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ENCLOSURE 2

Selected Operating Reactor Issues Program II

Reactor Coolant System Vents (NUREG-0737, Item II.B.1)
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FINAL TECHNICAL EVALUATION REPORT FOR FORT CALHOUN 1

Docket Number 50-285
NRC TAC Number 44374

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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 Omaha Public Power District has submitted information in References 1 through 3 in support of the vent system at Unit 1 of the Fort Calhoun Power 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 Fort Calhoun 1 reactor coolant gas vent system (RCGVS) provides venting capability from the reactor vessel head and the pressurizer steam space. The noncondensible gases, steam, and/or liquids vented from the reactor vessel head and pressurizer steam space are piped and discharged to either the containment atmosphere or the pressurizer quench tank. The RCGVS is designed to vent a volume of hydrogen in standard cubic feet equal to one half of the reactor vessel volume in one hour. Flow restriction orifices in the RCGVS paths, however, limit mass loss from a vent pipe break or inadvertent actuation of the RCGVS to less than the makeup capacity of a single charging pump. Hence, the licensee's compliance with 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors," has not been affected by the addition of the RCGVS.

The vent path from the reactor vessel head and the vent path from the pressurizer each contain two independently powered solenoid-operated valves in parallel and connect to a common header that discharges either to the containment atmosphere or to the quench tank. The lines to the containment atmosphere and the quench tank each contain an isolation valve powered from independent emergency power sources. Thus, a degree of redundancy has been provided by powering RCGVS valves from different emergency power supplies, to ensure that RCS venting capability from both the reactor vessel head and the pressurizer is maintained. Valve control switches and positive indication of valve position are provided in the main control room. RCGVS valve seat leakage is detected by pressure instrumentation with associated alarms in the main control room.

The portion of each RCGVS 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 RCGVS is designated Safety Class 2, meeting the same or better qualifications as were accepted for the RCS at the time of licensing (Class 1 upstream of the flow restriction orifices) and Seismic Category I in compliance with 10 CFR 50.55a and Regulatory Guides 1.26 and 1.29. The RCGVS is designed for pressures and temperatures corresponding to the RCS design pressure and temperature. In addition, the licensee has stated that all piping and valves used in the RCGVS are either Type 304 or Type 316 austentic stainless steel or equivalent. Socket welded connections are used throughout except where disassembly for maintenance, particularly refueling operation, is required. Also the licensee has stated that all piping and fittings shall be fabricated, installed, inspected and tested in accordance with requirements of C-E Design Specification Number 8879-DE-141. The RCGVS is 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 RCGVS 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 by the licensee that the vendor design specification requirements for fabrication and testing are in accordance with SRP Section 5.2.3 or other acceptable requirements. The licensee has further ascertained that the essential operation of safety-related systems will not be impaired by postulated failures of RCGVS components.

We have reviewed the licensee's RCGVS design to assure an acceptably low probability exists for inadvertent or irreversible actuation of the vent system. Each vent path has two solenoid-operated valves in series, and each valve has a separate key locked control switch. All remotely operable valves are administratively controlled. In addition, the valves are powered by emergency power supplies and fail to the closed position in the event of loss of power. Limit switches, which provide positive position indication in the main control room for both the fully open and fully closed positions for each RCGVS valve, and annunciators will alert the operator to an open valve. Furthermore, the licensee has stated that a human factor analysis has been performed on the location and placement of displays and controls added to the main control room as a result of the RCGVS to reduce the potential for operator error. However, the Fort Calhoun 1 RCGVS design includes Target Rock solenoid-operated valves which may be susceptible to a common mode failure because operation of one valve may cause other valves in the system to open temporarily. The licensee will be required to evaluate this problem and present their conclusions including any design changes necessary to minimize the probability of an inadvertent vent system actuation. We therefore 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 RCGVS, contingent on satisfactory resolution of the problem with Target Rock solenoid-operated valves.

We have also examined the locations where the RCGVS discharges to the containment atmosphere either directly or through the rupture disc on the pressurizer quench tank. Based on a word description provided by the licensee (Reference 3), these locations are in areas that 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, 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 licensee has stated that the required maintenance is limited to in-service inspection (ISI) of the Class 2 solenoid valves required by Section XI of the ASME Code and drains have been provided for this purpose. The licensee has also stated that the RCGVS solenoid-operated valves will be full-stroke exercised and leak-tested during refueling outages and cold shutdown conditions in accordance with subsection IWV of Section XI of the ASME Code.

CONCLUSION

We conclude that the Fort Calhoun 1 RCGVS design 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 conforms to the requirements of paragraph (c)(3)(iii) of 10 CFR 50.44. We therefore recommend that the Fort Calhoun 1 RCGVS design be found acceptable with the following two confirmatory items. The Target Rock solenoid-operated valve problem noted above must be satisfactorily resolved, and the requirements for RCGVS fabrication and testing must be found acceptable (e.g., in conformance to SRP Section 5.2.3). It should also be noted that the following items were excluded from the scope of our review: seismic and environmental qualification of the RCGVS, the RCGVS operating guidelines and plant-specific procedures, and required modifications to the plant technical specifications and in-service inspection program for the RCGVS.

REFERENCES

1. Letter, W.C. Jones (Omaha Public Power District) to R.A. Clark (NRC), with Attachment, "Response to Document Requirements of Section II.B.1 of NUREG 0737 Reactor Coolant System Vents," dated July 1, 1981.

2. Letter, W.C. Jones (Omaha Public Power District) to R.A. Clark (NRC), with Attachment, "Response to Document Requirements of Section II.B.1 of NUREG 0737 Reactor Coolant System Vents," dated September 17, 1981.

3. Letter, W.C. Jones (Omaha Public Power District) to R.A. Clark (NRC), with Attachment, "Omaha Public Power District's Response to the Commission's March 4, 1982 Letter," dated June 1, 1982.