UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

# SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

# RELATED TO REACTOR COOLANT SYSTEM LEAK DETECTION SYSTEMS

# ENTERGY OPERATIONS, INC.

# ARKANSAS NUCLEAR ONE, UNIT 2

# DOCKET NO. 50-368

## 1. INTRODUCTION

By letter to the Combustion Engineering Owners Group (CEOG) dated October 30, 1990, the staff provided an evaluation of Topical Report CEN-367, "Leak-Before-Break Evaluation of Primary Coolant Piping in Combustion Engineering Designed Nuclear Steam Supply Systems." In that evaluation the staff concluded that CEN-367 was acceptable for referencing by certain CEOG plants, including Arkansas Nuclear One, Unit 2 (ANO-2). In its conclusion, the staff stipulated that "when referencing the CEOG topical report as a technical basis for applying LBB [leak-before-break] to primary loop piping, licensees must submit information to demonstrate that leakage detection systems installed at the specific facility are consistent with Regulatory Guide 1.45." By letter dated September 16, 1994, Entergy Operations, Inc., (the licensee) informed the staff of plans to install a permanent reactor pressure vessel seal plate over the reactor vessel annulus at ANO-2. In order to install the plate, the licensee needs to apply LBB technology to primary loop piping covered under CEN-367 due to resulting restrictions in the vent path around the reactor pressure vessel annulus. Therefore, in its September submittal, the licensee provided a comparison of the ANO-2 reactor coolant system (RCS) leak detection systems to the guidelines of Regulatory Guide 1.45, "Reactor Coolant Pressure Boundary Leakage Detection Systems." In its initial review of the licensee's comparison to RG 1.45, the staff questioned the capability of the containment sump level instrumentation to detect a 1 gallon per minute (gpm) increase in RCS leakage rate within a 1 hour period as recommended by RG 1.45. In a subsequent submittal dated February 29, 1996, the licensee described modifications to the containment sump level instrumentation intended to increase the sensitivity of that sump level instrumentation to be in accordance with the RG 1.45 recommendations. The staff reviewed the ANO-2 RCS leakage detection systems (including both licensee submittals) to determine if the systems are consistent with Positions C.3 and C.5 of RG 1.45. These positions are related to the types of instrumentation used and the sensitivity and response times which are important to the application of LBB technology.

ENCLOSURE

2. EVALUATION

Position C.3 of RG 1.45 recommends having at least three separate RCS leakage detection methods and that two of these methods should be (1) sump level and flow monitoring, and (2) airborne particulate monitoring. The third method, according to Position C.3, should consist of either monitoring condensate flow rate from air coolers or monitoring of airborne gaseous radioactivity. Position C.5 of RG 1.45, specifies that each of these three instruments should be adequate to detect a leakage rate, or its equivalent, of one gpm in less than [within] one hour. The three systems used at ANO-2 to satisfy Position C.3 are the containment sump level monitoring system, the containment air particulate radioactivity monitoring system, and the containment gaseous radioactivity monitoring system. The staff considers the containment sump level monitor equivalent to a sump level and flow monitor provided the sump level instrument can be shown to have an adequate sensitivity and response time in accordance with Position C.5 of RG 1.45. These three monitoring systems are also the leakage detection system required by the ANO-2 plant technical specifications.

The airborne particulate and gaseous radioactivity monitors at ANO-2 are basically the same as those that are used at most all other nuclear plants. The sensitivity and response times of these instruments are subject to variation dependent upon the activity level in the reactor coolant and the amount of mixing in the containment. Depending on the location of the leak, the amount of existing known leakage, and the level of activity in the reactor coolant at the time of a leak rate increase, the air particulate and gaseous monitors could detect a leak rate increase of 1 gpm within a 1 hour period. However, like most other nuclear plants, ANO-2 normally operates with as little coolant activity as is reasonably achievable. Under normal (low) coolant activity level conditions, the airborne particulate and gaseous radioactivity monitors could take longer than a 1 hour period to detect and alarm a 1 gpm increase in the RCS leakage rate. The sensitivity and response time of these monitors are similar to the sensitivity and response time of airborne monitors at other plants where the staff has concluded that they are in accordance with RG 1.45. RG 1.45 recommends that instruments with sensitivities of $10^{-9}$ microcuries per cubic centimeter ($\mu$Ci/cc) for air particulate monitoring and $10^{-6}$ $\mu$Ci/cc for the gaseous monitoring be used. The airborne radioactivity monitors at ANO-2 have sensitivities that exceed these values. The staff, therefore, concludes that these monitors are consistent with the guidelines of RG 1.45.

Because of the sensitivity variation of the airborne monitors it is all the more important that the containment sump level instrument be capable of detecting a 1 gpm leakage rate increase within a 1 hour period. As described in the licensee's September 1994 submittal, the sump level monitoring system could not meet this sensitivity and response time because of the sump's large volume coupled with the fact that readings of the sump level are not taken every hour, but only once a shift. In its February 29, 1996, submittal, the licensee described modifications which effectively increased the response time of the containment sump level instrumentation through the use of the plant computer monitoring system. Additional points were added to the plant

computer monitoring system which included sump level. A rate-of-change algorithm which calculates sump level increase once per minute was also installed. When a sump level increase of 1 gpm is detected, an alarm is generated on the computer monitoring system. This alarm will assist the operator in detecting a 1 gpm leak rate increase within 1 hour. The staff, therefore, concludes that whenever the plant computer monitoring system is operable, the containment sump level monitoring system is capable of detecting a 1 gpm increase in RCS leakage rate within 1 hour in accordance with the recommendations of RG 1.45. The plant computer monitoring system monitors a large number of parameters that are important to everyday plant operations and, therefore, out of necessity the system has a very high availability rating. During the short time periods that the computer monitoring system may be down, the operator will still have the normal sump level instrumentation available. The staff, therefore, agrees with the licensee, that it is not necessary to declare the containment sump level monitor inoperable during computer outages.

In addition to the above three leakage detection systems required by technical specifications, ANO-2 also has detectors to monitor humidity, temperature, and pressure as indirect indication of leakage into containment as recommended by Position C.3 of RG 1.45. The licensee also routinely performs an inventory balance every 24 hours (at steady state) or when other monitored variables indicate possible unknown RCS leakage. The inventory balance is considered the most accurate method of determining the actual RCS leakage rate because it detects and measures only reactor coolant leakage and is not affected by coolant activity levels. Leaks rates less than 1 gpm can be detected by the inventory balance method which takes less than 1 hour to perform.

## 3. CONCLUSION

Based on its review of the RCS leakage detection systems at ANO-2 the staff concludes that with the modifications described in the licensee's February 29, 1996, submittal, the leakage detection systems are consistent with the guidance in RG 1.45. The staff, therefore, concludes that the RCS leakage detection systems are adequate to support the application of LBB technology as described in Topical Report CEN-367 which was found acceptable for referencing in the staff's safety evaluation dated October 30, 1990.

Principal Contributor: W. LeFave

Date: June 18, 1996