ENCLOSURE 2

LAWRENCE LIVERMORE LABORATORY

Selected Operating Reactor Issues Program II

Reactor Coolant System Vents (NUREG-00737, Item II.B.1.)
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FINAL TECHNICAL EVALUATION REPORT FOR OCONEE 1, 2, AND 3

Docket Numbers 50-269, 50-270, and 50-287

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TECHNICAL EVALUATION REPORT
ON REACTOR COOLANT SYSTEM VENTS
FOR OCONEE 1, 2, AND 3

INTRODUCTION

The requirements for reactor coolant system high point vents are stated in paragraph (c)(3)(iii) of 10 CFR 50.44, "Standards for Combustible Gas Control System in Light Water Cooled Power Reactors," and are further described in Standard Review Plan (SRP) Section 5.4.12, "Reactor Coolant System High Point Vents," and Item II.B.1 of NUREG-0737, "Clarification of TMI Action Plan Requirements." In response to these and previous requirements, the Duke Power Company has submitted information in References 1 through 4 in support of the vent system on Units 1, 2, and 3 of the Oconee Nuclear Station.

EVALUATION

The function of the reactor coolant system (RCS) vent system is to vent noncondensible gases from the high points of the RCS to ensure that core cooling during natural circulation will not be inhibited. Oconee 1, 2, and 3 provide venting capability from the high points of the reactor vessel head and both RCS hot legs with high point vents (HPVs). The existing power operated relief valve (PORV) can be used to vent the pressurizer. The noncondensible gases, steam, and/or liquids vented from the hot legs are separately piped to the basement of the reactor building where they are released into the discharge air stream of the reactor building coolers. The reactor vessel head vent ties into one of the hot leg HPVs downstream of the hot leg vent valves. Each path of the HPVs is designed to vent one half of the RCS volume per hour. The addition of the HPVs has not introduced any new piping whose size is not encompassed by existing pipe break analyses, and hence, the licensee's compliance with 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors," is not affected by the installation of the HPVs.

The HPV paths from the reactor vessel head and the RCS hot leg high points each contain two solenoid-operated valves in series which are remotely controlled from the main control room. Positive indication of valve position, sensed by limit switches in the solenoid valves, is also provided in the main control room. A degree of redundancy has been provided by powering each HPV path from a different emergency power train to ensure that RCS venting capability from at least one hot leg high point is maintained. Valve seat leakage from the RCS through the HPV valves can be determined with the current procedures described in Oconee Technical Specification 3.1.6. The PORV can be operated manually from the Integrated Control System (ICS) Cabinets adjacent to the main control room. The PORV is powered from a Class IE emergency panel and has an acoustical monitoring system which provides positive position indication and actuates an alarm in the main control room. The PORV block valve receives power from a non-load-shed motor control center that derives its power from Class IE switchgear. Controls and positive position indication for the PORV block valve are also in the main control room. The power supply and position indication provisions for the PORV and block valve have been previously accepted by the NRC (Reference 5).

The portion of each HPV path up to and including the second normally closed valve forms a part of the reactor coolant pressure boundary and thus must meet reactor coolant pressure boundary requirements. Consistent with the original (and previously accepted) piping design criteria presented in Section I.c.3, Vol. I of the Oconee FSAR, this piping, all of which is one inch and smaller in diameter, is designated Class III (USAS B31.7). The portion of the HPV paths up to and including the second normally closed valve are designed for pressures and temperatures corresponding to the RCS design pressure and temperature. In addition, the vent system materials are Type 304 stainless steel and are fabricated and tested in accordance with Section III of the ASME Boiler and Pressure Vessel Code. The HPVs are also acceptably separated and protected from missiles and the dynamic effects of postulated piping ruptures. However, the HPVs are not specifically designed to withstand potential dynamic loads associated with water slugs from the starting of reactor coolant pumps (RCPs). Therefore the licensee must either analyze the HPVs for these dynamic loads or develop and implement operating instructions that prohibit starting of the RCPs when the HPVs are open. All portions of the HPVs are seismically designed to withstand the safe shutdown earthquake, in accordance with Seismic Category I requirements. However, SRP Section 3.2.1 states that structures, systems, and components that are important to safety must be classified as Seismic Category I items and identified in an acceptable manner. Although the HPVs are designed to acceptable seismic criteria, the licensee has not verified that the portion of the vent system that is part of the reactor coolant pressure boundary has been acceptably identified and classified Seismic Category I. We therefore conclude that the design of the portion of the HPVs up to and including the second normally closed valve conforms to all reactor coolant pressure boundary requirements, including 10 CFR 50.55a and the applicable portions of General Design Criteria 1, 2, 4, 14, 30, and 31, with two confirmatory items. First, the licensee must provide either an analysis of the dynamic loads of water slugs potentially resulting from starting the RCPs or prohibit starting the RCPs with the HPVs open. Second, the licensee must confirm the classification of the reactor coolant pressure boundary portion of the vent system as Seismic Category I. The licensee has further ascertained that the essential operation of other safety-related systems will not be impaired by postulated failures of HPV components, with one exception. The licensee has not justified the use of a design pressure of 500 psig for the piping downstream of the second solenoid valve in each HPV path. This is an open item.

