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DENTON,H.R. Office of Nuclear Reactor Regulation, Director
STOLZ,J.F. Operating Reactors Branch 4

SUBJECT: Responds to 841226 NRC status rept re seismic qualification of auxiliary feedwater sys.Walkdown will be performed to inspect backup nitrogrogen supply to air operated valves.W/ one oversize illegible drawing.

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April 9, 1985

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. J. F. Stolz, Chief
Operating Reactors Branch No. 4

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287

Dear Sir:

By letter dated December 26, 1984, the NRC provided to Duke Power a status report on the seismic qualification of the Emergency Feedwater (EFW) System for Oconee Nuclear Station. The NRC Staff requested that Duke either provide a commitment to resolve the open items identified in the December 26, 1984 letter or appeal to NRR management to have the Staff's position modified.

By letters dated February 21, 1985 and March 20, 1985, Duke addressed delays associated with the preparation, review and submittal of our response. Please find attached Duke's detailed responses to each open item addressed in the NRC status report.

In summary, Duke concluded that although the existing EFW system may not fully meet all of the present day criteria the NRC has requested in the areas of seismic qualification, the EFW system will remain functionally operable following an earthquake of 0.10g magnitude. Furthermore, with the completion of the actions described in our response both trains of the EFW are considered to be fully capable of operating following an SSE.

Duke believes that our response adequately addresses the NRC concerns regarding the seismic qualification of the EFW system. However, should the NRC Staff maintain its position requiring Duke to upgrade the Oconee EFW via further analysis or modifications, Duke will elect to appeal to the NRR management to have the staff position modified.

Very truly yours,

Hal B. Tucker/lam

Hal B. Tucker

MAH:slb

Attachment

A001
1/1

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Duke Power Company
Oconee Nuclear Station

Response to the NRC Status Report on
Seismic Qualification of the Auxiliary Feedwater System

The following is Duke's response to each open item addressed in the NRC status report on seismic qualification of the Emergency Feedwater (EFW) System at the Oconee Nuclear Station, dated December 26, 1984:

A. Piping

"The piping for the AFW systems is seismically qualified to the SSE level out through the first isolation valves, which are normally closed. Piping beyond these boundary points is not currently seismically qualified. The licensee indicates that this situation is consistent with other safety-related systems at the Oconee station.

Generic Letter 81-14 requests licensees to consider the AFW systems as including piping up to and including the second valve which is normally closed, or capable of automatic closure when the isolation function is required. This system boundary definition is intended to assure that the safety function of the AFW will not be lost during a seismic event, assuming that the seismic event causes the failure of the non-qualified piping concurrent with a single failure in the isolation valve.

The licensee has not identified the particular piping protected by a single valve or offered any justification supporting the adequacy of a single isolation valve. Therefore, we are forced to conclude that to conform to the Generic Letter, the licensee must either provide double-valve protection on all AFW piping or provide a technical analysis that demonstrates that the intent of the Generic Letter, as stated above, is satisfied."

Response

(1) EFW System

The Oconee Final Safety Analysis Report (FSAR) in Section 10.4.7.1 states the following:

> "Sufficient redundancy and valving are provided in the design of the EFW piping system with isolation and cross-connections allowing the system to perform its safety-related function in the event of a single failure coincident with a secondary pipe break and the loss of normal station auxiliary A.C. power."

Duke contends that a single failure is not assumed to include the failure of normally closed manual isolation valves to the open position. A check valve in the reverse flow direction is considered normally closed. With the exceptions addressed below, the EFW piping is single failure proof and capable of withstanding an SSE, since the boundary valves are normally closed manual valves. All such valves are included within the seismically-designed and supported portions of the system.

Exceptions to the normally-closed manual boundary valves are:

(a) Three power-operated boundary valves are normally closed. These valves are designed to fail closed, and so are not assumed to violate the EFW boundary.

(b) Two valves found to be open will be revised to be normally closed except when required for operation of other (unrelated) systems. Evaluation is being done to determine if further actions are necessary to protect these boundaries.

(c) One normally closed air-operated valve is designed to fail open. Modifications at this boundary will be made to protect EFW against single failure.

(d) Two plant heating lines attached to each Upper Surge Tank (UST) below water level are not documented to withstand an SSE. These lines will be inspected in the walkdown to be discussed in the following Section F, Proposed Conditions/Actions.

(2) Support Systems

The supporting systems for the turbine-driven EFW pump are not addressed due to Oconee having sufficient redundancy with the two electric motor-driven pumps. The supporting system required for operation of the electric motor-driven pumps is the Low Pressure Service Water (LPSW) system. The LPSW piping is addressed below.

LPSW provides cooling water to numerous systems at Oconee. Portions of the system are SSE qualified (including cooling water to the motor-driven EFW pumps), and other portions have no safety function. The safety-related portions of the system are designed to operate even with the non-safety portions operating, so several isolation valves between these portions are normally open. The safety/non-safety boundary valves do not have to be closed to assure sufficient flow for supporting the EFW system. Additionally, the non-safety piping is designed and constructed in accordance with ANSI B 31.1 and is expected to remain intact during and following an SSE. This is consistent with general industry experience for ANSI B 31.1 piping subjected to seismic loading.

