LAWRENCE LIVERMORE LABORATORY

ENCLOSURE 2

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 FARLEY 1 AND 2

Docket Numbers 50-348 and 50-364
NRC TAC Numbers 44371 and 44372

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TECHNICAL EVALUATION REPORT ON REACTOR COOLANT SYSTEM VENTS FOR FARLEY 1 AND 2

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 Alabama Power Company has submitted information in References 1 through 4 in support of the vent system at Units 1 and 2 of the Joseph M. Farley Nuclear Plant.

EVALUATION

The function of the high point vent system is to vent noncondensible gases from the high points of the reactor coolant system (RCS) to assure that core cooling during natural circulation will not be inhibited. The Farley 1 and 2 reactor vessel head vent system (RVHVS) provides venting capability from the reactor vessel head while the pressurizer can be vented through the existing power operated relief valves (PORVs). The noncondensible gases, steam, and/or liquids vented from the reactor vessel head are piped and discharged above the reactor toward the reactor cavity walls, and the discharges from the pressurizer are piped to the pressurizer relief tank (PRT). The RVHVS is designed to vent a volume of hydrogen approximately equal to one half of the RCS volume in one hour. Flow restriction orifices in the RVHVS paths, however, limit the flow from a pipe rupture or from inadvertent actuation of the vent system to less than the capability of the reactor coolant makeup system. 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 addition of the RVHVS.

The RVHVS consists of two vent paths from the reactor vessel head to the reactor cavity, each containing two solenoid-operated valves in series which are controlled from the main control room. Positive indication of valve position is also provided by way of position switches located on the valve stems and by monitoring status lights in the main control room. A degree of redundancy has been provided by powering each RVHVS vent path from a separate emergency bus, to ensure that RCS venting capability from the reactor vessel head is maintained. RVHVS isolation valve seat leakage can be detected by the existing reactor coolant leakage detection system. The existing PORVs, used to vent the pressurizer to the PRT, can be manually controlled from the main control room. The PORVs and block valves receive power from independent emergency buses and have positive valve position indication in the main control room by way of valve stem limit switches. PORV seat leakage can be detected by temperature instrumentation on the PORV discharge lines and temperature, pressure, and level indication for the PRT.

The portion of each RVHVS 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. The licensee has stated that this portion of the RVHVS is designated Safety Class 2 (Safety Class 1 upstream of the flow restriction orifices) in compliance with 10 CFR 50.55a and Regulatory Guide 1.26. The licensee has also stated that this portion of the RVHVS has been designed and fabricated in accordance with the seismic loading requirements of Section III of the ASME Boiler and Pressure Vessel Code for Class 1 and 2 systems, but the licensee has not verified that this portion of the RVHVS has been designated Seismic Category I in accordance with Regulatory Guide 1.29. Confirmation by the licensee that this portion of the RVHVS will be classified as Seismic Category I is required. The RVHVS is designed for pressures and temperatures corresponding to the RCS design pressure and temperature. In addition, the vent system materials are compatible with the reactor coolant chemistry and are fabricated and tested in accordance with SRP Section 5.2.3, "Reactor Coolant Pressure Boundary Materials." The RVHVS and the pressurizer PORV vent system are also acceptably separated and protected from missiles and the dynamic effects of postulated piping ruptures. We therefore conclude that the design of the portions of the RVHVS 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, contingent on confirmation of acceptable seismic classification of this portion of the RVHVS. The licensee has further ascertained that the essential operation of other safety-related systems will not be impaired by postulated failures of RVHVS components.

We have reviewed the licensee's RVHVS design to assure an acceptably low probability exists for inadvertent or irreversible actuation of the vent system. Each vent path has two normally closed, fail closed valves in series, and each valve has an individual control switch and positive valve position indication by way of status lights in the main control room. Power for each RVHVS path is supplied by an independent emergency power train. The licensee has also stated that the controls and displays added to the main control room for the RVHVS will be considered in the long-term human factors analysis to reduce the potential for operator error. However, the Farley 1 and 2 RVHVS design includes Target Rock solenoid-operated valves which may be susceptible to common mode failure because operation of one valve may cause other valves in the system to open temporarily (see Reference 5). The licensee will be required to evaluate this problem and present their conclusions including any design changes necessary to minimize the probability of inadvertent vent system actuation. Therefore, we find that no single active component failure or human error should result in inadvertent opening or irreversible operation (i.e., failure to close after intentional opening) of the RVHVS, contingent on a satisfactory resolution of the problem with Target-Rock solenoid-operated valves.

We have also examined the locations where the RVHVS normally discharges to the containment atmosphere in the vicinity of the reactor cavity and where the pressurizer vent system discharges via the PRT rupture disc. Based on a description by the licensee (Reference 1) these locations are in areas that assure good mixing with the containment atmosphere 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 the operation of safety-related systems would not be adversely affected by the discharge of the anticipated mixtures of steam, liquids, and noncondensible gases.

The RVHVS is designed such that operability testing can be performed in accordance with the requirements of subsection IWV of Section XI of the ASME Code for Category B valves. The licensee has also stated that operability testing of the PORVs is accomplished in accordance with current plant technical specifications. However, the licensee must verify that the RVHVS valves will not be exercised every three months. This is a confirmatory item.

CONCLUSION

We conclude that the design of the Farley 1 and 2 RCS vent system, which includes the RVHVS and pressurizer PORV vent system, is sufficient to effectively vent noncondensible gases from the reactor coolant system without leading to an unacceptable increase in the probabililty 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. We therefore recommend that the Farley 1 and 2 RCS vent system design be found acceptable with the following three confirmatory items. First, the licensee must verify that the portion of the RVHVS that is a part of the reactor coolant pressure boundary will be classified Seismic Category I. Second, the Target Rock solenoid-operated valve problem noted above must be satisfactorily resolved. Third, the licensee must verify that the RCS vent system valves will be exercised during each refueling outage and not every three months. In addition, it should be noted that the following items were excluded from the scope of our review: seismic and environmental qualification of the RVHVS, RCS vent system operating guidelines and procedures, and required modifications to the plant technical specifications and in-service inspection program for the RVHVS.

REFERENCES

1. Letter, F.L. Clayton, Jr. (Alabama Power Company) to A. Schwencer (NRC), with enclosure, "TMI Related Question on Section II.B.1, Reactor Coolant System Vents," dated September 22, 1980.

2. Letter, F.L. Clayton, Jr. (Alabama Power Company) to S.A. Varga (NRC), "Farley Nuclear Plant Units 1 and 2, NUREG-0737 Response," dated January 14, 1981.

3. Letter, F.L. Clayton, Jr. (Alabama Power Company) to B.J. Youngblood (NRC), "Joseph M. Farley Nuclear Plant - Unit 2, NPF-8 License Condition 2.c.(21)(b)," dated June 25, 1981.

4. Letter, F.L. Clayton, Jr. (Alabama Power Company) to S.A. Varga (NRC), "Joseph M. Farley Nuclear Plant - Units 1 & 2, NUREG-0737, Item II.B.1, Information Request for Reactor Coolant System Vents," dated April 30, 1982.

5. NRC Memorandum, T.P. Speis (Division of Systems Integration) to T.M. Novak (Division of Licensing), "Unintentional Lifting of Solenoid Operated Pilot Valves in RCS Vent System," dated March 9, 1982.