of 30°F conservatively bounds the subcooled margin uncertainty of 18°F.

The licensee also stated local conditions will not impact the measurements required to implement the T2/L2 strategy. Based on the information provided by the licensee, the response is considered acceptable for the temperature inputs to the subcooled margin monitor. For the pressure transmitters, the licensee stated the transmitters were outside the secondary shield wall where they would not be affected by fluid jets or pipe whip. However, the licensee's response did not consider the sensors, cables, and other components that may be required to connect the transmitters to the primary system nor were the secondary radiation monitors discussed. The licensee's response is still considered adequate because the use of redundant equipment (as indicated by having the pressure measurement meet the requirements of NUREG-0737, Item II.F.2, and having several ways of detecting secondary radiation) indicates that single failures of instrument hardware can be tolerated, regardless of the cause of failure. Thus, the response to this item is considered acceptable.

2.3 GL 86-06, Item 3 - Generic and Plant Specific Analyses

The NRC requested the licensee to identify uncertainties associated with the CEOG generic analyses and atypical plant specific features.

Response for ANO-2:

The licensee referenced Section 3 of the CEOG report, CEN-268. This section described the models and assumptions used in the analyses and discussed the applicability of the analyses to the spectrum of C-E plants.

In response to the NRC request for information, the licensee noted that the core power for ANO-2 was 115 MW_t higher than for the 2700 MW_t reference plant. However, the ANO-2 high pressure safety injection (HPSI) capacity, low pressure safety injection capacity, and the safety injection tank pressure are higher than those used in the reference analysis. In addition, the cutoff head for the ANO-2 HPSI pumps is higher than in the reference analysis. Therefore, the licensee concluded the reference plant analysis is conservative for ANO-2.

EG&G Idaho evaluation:

Based on the information provided by AP&L, EG&G Idaho agrees the reference plant analysis should be conservative for ANO-2. In addition, EG&G Idaho compared the maximum HPSI flows for ANO-2 and the 2700 MW_t reference plant. The value provided in Reference 6 for ANO-2 was approximately twice that used in the reference plant analysis as provided in Reference 4. This indicates the conservative nature of the reference plant analysis.

With respect to the analysis performed by C-E to determine the recommended pressure setpoint for tripping the first two pumps, EG&G Idaho noted that a separate recommendation was made for ANO-2 in CEN-268. Because ANO-2 was the only plant is this group, EG&G Idaho concluded plant specific information for ANO-2 would have been used in the equation provided in Reference 4 to determine the recommended pressure setpoint for ANO-2. Therefore, the pressure recommended would be directly applicable to ANO-2. The response to Item 3 is considered acceptable.

2.4 GL 86-06, Item 4 - Operator Procedures and Training

The NRC requested the licensee to identify plant procedures that require RCP trip guidelines and describe the training and procedures that provide direction for use of individual steam generators with and without operating RCPs.

Response for ANO-2:

EOP 2202.01 was identified as the only EOP requiring the use of RCP trip guidelines. This procedure is based on the current revision of the ANO-2 Emergency Operating Procedure Technical Guidelines that was submitted as part of the Procedures Generation Package in response to NUREG-0737, Item I.C.1. In this EOP there are sections dealing with the following types of transients and accidents: reactor trip, recovery actions for emergency reactivity control, recovery actions for degraded power, recovery actions for (station) blackout, recovery actions for overcooling (event), recovery

actions for MSIS (main steam isolation), recovery actions for SIAS (safety injection actuation), recovery actions for steam generator tube rupture within charging pump capacity, recovery actions for steam generator tube rupture greater than charging pump capacity, and actions for inadequate core cooling.

Operator training was also described in the Procedures Generation Package submitted to the NRC. In Reference 6, AP&L stated that operator training on use of the EOP is included in both the initial licensing training and also as part of annual requalification training. Detailed classroom lectures and plant simulator sessions are included in both phases.

With respect to procedures and training of operators for use of single steam generators with and without operating RCPs, AP&L stated in Reference 6 that use of individual steam generators with operating pumps is covered in the sections of the EOP dealing with operator response to a steam generator tube rupture and main steam isolation signal.

EG&G Idaho evaluation:

AP&L identified the procedure requiring use of the RCP trip guidelines, EOP 2202.01, and identified the plant situations where EOP 2202.01 would be used. AP&L also identified those sections in the EOP covering the use of single steam generators. Operator training was also discussed. The response to this item is acceptable.

3. CONCLUSION

AP&L's responses for Arkansas Nuclear One, Unit 2, to Generic Letter 86-06 were reviewed. The information in these responses clarifies the plant specific implementation of the CEOG strategy for reactor coolant pump trip. The review found the submittal for Arkansas Nuclear One, Unit 2, meets the NRC position established in the review of the CEOG report.

4. REFERENCES

1. W. J. Dircks, NRC, "Staff Resolution of the Reactor Coolant Pump Trip Issue," SECY-82-475, November 30, 1982.

2. F. J. Miraglia, NRC, ltr to All Applicants and Licensees with CE Designed Nuclear Steam Supply Systems (Except Maine Yankee), "Implementation of TMI Action Item II.K.3.5, Automatic Trip of Reactor Coolant Pumps," Generic Letter 86-06, May 29, 1986.

3. Justification of Trip-Two/Leave-Two Reactor Coolant Pump Trip Strategy During Transients, CEN-268, March 1984.

4. Response to NRC Request for Additional Information on CEN-268, CEN-268 Supplement 1-NP, November 1984.

5. J. T. Enos, AP&L, ltr to F. J. Miraglia, NRC, "Arkansas Nuclear One - Unit 2, Docket No. 50-368, License No. NPF-6, Implementation of TMI Action Item II.K.3.5, 'Automatic Trip of Reactor Coolant Pumps,' Response to Generic Letter 86-06," 2CAN118608, November 24, 1986.

6. D. R. Howard, AP&L, ltr to U. S. Nuclear Regulatory Commission, Document Control Desk, "Arkansas Nuclear One - Unit 2, Docket No. 50-368, License No. NPF-6, Additional Information Response, RCP Trip Criteria (TAC No. 49676)," 2CAN068806, June 3, 1988.

7. J. R. Marshall, AP&L, ltr to Director of Nuclear Reactor Regulation, NRC, "Arkansas Nuclear One - Unit 2, Docket No. 50-368, License No. NPF-6, Reactor Coolant Pump Trip - Generic Letter 83-10," 2CAN948409, April 20, 1984.