The safety-related LPSW piping (required for EFW) is considered to be single failure-proof and capable of withstanding an SSE.

B. Valves and Actuators

"The following are the only valves in the AFW that are not qualified for the SSE.

1. The oil valves in AFW support systems are not qualified for an SSE.

2. The air-operated valves are not fully qualified.

3. Some motor-operated valves (MOVs) do not have retrievable qualification documentation.

The licensee has indicated that the areas lacking qualification have no effect on the operability of the AFW. It is likely that all the oil valves that support the AFW are related to the turbine-driven pump. If this is the situation, these valves would be acceptable on the basis that, given no other equipment failures, the plant can be placed in the cold shutdown conditions without the turbine-driven pump. The licensee should confirm that all the oil support valves involved are for service to the turbine-driven pump.

With regard to the potential failure of air-operated valves the licensee has stated that the air-operated valves will fail to the open position, except for the flow control valves for which a backup bottled nitrogen system is provided. The licensee has also stated that all motor-generated-valves are pre-positioned and fail as-is upon loss of power, thus permitting auxiliary feedwater to flow to the steam generators. While we agreed that the failure resulting from a loss of air or power will not lead to loss of safety function, we remain concerned that seismically induced failures in the internal mechanical portions of the valves may result in either blockage of the flow path or loss of control of the flow leading to steam generator overfilling. If mechanical failure causes flow blockage, it is not clear that either handwheels on the valves will be effective in establishing AFW flow or that the time available before the once-through-steam-generator (OTSG) boils dry is sufficient to allow credit for manual operator actions at locations outside the control room. Therefore, the licensee should reanalyze and/or modify the system to demonstrate an SSE-level of seismic capability for the AFW valves."

Response

With respect to the oil valves Duke confirms that all the oil support valves involved are for service to the turbine-driven pump.

As far as the motor-operated valves (MOVs) are concerned, excluding valves in the turbine-driven EFW pump support systems, all MOV's are pre-positioned for EFW operation, fail as is, and are not required to change position any time during or following an SSE. The turbine-driven pump support system valves are not required to be qualified since failure of the turbine-driven pump is acceptable to the NRC as stated in the NRC letter dated December 26, 1984. No MOV's are required for EFW flow control. Normally open, fail open valves are not assumed to fail closed and block EFW flow.

With regard to the concern for potential failure of the air-operated valves, only two valves in the EFW system per unit must change position to establish and/or control flow to the steam generators. These valves are air-operated, are normally closed, and fail to the open position. Documentation on the seismic qualification of these valves is not available. In order to provide assurance that these valves will be capable of operating following an SSE, Duke plans to qualify these valves either by analysis or by replacement, as required.

C. Power Supplies

"Electric power to some of the motor-operated valves and pneumatic sources for air-operated valves are not seismically qualified. For the MOVs, the licensee stated that electric power is not essential since the MOVs fail as-is and are not required to change position to establish flow. While we agree that establishing AFW flow is acceptably independent of electric power, we remain concerned regarding control of AFW flow. We do not find that manual operation of the valves locally is an acceptable substitute for seismically-qualified power sources and cabling to the components. Although we are not closing out the licensee's option to attempt to convince us of the acceptability of local manual controls in lieu of an adequate power source, we believe the licensee should provide a seismically qualified power source to all AFW components that are necessary to control OTSG water level.

For the air-operated valves, which includes the normal flow control-valves (FCV's) for the AFW, the licensee has provided an automatic bottled nitrogen system which can serve as an alternate to the air source. However, in that this backup source is not either designed or installed in a SSE-qualified manner either, we are forced to assume that the postulated seismic event could lead to loss of pneumatic power. In such a case the air-operated valves would fail to the full-open positions, which assures AFW flow but does not fully eliminate the questions regarding adequate flow control."

Response

A walkdown will be performed to inspect the backup nitrogen supply to the air-operated valves to assure the supply system will withstand an SSE. The power to the solenoid valves on the air operators is already seismically qualified.

The manual operation of these valves (located convenient to the control room) is an additional means to provide SG level control. A drawing showing valve proximity to the control rooms is attached.

D. Structures

"The turbine building which houses portions of the AFW system is seismic Class II. Therefore, the licensee should re-analyze and provide a discussion as to how the turbine-building might be modified to attain a demonstrated SSE level of seismic capability.

Response

(1) Seismic Capability of Turbine Building

The seismic capability of the Turbine Building structure is addressed in the Oconee FSAR section 3.8.5.4. A dynamic seismic analysis of the building was performed consisting of a three mass system using maximum ground acceleration of 10% of gravity (0.10g). The structure was analyzed using the accelerations from the dynamic analysis and stresses were within design criteria.

