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SUBJECT: Corrects responses to 850409 & 0711 ltrs re Generic Ltr 81-14. Changes reflect current available info on seismic qualification of emergency feedwater valves & piping & low pressure svc water.

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May 7, 1986

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

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

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

Dear Sir:

Duke Power Company (Duke) has completed a review of the seismic qualification of Emergency Feedwater (EFW) valves and piping and Low Pressure Service Water (LPSW) on all three Oconee units. As a result of this review, certain corrections to previous Duke's submittals concerning Generic Letter 81-14 are provided for your information. The original submittals include attachment to Duke's letter dated April 9, 1985 and Enclosure 4 to the NRC letter of July 11, 1985.

A complete copy of attachment to Duke's April 9, 1985 letter and Enclosure 4 to the NRC letter of July 11, 1985 with the corrections indicated by change bars are provided in Attachments 1 and 2, respectively. These changes reflect the current available information and are intended to supplement the referenced submittals.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

MAH/jgm
Attachment

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ATTACHMENT 1

CORRECTED VERSION OF ATTACHMENT TO DUKE'S SUBMITTAL

DATED APRIL 9, 1985

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. (C-374, C-384, C-391)

(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. (1C-168, C-211)

(c) Two hotwell make-up line isolation valves are normally open (C-186, C-191). 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.

(e) One boundary valve in the turbine-driven pump discharge is normally open. This line provides for pump recirculation flow and has no impact on the two motor-driven pump trains.

(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, the MOV's (C-152,-153) are pre-positioned for EFW operation, fail as is, and are not required to change position any time during or following an SSE. These valves will be modified to qualify them for 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 (FDW-315,-316). 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.

Additionally, four pressure-regulating valves (FDW-86, -87, -129, -218) in the turbine-driven pump seal lines are not qualified. These have no impact on the motor-driven pump trains. A check valve in the line to the 'B' steam generator (FDW-318) plus two capped test line valves in Unit 1 (1FDW-433, -434) also are not qualified and will either be qualified or replaced.

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/O/A/1600/11 and EP/O/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).

ATTACHMENT 2

CORRECTED VERSION OF ENCLOSURE 4 TO

THE NRC LETTER DATED JULY 11, 1985

Enclosure 4

Duke Power Company
Oconee Nuclear Station

Response to the NRC Request for Information on
Seismic Qualification of the Auxiliary Feedwater System

The following is Duke's response to each item addressed in the NRC Request for Information of Seismic Qualification of the Emergency Feedwater (EFW) System of Oconee Nuclear Station, dated June 18, 1985:

1. "In your April 9, 1985 submittal, you state that a single failure is not assumed to include the changing of safely positioned manual valves to the unsafe position. This assumption is correct only if the following conditions exist:

   a. the valves are seismic Category I;"

      Response: All of the normally closed boundary valves are seismically qualified.

   "b. the valve position is inspected every 30 days or after valve position changes or repairs;"

      Response: All safety-related valve positions, once set, are independently verified. Position-verification is always performed after maintenance and repairs. All valve positions are verified each refueling outage, and once every quarter valve positions are inspected to insure a flow path exists for Emergency Feedwater.

      This position-verification policy is implemented by procedure and is consistent with other safety-related systems at Oconee.

   "and
   c. the circuit breaker to any electricl controls for the valve operator is opened and the breaker position is inspected every 30 days or after position change or repairs.

      Verify that these conditions are satisfied by all the valves you assumed to fail as is or do not change position due to a single active failure."

      Response: The three MOV's that normally closed boundary valves have closed breakers so that alternative flow paths for Emergency Feedwater can be aligned quickly if needed. This does not compromise EFW reliability; the valves remain closed on loss of power and continue to protect the boundary.

2. "Two plant heating lines attached to each Upper Surge Tank (UST) below water level are not documented to withstand an SSE. Either verify by analysis that these lines can withstand an SSE or verify that the failure

of these lines will not result in the loss of the auxiliary feedwater system function."

Response: These lines will be analyzed and supports will be revised as required to insure that lines will withstand an SSE.

3. "The Low Pressure Service Water System (LPSW) provides cooling water to the two electric motor driven pumps in the auxiliary feedwater system. Portions of the system are seismically qualified 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. This statement is acceptable only if the non-safety related portions remain intact after a seismic event; therefore, either verify by analysis that these lines can withstand an SSE or verify that the failure of these lines will not result in the loss of the auxiliary feedwater system function."

