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U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
Evaluation of Isolation Provisions for Service Water System
(TAC Nos. M77301 & M77302)

REFERENCE: (a) Calvert Cliffs Licensee Event Report 89-23, Revision 2, dated December 14, 1990, Postulated Rupture in Non-Safety-Related Service Water (SRW) Could Cause Failure of Both Safety-Related Subsystems

Gentlemen:

During a system design review in 1989, we identified a potential vulnerability to the loss of the safety-related (SR) portion of the Service Water (SRW) System during a Safe Shutdown Earthquake (SSE). This concern was described and a resolution proposed in Licensee Event Report (LER) 89-23 (Reference a). As a result of an engineering evaluation performed in response to the issue, we have resolved the concern in a manner different than that described in the LER. This letter explains our resolution.

The SRW System is divided into SR and non-safety-related (NSR) portions. The NSR portion of the system serves equipment in the Turbine Building. There are two isolation valves in series between the SR and NSR portions. These valves close automatically upon receipt of a Safety Injection Actuation Signal and loss of instrument air. However, these valves do not close automatically during a seismic event. This was the concern identified in LER 89-23, and we indicated we would resolve this issue by installing a diverse isolation signal to these valves. We have since determined that automatic isolation of the NSR portion of the system during a seismic event is not a practical solution.

Engineering studies were performed to examine various ways of providing an automatic signal to isolate the SRW System. These proposed modifications would have resulted in a reduction in overall SRW System reliability. We also evaluated the seismic capabilities of the Turbine Building and the NSR portion of the SRW System. We determined that both the Turbine Building and the NSR piping were rugged enough to withstand an SSE without collapse or gross rupture. During this

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review, five small branch lines were identified as potential break points in NSR SRW piping in the Turbine Building. Supports and pipe routing for these five lines were modified during the last Unit 1 and 2 refueling outages to prevent failure. As a result, the Turbine Building piping will now withstand an SSE. Further details of this evaluation are presented in the attachment to this letter.

Based on the engineering evaluation described above, our initial assumption of gross failure of the NSR SRW System during a seismic event was unrealistic and overly conservative. We have determined that the SRW System satisfies the appropriate licensing and design criteria for Calvert Cliffs. Specifically, the system design complies with General Design Criteria 2 (draft) in that it is capable of withstanding local natural phenomena and still performing its safety function. The capability of the NSR portion of the SRW System to withstand seismic events without rupture has been evaluated. Therefore, we have provided reasonable assurance that the SRW System will withstand seismic Category I accelerations and remain functional as described in the UFSAR Section 9.5.2.2.

Should you have any further questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

RED/EMT/PSF/emt/dlm

Attachment

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ATTACHMENT

TECHNICAL DISCUSSION OF ISSUES CONCERNING ISOLATION OF NON-SAFETY-RELATED SERVICE WATER PIPING AND COMPONENTS

BACKGROUND

On December 14, 1990, Licensee Event Report (LER) 89-23 identified the potential for a seismically-induced breach of the non-safety-related (NSR) portion of the Service Water (SRW) System to cause drainage and failure of the safety-related (SR) portion. This LER reported a postulated, not an actual, event. Our letter to the NRC, dated August 24, 1990, stated that our long-term plan to resolve this issue was to "enhance the system's design by providing automatic isolation of the safety-related SRW portion on indication of rupture in the non-safety-related portion." At that time, worst-case damage to the NSR portion of the system was conservatively assumed to be a double-ended guillotine break.

The SRW System at Calvert Cliffs is described in the Updated Final Safety Analysis Report (UFSAR) in Chapter 9. Unit 1 and Unit 2 each have an SRW System independent of the other unit. Except as noted, this letter will discuss a single system with the understanding that the discussion applies equally to either unit. Each unit system has an SR portion in the Auxiliary Building and an NSR portion in the Turbine Building. A simplified diagram is provided as Figure 1.

The SR portion of the system is divided into two trains for single-failure protection. In response to Engineering Safety Features Actuation Signal (ESFAS), one train provides cooling water to two containment coolers and the Emergency Diesel Generator (EDG) designated to serve the unit. The other train provides cooling water to 12 EDG (the swing diesel) and the other two containment coolers. These components are not needed for safe shutdown unless a Loss-of-Coolant Accident (LOCA) or Loss of Offsite Power (LOOP) occurs.

The NSR portion is a single loop in the Turbine Building connected to both SR trains. It is isolable from the SR portion on the supply side by two air-operated control valves in series for each train and on the return side by a single, common check valve backed up by another check valve and a manually operated butterfly valve for each train. The control valves are shut automatically on Safety Injection Actuation Signal (SIAS). Remote manual isolation is possible from the Control Room for other events such as earthquakes or any other incidents that may result in system leakage. A rupture in the NSR portion of the SRW System, taken by itself, is not a significant contributor to risk because the components served are not needed for safe shutdown.