During the course of a Probabilistic Risk Analysis for Oconee, an independent consultant, Structural Mechanics Associates (SMA) compiled a report entitled "Conditional Probabilities of Seismic Induced Failures for Structures and Components for Oconee Generating Station Unit 3". This report is included in a document, NSAC-60, Vol. 4, Oconee PRA dated June 1984, prepared jointly by Nuclear Safety Analysis Center and Duke Power Company. This report establishes safety factors against failure as a function of peak ground acceleration for structures and equipment. The factor of safety of a structure or component is defined as the resistance capacity divided by the response associated with an earthquake of 0.10g peak ground acceleration.

Results from the above noted SMA study show the median ground acceleration capacity expected for failure of the Turbine Building steel frame is approximately 1.2g in the longitudinal direction (N-S) and approximately 3g in the lateral direction (E-W). These results indicate a minimum total median factor of safety of 12 compared to the maximum ground acceleration of 0.10g.

The SMA report further states that the assumptions used in the seismic analysis of the Turbine Building as defined in the FSAR were extremely conservative and greater margins of safety against structural collapse are believed to exist, particularly for the lower elevations, than are reported for failure of the Turbine Building.

The results of the seismic analysis presented in the FSAR using maximum ground acceleration of 0.10g and the results of the studies conducted by Structural Mechanics Associates indicate that the Turbine Building is capable of withstanding a maximum ground acceleration of 0.10g without failure in its primary structural components.

(2) EFW Seismic Risk

In addition, Duke has completed a detailed review of the EFW system's contribution to seismic risk. The following paragraphs summarize the results of this review.

Assuming that an earthquake has occurred, the emergency feedwater system's (EFW) potential contribution to the frequency of severe core damage can be determined in two ways:

1. For various ground motions of interest, a probability of EFW failure can be developed and related to a change in the core damage frequency.

2. Also, the EFW system's seismic capacity in relation to other system's capacity can provide a useful measure of the EFW system's "seismic importance".

Considering the range of ground accelerations between the OBE and the SSE and the associated failure probabilities, the change in risk between these two accelerations can be considered negligible. The change in risk is considered to be negligible because the absolute risk values associated with the OBE and SSE are so low that they cannot be developed as these values lie somewhere below the threshold of the seismic risk analysis.

For earthquakes to have any risk significance at all, the ground acceleration must be greater than the SSE. At these higher ground accelerations, the EFW system is not the dominant contributor to seismic risk. Other systems or structures are expected to fail at about the same or lower fragility levels as the EFW system.

In conclusion, based on the above discussion Duke believes that further analyses for modifications to the Turbine Building are not necessary.

E. Standby Shutdown Facility (SSF)

"In order for the SSF to be considered a substitute for the AFW, it would have to be capable of withstanding an SSE concurrent with a single active failure."

Response

The SSF is designed as a standby system for use under extreme emergency conditions. The system provides additional "defense-in-depth" protection for the health and safety of the public by serving as a backup to existing safety systems. The SSF is designed to provide an alternate and independent means to achieve and maintain decay heat removal following postulated fire, sabotage and flooding events. The SSF requires manual activation and would only be operated in the event installed normal and emergency systems are inoperable.

The single failure criterion is not required, in that the SSF is a backup to existing redundant safety systems. The SSF provides additional assurance that decay heat can be removed via the steam generator.

F. Proposed Conditions/Actions

"Since the licensee has not demonstrated that the SSF is capable of withstanding a single active failure, we would propose the following conditions:

1. Demonstrate that the SSF is capable of withstanding a single active failure.

2. Establish the switchover procedure from the AFW to the SSF system commensurate with the startup operation of the SSF system; and

3. Meet the boundary requirements specified in GL 81-14 for the AFW and SSF system boundaries.

If the licensee cannot meet the above conditions, then we would propose the following actions as a solution:

1. Perform a walkdown of the currently non-seismically qualified areas of the AFW system;

2. Upgrade the non-seismic portions of at least one train of the AFW system to seismic Category I;

3. Establish the switchover procedure from AFW to the SSF system commensurate with the startup operation of the SSF system; and

4. Meet the boundary requirements specified in GL 81-14 for the AFW and SSF system boundaries."

Response

Since the SSF is not intended to meet GL 81-14 criteria for AFW systems, this response is to the second set of conditions proposed above.

1. Walkdown - A walkdown will be performed to inspect the following:

   a. The backup air supply (nitrogen bottles) to the EFW flow control valves.

   b. The two plant heating lines connected to each UST back thru the first closed valve to insure UST integrity.

   c. Any portions of the EFW and LPSW systems not already surveyed under IE Bulletin 79-14 (i.e., small-diameter piping) but required for operation of the EFW system.

2. Upgrade - With the completion of the actions described herein, both trains of the EFW are considered to be fully capable of operating following an SSE.

3. Switchover Procedure - Duke has developed and implemented procedures (procedures OP/0/A/1600/11 and EP/0/A/1800/14) to supply flow to the steam generators with the Standby Shutdown Facility through use of the SSF Auxiliary Service Water System as an alternate method for feeding steam generators.

4. Boundaries - The full intent of the GL 81-14 boundary requirement is met for the EFW system as discussed in a preceding response (A - Piping).