We have reviewed the licensee's HPV design to assure an acceptably low probability exists for inadvertent or irreversible actuation of the vent system. Each HPV path has two solenoid-operated valves in series. Each valve has a power switch that (1) removes power from the valves in each HPV path during normal operation to prevent inadvertent operation, and (2) minimizes the probability of isolation failure due to hot shorts in the control switches. Valve position indicator lights, which operate independently of the power switch position, will alert operators in the event of an open valve. Each valve also has a separate pushbutton control to actuate the valve, with a spring return to interrupt power and close the valve. The HPV valves all receive emergency Class IE power and fail to the closed position in the event of loss of power. Operator access to the ICS Cabinets for manual operation of the PORV is limited by administrative controls to provide resistance to inadvertent operation. The PORV vent path from the pressurizer is protected from potential irreversible actuation since the PORV and block valve are powered from different power sources. The licensee has stated that displays and controls added to the main control room by the installation of the HPVs will be considered in the human factors analysis during the "Control Room Design Review" required by NUREG-0737 Item I.D.1. We therefore find that no single active component failure or human error should result in inadvertent opening or failure to close after intentional opening of the HPVs and the PORV pressurizer high point vent.

We have also evaluated the licensee's word description of the locations where the HPVs normally discharge to the containment atmosphere in the reactor building basement (References 1 and 4). Since the HPV discharges are directed to the discharge air streams of the reactor building coolers at opposite sides of the reactor building, good mixing with the containment atmosphere is assured to prevent the accumulation or pocketing of high concentrations of hydrogen in compliance with 10 CFR 50.44, "Standards for Combustible Gas Control System in Light Water Cooled Power Reactors." Additionally, these locations are such that operation of safety-related systems would not be impacted by the discharge of the anticipated mixtures of steam, liquids, and noncondensible gases.

The design provides for individual test and open/closed indication of each HPV valve, and the licensee has stated that operability testing of the HPV valves will be performed in accordance with subsection IWV of Section XI of the ASME Code for Category B valves during each scheduled refueling outage.

CONCLUSION

We conclude that the design of the Oconee 1, 2, and 3 RCS vent system, which includes the HPVs and PORV pressurizer high point vent system, is sufficient to effectively vent noncondensible gases from the reactor coolant system without leading to an unacceptable increase in the probability of a LOCA or a challenge to containment integrity, meets the design requirements of NUREG-0737 Item II.B.1 and the applicable portions of General Design Criteria 1, 2, 4, 14, 30, and 31, and conforms to the requirements of paragraph (c)(3)(iii) of 10 CFR 50.44, with one exception concerning the design pressure of piping downstream of the second solenoid valve in each HPV path. The justification of the design pressure for these sections of piping is an open item. We therefore recommend following resolution of this open item that the Oconee 1, 2, and 3 RCS vent system design be found acceptable with the following confirmatory items. Either the dynamic loads on the HPVs from starting the RCPs must be analyzed or operating procedures to prohibit starting the RCPs while the HPVs are open must be developed. Also, the licensee must verify that the portion of the HPVs that is part of the reactor coolant pressure boundary is classified Seismic Category I. In addition, it should be noted that the following items were excluded from the scope of our review: seismic and environmental qualification of the HPVs, the RCS vent system operating guidelines and procedures, and required modifications to the plant technical specifications and in-service inspection program for the RCS vent system.

REFERENCES

1. Letter, W.O. Parker, Jr. (Duke Power Company) to H.R. Denton (NRC), providing information concerning NUREG-0578 requirements, dated January 2, 1980.

2. Letter, W.O. Parker, Jr. (Duke Power Company) to H.R. Denton (NRC), "Oconee Nuclear Station, Docket Nos. 50-269, -270, -287," dated April 2, 1980.

3. Letter, W.O. Parker, Jr. (Duke Power Company) to H.R. Denton (NRC), providing information concerning the design and operation of the RCS high point vent system, dated June 29, 1981.

4. Letter, W.O. Parker, Jr. (Duke Power Company) to H.R. Denton (NRC), "Oconee Nuclear Station, Docket Nos. 50-269, -270, -287," dated March 26, 1982.

5. Letter, R.W. Reid (NRC) to W.O. Parker, Jr. (Duke Power Company), with enclosure, "Evaluation of Licensee's Compliance with Category 'A' Items of NRC Recommendations Resulting from TMI-2 Lessons Learned," dated April 7, 1980.