ENCLOSURE 2

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 THREE MILE ISLAND 1

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NOTICE

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TECHNICAL EVALUATION REPORT ON REACTOR COOLANT SYSTEM VENTS FOR THREE MILE ISLAND 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, Metropolitan Edison Company has submitted information in References 1 and 2 in support of the vent system at Unit 1 of the Three Mile Island 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 Three Mile Island 1 high point vent system provides venting capability from high points of the reactor vessel head, the pressurizer, and both RCS hot legs. The noncondensible gases, steam, and/or liquids vented from the reactor vessel head are piped and discharged directly to the containment atmosphere. Discharges from the pressurizer and the hot legs are normally directed to the reactor coolant drain tank (RCDT) and may be vented to the containment atmosphere through a new RCDT vent. The hot leg vent paths may also discharge directly to the containment atmosphere via a rupture disc. The high point vent system is designed to be capable of venting a volume of noncondensible gas equivalent to one half of the RCS volume in one hour. However, the reactor vessel head and hot leg vent line sizes have been selected to ensure that the flow from a pipe rupture or from inadvertent actuation of the vent system would be limited to less than the capability of the reactor coolant makeup system. The pressurizer high point vent piping is connected to previously existing pressurizer piping, and therefore the flow from a pipe rupture or inadvertent actuation of

the pressurizer high point vent would be equal to or less than that from previously analyzed pipe ruptures. 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 high point vent system.

The vent paths from the reactor vessel head, the pressurizer, and the RCS hot leg high points each contain two valves in series which are remotely controlled from the main control room. Positive indication of valve position is also provided in the main control room. The licensee has stated that this positive valve position indication is derived from stem operated limit switches or comparable means to provide actual valve position for all new vent valves, but the power supply and the method of positive valve position indication for the existing motor-operated valve RC-V28 in the pressurizer vent line have not been described. This is a confirmatory item. A degree of redundancy has been provided by powering each hot leg vent path from a different Class 1E emergency bus to ensure that RCS venting capability from at least one hot leg high point is maintained. Flow elements in each vent path with associated indication in the main control room may be used to detect valve seat leakage from the reactor coolant system through the vent system isolation valves.

The portion of each high point 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 high point vent system is designated Seismic Category I in compliance with Regulatory Guide 1.29. The licensee has also classified the new piping and valves up to and including the second normally closed valve as Nuclear Class 2 in accordance with the original plant design. The vent system 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 will be fabricated and tested in accordance with existing plant requirements and/or the ASME Boiler and Pressure Vessel Code. The 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 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 other safety-related systems will not be impaired by postulated failures of vent system components.

We have reviewed the licensee's high point vent system design to assure an acceptably low probability exists for inadvertent or irreversible actuation of the vent system. The reactor vessel head and hot leg high point vent paths each have two Target Rock solenoid-operated valves in series, and the pressurizer high point vent path has one solenoid- and one motor-operated valve in series. Each valve has an individual key-locked control switch, which is administratively controlled, and positive position indication in the main control room. The valves all receive emergency Class IE power and the solenoid-operated valves fail to the closed position in the event of loss of power. Also, an alarm in the main control room is activated if both valves in a vent path are in the open position, and each vent path has a flow/no-flow indicator in the main control room. Furthermore, the licensee has stated that all displays and controls located in the main control room due to addition of the high point vent system have been 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 Three Mile Island I high point vent system design may be susceptible to common mode failure because operation of an upstream solenoid-operated valve may cause the downstream solenoid-operated valve to open temporarily. The licensee will be required to evaluate this potential 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 high point vent system, contingent on satisfactory resolution of the above identified potential solenoid-operated valve problem.

We have also examined the locations where the vent system normally discharges to the containment atmosphere. Based on a description provided by the licensee, 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 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 made provisions for operability testing of the high point vent system in accordance with subsection IWV of Section XI of the ASME Code for Category B valves and has stated that the vent valves will be exercised during refueling.

CONCLUSION

We conclude that the Three Mile Island I 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 conforms to the requirements of paragraph (c)(3)(iii) of 10 CFR 50.44. We therefore recommend that the Three Mile Island I high point vent system design be found acceptable with the following two confirmatory items. The power source and the method of valve position indication for motor-operated valve RC-V28 must be described in sufficient detail for NRC to determine that they are acceptable, and the potential common mode failure problem noted above concerning solenoid-operated valves must be satisfactorily resolved. In addition, it should be noted that the following items were excluded from the scope of our review: seismic and environmental qualification of the high point vent system, operating guidelines and procedures for the high point vent system, and required modifications to the plant technical specifications and in-service inspection program for the high point vent system.

REFERENCES

1. Letter, H.D. Hukill (Metropolitan Edison Company) to J.F. Stolz (NRC), "Three Mile Island Nuclear Station, Unit I (TMI-I), Operating License No. DPR-50, Docket No. 50-289, RCS High Point Vents (LM-21)," dated September 3, 1981, and referenced documents.

2. Letter, H.D. Hukill (GPU Nuclear) to J.F. Stolz (NRC), "Three Mile Island Nuclear Station, Unit I (TMI-I), Operating License No. DPR-50, Docket No. 50-289, RCS Vents (NUREG 0737 II.B.I)," dated August 23, 1982.