EVALUATION OF AUTO-ISOLATION OPTIONS

Our engineering staff evaluated the SRW System with the installed methods of isolation and came to the conclusion that, given the magnitude of the assumed (double-ended guillotine) failure, the isolation system could not be practically redesigned to automatically isolate the SR portion fast enough to avoid SR inventory loss. The options evaluated are described below:

1. Detection of a seismic event by use of seismic accelerometers: (Rejected)

   We do not feel that existing technology is sufficiently reliable to be used in an SR application. Inadvertent actuation could cause a signal leading to unintentional SRW isolation and subsequent plant trip.

2. System leak detection by use of acoustic pipe monitors: (Rejected)

   Existing technology is not sufficiently reliable to be used in an SR application.

3. System leak detection by use of pressure differential: (Rejected)

   The pressure differential would not be great enough to act as a reliable indicator. Use of an orifice installed to create a reliable pressure differential would increase the potential for short duration pump cavitation during normal operation.

4. An SRW isolation signal generated by detecting a low level in the system head tanks: (Rejected)

   Since the spread between the normal operating level and the proposed isolation signal setpoint is not sufficient to prevent normal operational transients from challenging the setpoint, a higher operating level in the head tank would be necessary and the head tanks would have to be cross-connected. Because the level in the head tank varies during normal operation, setting the operating level higher increases the possibility of operational alarms. Cross-connecting the head tanks is not desired because maintaining system separation would require additional automated control valves. This option would cost between 0.5 and 1.0 million dollars.

5. Change the valve operating solenoids to a type that would release the valves (the valves are fail closed) on LOOP: (Rejected)

   This solution would not isolate the NSR portion of the system if there was a release of water inventory without a LOOP.

The solutions discussed above, all initially considered viable, were rejected because of high cost, lack of suitable technology, ineffectiveness, or because the change decreased operational safety margin.

SEISMIC WALKDOWNS AND ANALYSES

The results of the above evaluation led to the need to explore other options for providing an adequate degree of protection against the effects of failure of NSR piping on the SR portion of the SRW System. The most likely initiating mechanism for a large rupture of NSR portion of the SRW System piping is a severe seismic event. Our review of the Turbine Building structural design revealed that it is a ductile structure with inherent damping and energy absorbing capacity. The building is built to withstand 90 mph winds, thereby resisting lateral loads in excess of UBC seismic requirements. In addition, it is a Seismic Category II structure designed for 0.08g acceleration and the complexity of the structure would result in several significant modes of vibration which would serve to reduce the magnitude of the building resonant frequencies. All these factors would limit the building's response to seismic excitation and it would maintain its integrity during a seismic event. Considering the design of the Turbine Building and the inherent ruggedness of steel piping in general (ASME Code Case N-411), the occurrence of a severe seismic event is not expected to result in a large pipe rupture. However, since the NSR portion of the SRW System is not seismically qualified (Category I), we conducted a walkdown with a recognized expert in seismic studies. The intent of the walkdown was to identify those locations most likely to be affected by a Safe Shutdown Earthquake (SSE). The walkdown was conducted in accordance with EPRI guidelines that are endorsed by the NRC in NUREG-1407. Although these guidelines are not directly applicable to piping systems, the guidance on conduct of seismic walkdowns and the analysis of results is useful in this instance. Our consultant's conclusions are summarized below:

1. The piping is supported in "a normal flexible manner for fossil fueled power plants and other heavy industrial facilities, even for those located in earthquake-prone regions like California."

2. Use of studies of industrial piping for application to nuclear power plants is consistent with the 1985 NRC report "Summary and Evaluation of Historical Strong-Motion Earthquake Seismic Response and Damage to Aboveground Industrial Piping," NUREG-1061.

3. Welded steel piping such as that in question "does not fail in earthquakes from its own inertial loads." This conclusion is supported by the NRC/EPRI Piping and Fitting Reliability joint test program.

4. The points at which failure is likely to occur are at five (for both units) small (3/4" - 2") branch lines due to:

   a. a threaded connection
   b. branch line restraints
   c. branch line contact with a structural member or other interference due to movement of the main pipe.

5. It would be a conservative approach to assume that all five branch pipes (four in Unit 1 and one in Unit 2) will break at once (but that the breaks would not be totally open; i.e., cracks or splits).

6. There is no need "to consider it credible for the Calvert Cliffs safe shutdown earthquake to cause loss of pressure boundary in the large bore pipes" (this conclusion negates the need to consider a double-ended guillotine break of the 14" main pipe as a credible failure).

SUMMARY

We considered options for automatic isolation of the NSR from the SR portion of the system on a seismic event. We concluded that, although we might achieve automatic isolation, we would do so at some reduction of safety margin.

A reevaluation of the system found that the system piping and the Turbine Building could withstand an SSE. We identified five branch lines (total in both units) that were vulnerable to seismic-induced damage. These were fixed by rerouting and adding supports. This proved to be the most cost-effective and least intrusive of all the solutions.

FIGURE 1

SIMPLIFIED SRW SYSTEM