Response: The LPSW System is judged to be capable of withstanding an SSE and supporting the EFW function even though this is not verified by detailed analysis. Flexibly supported piping systems are naturally resistant to failure due to seismic loading. Industry experience* has shown flexible piping systems (including those designed and supported in accordance with ANSI B31.1) are extremely resistant to damage by earthquakes of a magnitude several times larger than the Oconee SSE. The Oconee LPSW System is a flexible piping system, is designed and supported in accordance with ANSI B31.1, and is considered fully satisfactory for an SSE event.

The High Pressure Service Water System serves as back-up to LPSW cooling water for the Turbine-Driven (TD) EFW pumps. This TD train plus other systems, including Auxiliary Service Water, SSF Auxiliary Service Water (and Main Feedwater), provide added assurance that feedwater flow to the steam generators will not be lost.

4. "Switchover procedures (OP/O/A/1600/11 and EP/O/A/1800/14) were developed and implemented to supply flow to the steam generators with the Standby Shutdown Facility (SSF) through use of the SSF auxiliary service water system as an alternate method for feeding steam generators. Since the SSF auxiliary service water system contains only one train and one pump, the switchover procedures must restrict the use of the SSF auxiliary service water system to one unit for each accident or event. Failure to restrict the use of the SSF auxiliary service water system would result in the violation of General Design Criteria 5, "Sharing of Structures, Systems and Components." Verify that the switchover procedures restrict the use of the SSF auxiliary service water system to one unit for each accident or event."

*Reference Seismic Qualification Utilities Group (SQUG) research reports.

Response: The Standby Shutdown Facility (SSF) includes system and components necessary to provide an alternate and independent means to achieve and maintain a hot shutdown condition for one or more of the three Oconee units. The SSF was designed to resolve the safe shutdown requirement for fire protection, turbine building flooding, and sabotage.

The SSF Auxiliary Service Water System (SSFASW) is a high-head, high-volume system designed to provide sufficient steam generator inventory for adequate heat removal for all units during a loss of normal AC power in conjunction with the loss of the main and emergency feedwater systems. The SSFASW is designed to seismic Category I and can provide 580 gpm at full system pressure to each of three units.

As a part of emergency safety systems, the Emergency Feedwater (EFW) System, as designed and described in Oconee FSAR, provides redundant and sufficient feedwater to assures sufficient feedwater to the steam generators, the SSFASW can also provide an additional alternate method for EFW. However, the safety analyses in the FSAR do not take credit for SSFASW for mitigation of a loss of feedwater event. Switchover procedures OP/O/A/1600/11 and EP/O/A/1800/14 were developed and implemented to utilize the SSFASW capability as an additional means for feeding steam generators to enhance the overall safety of the plants. The SSF, by design objectives, is able to achieve and maintain a hot shutdown condition for one or more units during events such as fire, flooding, or sabotage which can affect one or more units. To restrict the use of SSFASW by procedures to one unit for each accident is contrary to the design and objectives of the SSF which has been reviewed and approved by the NRC in their SER dated April 28, 1983. Considering the SSFASW design and capabilityies, Duke believes that the switchover procedures as developed and implemented are consistent with the design philosophy of the SSf as a whole plant system for more than one event and provide an additional alternate method of feeding steam generators beyond the means of normal and emergency feedwater systems. Therefore, by design objectives, the SSF as a system meets the requirements of General Design Criterion 5.

Futhermore, the present main and emergency feedwater systems consisting of two turbine-driven main feedwater pumps, one turbine-driven and two motor-driven EFW pumps, and the Auxiliary Service Water System provide redundancy and capability for decay heat removal. Utilization of the SSFASW as an additional alternate source of feedwater not only will not impair its designed safety function but will increase the margin of safety during events which could result in complete loss of main feedwater and emergency feedwater systems.

Summary

Generic Letter 81-14 was issued with the purpose "to ultimately provide reasonable assurance, where necessary, that [AFW systems] are able to function following the occurrence of earthquakes up to and including the design SSE". The Oconee EFW System has been thoroughly reviewed, deficiencies have been identified, and modifications have been committed to for assurance that the system will withstand an SSE. It is Duke's opinion that this assurance has been provided.

Duke Power has a high degree of confidence that feedwater flow to the steam generators will always be available during and following an SSE. Feedwater can be provided by seven different trains: two turbine-driven main feedwater trains, two motor-driven EFW trains, one turbine-driven EFW train, one Auxiliary Service Water train and one train of SSF Auxiliary Service Water. Four of these trains are considered SSE-qualified; the Turbine-Driven EFW train is mostly qualified. Failure of any of the trains is very unlikely, which is reinforced by SQUG research.