ENCLOSURE 2

Lawrence Livermore National 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 SALEM 1 AND 2

Docket Numbers 50-272 and 50-311
NRC TAC Numbers 44405 and 44406

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# TECHNICAL EVALUATION REPORT ON REACTOR COOLANT SYSTEM VENTS FOR SALEM 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 Public Service Electric and Gas Company has submitted information in References 1 and 2 in support of the vent system on Units 1 and 2 of the Salem Nuclear Generating Station.

## 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 Salem 1 and 2 reactor vessel head vent system 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 either the reactor vessel head or the pressurizer are piped and discharged to the pressurizer relief tank (PRT). The reactor vessel head vent system is designed to vent a volume of gas approximately equal to one half of the RCS volume in one hour. A flow restriction orifice, however, limits the flow from a pipe rupture or from inadvertent actuation of the reactor vessel head 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 Power Reactors," has not been affected by the addition of the reactor vessel head vent system.

The vent path from the reactor vessel head to the PRT contains two parallel sets of two normally closed solenoid-operated valves in series which are remotely controlled from the main control room. Each of the two solenoid-operated vent valves in series in each set is powered from one of two redundant vital DC buses. The two parallel sets of valves are cross-connected downstream of the first normally closed valves, so reactor vessel head venting capability will be maintained in the event of failure of one of the vital DC buses. Indication of valve position, derived from limit switches located in all four reactor vessel head vent valves, is provided in the main control room. NRC has previously determined that each PORV and PORV block valve also has positive position indication in the main control room (Reference 3). The PRT has pressure, temperature, and level indications and alarms in the main control room which can be used to detect valve seat leakage from the reactor coolant system through the reactor vessel head vent system valves and the PORVs. Valve seat leakage from the PORVs can also be detected by the temperature display and alarm provided in the main control room for the common pressurizer header.

The portion of the reactor vessel head vent system 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 the vent system is designated Seismic Category I in compliance with Regulatory Guide 1.29. The licensee has also classified the piping and valves up to and including the second normally closed valve as Safety Class 2 in compliance with 10 CFR 50.55a and Regulatory Guide 1.26. The vent system is designed for pressures and temperatures corresponding to the RCS design pressure and temperature. The piping and valves are stainless steel and are compatible with the reactor coolant chemistry. In addition, the vent system is acceptably protected from missiles and the dynamic effects of postulated piping ruptures. However, the licensee has not verified that the reactor vessel head vent system materials will be fabricated and tested in accordance with the requirements of SRP Section 5.2.3 or other acceptable standards. We therefore conclude that the design and construction of the portion of the reactor vessel head vent system 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 verification of acceptable material fabrication and testing provisions. The licensee has further ascertained that the essential operation of other safety-related systems will not be impaired by postulated failures of vent system components.

We have reviewed the licensee's reactor vessel head vent system design to assure an acceptably low probability exists for inadvertent or irreversible actuation of the vent system. Each vent path from the reactor vessel head includes two normally closed solenoid-operated vent valves in series from which power is removed during normal operation. Each reactor vessel head valve also has an individual key-locked control switch, with both visual and audible valve position indications in the control room. In addition, each solenoid-operated vent valve is powered from one of two redundant vital DC buses and fails to the closed position in the event of loss of power. Furthermore, the licensee has stated that all displays and controls located in the main control room due to addition of the reactor vessel head vent system will be considered in the human factors analysis in accordance with NUREG-0700 in order to reduce the potential for operator error. 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 reactor vessel head vent system. However, reactor vessel head vent valve position indication is powered from the same power supply which supplies control power. If the licensee's intention is to remove control power by opening the breakers rather than locking out power to the valves by the key-lock switches, positive valve position indication will be lost. Until the licensee verifies that the control power breakers will not be maintained open during normal operation or the licensee provides an acceptable alternative method of continuous, direct valve position indication, this is an open item.

We have also examined the location where the reactor vessel head vent system and PORVs would discharge to the containment atmosphere through the PRT rupture disc. Based on a description provided by the licensee (Reference 2) this area is adequately ventilated following an accident and will provide 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, this location is 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 valve, and the licensee has stated that operability testing of the reactor vessel head vent valves, PORVs, and PORV block valves will be performed in accordance with Subsection IWV of Section XI of the ASME Code for Category B valves. However, the licensee has not

stated that the reactor vessel head vent valves will be exercised during cold shutdown or refueling rather than every three months. This is a confirmatory item. NRC has previously determined that the operability testing provisions for the PORV and block valves are acceptable (Reference 3).

## CONCLUSION

We conclude that the Salem 1 and 2 RCS vent system design, consisting of the reactor vessel head vent system and existing PORVs, 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 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 positive valve position indication as noted above. We therefore recommend following resolution of this open item that the Salem 1 and 2 RCS vent system design be found acceptable with the following two confirmatory items. The material fabrication and testing provisions for the portions of the reactor vessel head vent system that form part of the reactor coolant pressure boundary must be determined to be acceptable, and the licensee must commit to exercise the reactor vessel head vent valves during cold shutdown or refueling rather than every three months in accordance with the requirements of subsection IWV of Section XI of the ASME Code for Category B valves. It should also be noted that the following items were excluded from the scope of our review: seismic and environmental qualification of the RCS vent system, 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, R.L. Mittl (Public Service Electric and Gas Company) to F.J. Miraglia (NRC), "Reactor Coolant System Vents, No. 2 Unit, Salem Nuclear Generating Station, Docket No. 50-311," dated June 30, 1981

2. Letter, E.A. Liden (Public Service Electric and Gas Company) to S.A. Varga (NRC), "Reactor Coolant System Vents (Item II.B.1), Units 1 and 2, Salem Nuclear Generating Station, Docket No. 50-272 and 50-311," dated April 28, 1982

3. Letter, S.A. Varga (NRC) to F.W. Schneider (Public Service Electric and Gas Company), "Category A Items of TMI Lessons Learned," dated March 21, 1981