ENCLOSURE 2

Lawrence Livermore National Laboratory

Selected Operating Reactor Issues Program II

Reactor Coolant System Vents (NUREG-00737, Item II.B.1.)
NRC FIN A0250 - Project 9

FINAL TECHNICAL EVALUATION REPORT FOR DAVIS-BESSE 1

Docket Number 50-346
NRC TAC Number 44364

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

TF-366/0817a

March 14, 1983

Docket Number 50-346
NRC TAC Number 44364

TECHNICAL EVALUATION REPORT ON REACTOR COOLANT SYSTEM VENTS FOR DAVIS-BESSE 1

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 Toledo Edison Company has submitted information in References 1 through 4 in support of the vent system on Davis-Besse Nuclear Station Unit 1.

EVALUATION

The function of the reactor coolant system (RCS) high point vent system is to vent noncondensible gases from the high points of the RCS to assure that core cooling during natural circulation will not be inhibited. The Davis-Besse 1 RCS high point vent system provides venting capability from high points of the pressurizer and both RCS hot legs. However, the Davis-Besse 1 high point vent system does not include a reactor vessel head vent as required by 10 CFR 50.44 (c)(3)(iii). Until an acceptable reactor vessel head vent is provided, this is an open item.

The noncondensible gases, steam, and/or liquids vented from the hot legs discharge to the containment atmosphere by way of the steam generator compartments. The pressurizer vent discharges into the pressurizer quench tank. Each path of the RCS high point vent system is designed to vent at least three cubic feet of hydrogen per second at design RCS operating temperature and pressure. A flow restriction orifice in each RCS high point vent system path limits the flow from a pipe rupture or from inadvertent actuation of the RCS high point vent system to less than the capability of the reactor coolant makeup system. The flow restriction orifices are located downstream of the isolation valves so

that maximum protection from flashing and cavitation is afforded to the isolation valves. In addition, the vent system 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 Power Reactors," is not affected by the installation of the high point vents.

The vent paths from both RCS hot leg high points to the containment atmosphere each contain two solenoid-operated valves in series. The vent path from the pressurizer to the pressurizer quench tank contains two previously existing motor-operated valves in series. The valves in all three vent paths are remotely controlled from the main control room. Positive indication of valve position is also provided in the main control room by the means of position switches mounted on the valves. A degree of redundancy has been provided by powering each of the four solenoid-operated valves in the hot leg vent paths from a different emergency bus to ensure that RCS venting capability from at least one hot leg high point is maintained. Isolation valve seat leakage can be detected together with other unidentified RCS leakage by way of increased makeup requirements and the existing pressurizer, containment, and pressurizer quench tank instrumentation.

The portion of each vent 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 the vent system is designated Quality Class I (equivalent to Safety Class 1) and Seismic Category I in compliance with 10 CFR 50.55 and Regulatory Guides 1.26 and 1.29. The RCS high point vent system is designed for pressures and temperatures corresponding to the RCS design pressure and temperature. In addition, based on a description provided by the licensee, the vent system materials are as follows:

pipe, ASME SA-376 Type 316 stainless steel.

fittings, ASME SA-182 F316 stainless steel.

valves, ASME SA-182 F316, SA-240 type 316, SA-479 type 316 stainless steel.

restriction orifice, ASME SA-479 type 316 stainless steel.

All of these materials are compatible with the reactor coolant chemistry. The fabrication and installation specifications meet the requirements of SRP Section 5.2.3 and NRC Regulatory Guide 1.44. The RCS high point vent system is also acceptably

protected from missiles and the dynamic effects of postulated piping ruptures. We therefore conclude that the design and construction of the portion of the RCS high point 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. The licensee has further ascertained that the essential operation of safety-related systems will not be impaired by postulated failures of vent system components.

We have reviewed the licensee's RCS high point vent system design to assure an acceptably low probability exists for inadvertent or irreversible actuation of the vent system. Each hot leg vent path has two solenoid-operated vent valves in series with separate Class 1E power supplies. The pressurizer vent path has two motor-operated valves in series with the same Class 1E power supply, but separation requirements are imposed on the power circuits and control wiring for the two valves to prevent the possibility of hot shorts causing inadvertent or irreversible opening of the pressurizer vent path. The licensee has stated that the valves in both hot leg and pressurizer vent paths will fail closed on loss of power and that power will be removed from the valve operators during normal operation. The licensee has also stated that a human factors analysis will be performed on the additional displays and controls located in the main control room due to addition of the RCS high point vent system. 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 RCS high point vent system. However, from the design information submitted by the licensee it is not clear whether vent valve position indication is dependent on control power. Depending on the configuration of valve control and position indication power, removing power from the valves as described above may result in loss of positive valve position indication during normal reactor operation. Until it is ensured that direct position indication is continuously provided, this is a confirmatory item.

We have also examined the locations where the RCS high point vent system normally discharges to the containment atmosphere inside the steam generator compartments and through the pressurizer quench tank. Based on a description provided by the licensee, these locations are in areas that would 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

operation of safety-related systems would not be impacted by the discharge of the anticipated mixtures of steam, liquids, and noncondensible gases.

The licensee has proposed that the surveillance requirements of Davis-Besse Technical Specification 4.0.5 be applied to the RCS high point vents except that the surveillance will be performed once per 18 months during the cold shutdown or refueling modes.

CONCLUSION

We conclude that the Davis-Besse 1 RCS high point vent system 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 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 required reactor vessel head vent as noted above. We therefore recommend following resolution of this open item that the Davis-Besse 1 RCS high point vent system design be found acceptable with the following confirmatory item. The potential problem concerning the removal of valve control power and positive position indication must be satisfactorily resolved. It should also be noted that the following items were excluded from the scope of our review: seismic and environmental qualification of the RCS high point vent system, RCS high point vent system operating guidelines and procedures, and required modifications to the plant technical specifications and in-service inspection program for the RCS high point vent system.

REFERENCES

1. Letter, R.P. Crouse (Toledo Edison Company) to R.W. Reid (NRC), with attachment, "Reactor Coolant High Point Vents System Design Criteria (Revision 1)," dated February 27, 1981.

2. Letter, R.P. Crouse (Toledo Edison Company) to J.F. Stolz (NRC), with attachment, "Reactor Coolant High Point Vents System Design Criteria (Revision 2)," dated March 23, 1982.

3. Letter, R.P. Crouse (Toledo Edison Company) to J.F. Stolz (NRC), responding to NRC's request for additional information on reactor coolant system high point vents, dated April 13, 1982.

4. Letter, R.P. Crouse (Toledo Edison Company) to J.F. Stolz (NRC), with Attachment 1, "Application for Amendment of Facility Operating License No. NPF-3 for Davis-Besse Nuclear Power Station Unit No. 1," dated May 5, 1982.