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 PRAIRIE ISLAND 1 AND 2

Docket Numbers 50-282 and 50-306
NRC TAC Numbers 44398 and 44399

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TECHNICAL EVALUATION REPORT ON REACTOR COOLANT SYSTEM VENTS FOR PRAIRIE ISLAND 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 Northern States Power Company has submitted information in References 1 through 3 in support of the vent system at Units 1 and 2 of the Prairie Island Nuclear Generating Plant.

EVALUATION

The function of the reactor coolant system (RCS) 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 Prairie Island 1 and 2 RCS vent system provides venting capability from high points of the pressurizer steam space 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 one of two locations, the pressurizer relief tank (PRT) or directly to the containment. Each RCS vent path is designed to vent a volume of gas approximately equal to one half of the RCS volume in one hour. A flow restriction orifice in each RCS vent path, however, limits 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 RCS vent system.

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 RCS vent 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. RCS vent valve seat leakage is detected by pressure instrumentation with associated alarms in the main control room.

The portion of each RCS 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 this portion of the vent system is designated Safety Class 2 (Safety 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 RCS vents are 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 the reactor vessel head vent and the pressurizer vent are acceptably separated and protected from missiles and the dynamic effects of postulated piping ruptures. However, the licensee has not demonstrated that the vent system will be fabricated and tested in accordance with acceptable requirements (e.g., SRP Section 5.2.3). We therefore conclude that the design of the portions of the RCS 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 by the licensee that the vent system will be fabricated and tested in accordance with SRP Section 5.2.3 or other acceptable requirements. The licensee has further ascertained the essential operation of other safety-related systems will not be impaired by postulated failures of RCS vent system components.

We have reviewed the licensee's RCS vent system 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 control switch. Power will be normally removed from the valves at the power supply panel, minimizing the probability of isolation failure due to hot shorts and at the same time minimizing the probability of inadvertent operation of the vent system. After the need to vent has been determined and administrative approval to energize power to the valves

has been given, the valves will then be repowered by replacing the fuses at the panel. The valves are designed to fail closed upon loss of electrical power and will remain leak tight in a deenergized state. The licensee has also stated that the controls and displays added to the main control room will be considered in a human factors analysis during the Detailed Control Room Design Review to be conducted at a later date in accordance with NUREG-0700. However, the Prairie Island 1 and 2 RCS vent system 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 4). 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 RCS vent system, contingent on satisfactory resolution of the problem with Target Rock solenoid-operated valves. However, RCS vent valve position indication is dependent on control power, and therefore removing control power as described above will result in loss of positive valve position indication during normal plant operation. Until an acceptable alternate method of minimizing the probability of inadvertent operation or ensuring continuous position indication is provided, this is an open item.

We have also examined the locations where the vent system discharges to the containment atmosphere, either directly or via the PRT rupture disc. Based on a description provided by the licensee (Reference 3), these locations are in areas that assure 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 will be performed in accordance with subsection IWV of Section XI of the ASME Code for Category B valves during refueling.

CONCLUSION

We conclude that the Prairie Island 1 and 2 RCS 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 with one exception concerning positive valve position indication as noted above. We therefore recommend following resolution of this open item that the Prairie Island 1 and 2 RCS vent system 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 fabrication and testing of the portion of the vent system that forms part of the reactor coolant pressure boundary must be determined to be acceptable (e.g., in accordance with SRP Section 5.2.3). In addition, it should 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, L.O. Mayer (Northern States Power Company) to Director of Nuclear Reactor Regulation (NRC), "Lessons Learned Implementation," dated December 31, 1979

2. Letter, L.O. Mayer (Northern States Power Company) to Director of Nuclear Reactor Regulation (NRC), "Information Submitted in Response to TMI Action Plan Items II.B.1 and II.D.1," dated July 6, 1981

3. Letter, L.O. Mayer (Northern States Power Company) to Director, Office of Nuclear Reactor Regulation (NRC), "Response to Request for Additional Information Concerning Reactor Coolant System Vents," dated April 26, 1982

4. 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