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 POINT BEACH 1 AND 2

Docket Numbers 50-266 and 50-301
NRC TAC Numbers 44396 and 44397

Prepared by J. T. Held of Energy Incorporated - Seattle (Subcontract 4324401) for Lawrence Livermore National Laboratory under contract to the NRC Office of Nuclear Reactor Regulation, Division of Licensing.

NRC Lead Engineer - Gus Alberthal

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TECHNICAL EVALUATION REPORT ON REACTOR COOLANT SYSTEM VENTS FOR POINT BEACH 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 Wisconsin Electric Power Company has submitted information in References 1 through 4 in support of the vent system at Point Beach Nuclear Plant, Units 1 and 2.

EVALUATION

The function of the Reactor Coolant System Gas Vent System (RCSGVS) 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 Point Beach 1 and 2 RCSGVS provides venting capability from high points of the pressurizer and the reactor vessel head. The noncondensible gases, steam, and/or liquids vented from either the pressurizer or the reactor vessel head are piped and discharged to the pressurizer relief tank (PRT) or directly to the containment atmosphere. The RCSGVS is capable of venting a volume of gas in standard cubic feet approximately equal to one half of the RCS volume in one hour. Flow restriction orifices are provided in each vent path, however, to 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 RCSGVS.

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 PRT. The lines to the containment atmosphere and the PRT each contain an isolation valve powered from independent power sources. Thus, a degree of redundancy has been provided by powering RCSGVS 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 indication of valve position are provided in the main control room. Positive indication of valve position is provided by way of magnetic reed limit switches on the solenoid valves. RCSGVS valve seat leakage is detected by pressure instrumentation with associated alarms in the main control room.

The portion of each RCSGVS 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 vent system is designated Safety Class 1 upstream of and including the flow restriction orifices and Safety Class 2 downstream of the flow restriction orifices up to and including the second solenoid valve in compliance with 10 CFR 50.55a and Regulatory Guide 1.26. The RCSGVS is designed for pressures and temperatures corresponding to the RCS design pressure and temperature. Also, the vent system materials are compatible with the reactor coolant chemistry and are fabricated and tested in accordance with the ASME Code and SRP Section 5.2.3. In addition, the reactor vessel head vent and the pressurizer vent are acceptably separated and protected from missiles and the dynamic effects of postulated piping ruptures. Furthermore, the entire RCSGVS is designed 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 RCSGVS is 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 portions of the RCSGVS 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 by the licensee of the classification of this portion of the RCSGVS 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 RCSGVS components.

We have reviewed the licensee's RCSGVS 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 an individual key locked control switch. Physical restraining devices will be fitted on or over the valve control switches to minimize the possibility of inadvertent RCSGVS operation. An annunciator and valve position indicator lights will alert operators in the event of an open valve. The valves all receive emergency Class 1E power and fail to the closed position in the event of loss of power. Furthermore, the licensee has stated that all displays and controls added to the main control room for the RCSGVS will be considered in the human factors analysis required by NUREG-0737 Item I.D.1, "Control-Room Design Reviews," in order to reduce the potential for operator error. However, the Point Beach 1 and 2 RCSGVS 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 (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 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 RCSGVS, contingent on satisfactory resolution of the problem with the Target Rock solenoid-operated valves.

We have also examined the locations where the RCSGVS discharges to the containment atmosphere either directly or through the PRT rupture disc. Based on RCSGVS isometric drawings and a 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 design provides for individual test and open/closed indication of each valve, and the licensee has stated that operability testing of the RCSGVS valves will be done in accordance with subsection IWV of Section XI of the ASME Code for Category B valves during refueling.

CONCLUSION

We conclude that the Point Beach 1 and 2 RCSGVS 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 Point Beach 1 and 2 RCSGVS design be found acceptable with the following confirmatory items. The Target Rock solenoid-operated valve problem noted above must be satisfactorily resolved, and the licensee must verify that the portion of the RCSGVS 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 RCSGVS, RCSGVS operating guidelines and procedures, and required modifications to the plant technical specifications and in-service inspection program for the RCSGVS.

REFERENCES

1. Letter, C.W. Fay (Wisconsin Electric Power Company) to H.R. Denton (NRC), "Docket Nos. 50-266 and 50-301, Implementation of NUREG-0578, Point Beach Nuclear Plant, Units 1 and 2," dated March 14, 1980

2. Letter, S. Burstein (Wisconsin Electric Power Company) to H.R. Denton (NRC), "Docket Nos. 50-266 and 50-301, Response to NUREG-0737, Update to Schedule Requirements and Implementation Status," dated September 14, 1981

3. Letter, C.W. Fay (Wisconsin Electric Power Company) to H.R. Denton (NRC), "Docket Nos. 50-266 and 50-301, Reactor Coolant System Gas Vent System, Point Beach Nuclear Plant, Units 1 and 2," dated June 18, 1982

4. Letter, C.W. Fay (Wisconsin Electric Power Company) to H.R. Denton (NRC), "Docket Nos. 50-266 and 50-301, Reactor Coolant System Gas Vent System, Point Beach Nuclear Plant, Units 1 and 2," dated October 15, 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