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April 26, 1982

Director
Office of Nuclear Reactor Regulation
U S Nuclear Regulatory Commission
Washington, DC 20555

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
Docket Nos. 50-282 License Nos. DPR-42
50-306 DPR-60

Response to Request for Additional Information
Concerning Reactor Coolant System Vents

In a letter dated February 24, 1982, from Mr Robert A Clark, Operating Reactors Branch #3, Division of Licensing we were requested to provide additional information related to our implementation of NUREG-0737, Item II.B.1, at the Prairie Island Nuclear Generating Plant. This item requires the installation of high point vents in the reactor coolant system.

The requested information is provided in the attachment to this letter. Please contact us if you have any questions related to this information.

L.O. Mayer

L O Mayer, PE
Manager of Nuclear Support Services

LOM/DMM/bd

cc: Regional Administrator-III
NRR Project Manager, NRC
Resident Inspector, NRC
G Charnoff

Attachment

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Director of NRR
April 26, 1982
Attachment

Response to Request for Additional Information

Prairie Island Nuclear Generating Plant

NUREG-0737, Item II.B.1

1. Verify that the reactor coolant system (RCS) vent system flow restriction orifices are smaller than the size corresponding to the definition of a loss-of-coolant accident (10 CFR Part 50, Appendix A) by providing the pertinent design parameters of the reactor coolant makeup system and a calculation of the maximum rate of loss of reactor coolant through the RCS vent system orifices (reference NUREG-0737 Item II.B.1 Clarification A.(4)).

   Response

   The pertinent design parameters of the makeup system at Prairie Island during normal operation (and valve lineup) and one charging pump operation are as follows:

1 charging pump	60 gpm max.
2 RCP seal return flow	6 gpm
Total makeup flow into RCS	54 gpm max.

   Letdown flow from the RCS would isolate on a low pressurizer level if a leak occurred in the RCS vent system. This would allow the entire 54 gpm to be used as makeup flow to the RCS.

   In addition, the Technical Specifications require two charging pumps so an additional 60 gpm would be available, giving a total makeup flow of 114 gpm.

   The orifice supplier has supplied data which give a maximum of 44 gpm flow at 2235 psig and 550°F, considerably less than the makeup capacity.

   The 44 gpm is based on a Combustion Engineering standard orifice calculation which has been in use for several years. The 7/32" orifice is used as a standard size for instrument and sensing lines. The calculation accounts for flashing of the fluid passing through the orifice and sharpness of the orifice port and is supported by empirical data.

2. The following items apply to the portions of the RCS vent system that form a part of the reactor coolant pressure boundary, up to and including the second normally closed valve (reference NUREG-0737 Item II.B.1 Clarification A.(7)):

   a. Provide the design temperature and pressure of the piping, valves, and components.

   b. Verify that the piping, valves, components, and support are classfied Seismic Category 1.

c. Verify that the materials of construction will be fabricated and tested in accordance with SRP Section 5.2.3, "Reactor Coolant Pressure Boundary Materials."

d. Demonstrate that internal missiles and the dynamic effects associated with the postulated rupture of piping will not prevent the essential operation of the RCS vent system (i.e., at least one vent path remains functional) (reference Appendix A to 10 CFR Part 50, General Design Criterion 4).

Response

a. The design pressures and temperatures of the piping, valves and components are as follows:

	Press	Temp.
Manual Valves	2500 psia	700°F
Solenoid Valves	2500 psia	700°F
Piping (304 ss.)	2500 psia	650°F

b. The piping, valves, components and support are classified seismic category I and have been analyzed to meet the seismic criteria for the Prairie Island site.

c. We believe the requirements of SRP Section 5.2.3 are satisfied.

d. The RCS vent system is designed such that both the reactor head and pressurizer vents remain operable in the event of any single failure. The power supplies to the valves are redundant and are physically separated to prevent missiles or fluid sprays from impinging on both power supplies. This will allow one train (and it's associated vent path) to remain operable following these events.

3. For new piping, valves, and components added as a result of the requirement for RCS vents, verify that the following failures have been analyzed and found not to prevent the essential operation of safety-related systems required for safe reactor shutdown or mitigation of consequences of a design basis accident:

a. Seismic failure of RCS vent system components that are not designed to withstand the safe shutdown earthquake.

b. Postulated missiles generated by failure of RCS vent system components.

c. Fluid sprays from RCS vent system component failures. Sprays from normally unpressurized portions of the RCS vent system that are Seismic Category I and Safety Class 1,2, or 3 and have instrumentation for detection of leakage from upstream isolation valves need not be considered.

Response

a. All components in the RCS vent system are designed to withstand the safe shutdown earthquake.

b. The design of the RCS vent system has the pressurized piping sections routed away from critical components and power supplies. The solenoid valves and major components of the system are mounted onto the pressurzier missile shield wall to provide missile protection. Since the system is seismically designed, the probability of failure is very low. The solenoid valves are also designed with a sealed bonnet and an integral backseat, minimizing any change for the valve stem to become a missile. The manual valves are of a packless design, also minimizing the chance of creating a missile.

c. Pressurized piping runs were minimized to reduce the probability of pipe ruptures and fluid sprays. As mentioned above, the piping was routed away from critical components & power supplies so fluid sprays from the RCS vent system failures will not prevent essential operation of safety related systems required for safe shutdown or mitigation of consequences of a design basis accident.

The design of the solenoid valves minimizes the probability of fluid sprays from these components.

4. Describe the design features or administrative procedures, such as key-locked valves or removal of power from valves during normal operation, that will be employed to prevent inadvertent actuation of the RCS vent system (reference NUREG-0737 Item II.B.1 Clarification A.(7)).

Response

Power will be normally removed from the valves at the 125 V.D.C. power supply panel. 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 125 V.D.C. panel. The valves are a fail-closed design, and will remain leak tight in a deenergized state.

5. Demonstrate, using engineering drawings (including isometrics) and design descriptions as appropriate, that the RCS vent paths to the containment atmosphere (both direct and via the pressurizer relief tank rupture disc) discharge into areas:

a. That provide good mixing with containment air to prevent the accumulation or pocketing of high concentrations of hydrogen, and

b. In which any nearby structures, systems, and components essential to safe shutdown of the reactor or mitigation of a design basis accident are capable of withstanding the effects of the anticipated mixtures of steam, liquid, and noncondensible gas discharging from the RCS vent system (reference NUREG-0737 Item II.B.1 Clarification A.(9)).

Response

a. The discharge to containment atmosphere line is routed to the top of the pressurizer vault. The upper containment has good mixing due to the containment fan coil unit discharge (2 fans @ 61,500 cfm each) and the dome recirculation fans (2 fans @ 3000 cfm each)

The discharge path via the pressurizer relief tank (PRT) rupture disc will discharge into the ground floor of containment. The PRT is next to an open stairway which is next to 2 fan coil units (again @ 61,500 cfm each) which would recirculate the gases from the stairwell area throughout containment.

b. The addition of the RCS vent system should not introduce any more severe accident environments than are considered for the Design Basis Accident (DBA). Critical structures, systems and components in the areas of the discharge required to withstand the DBA should also withstand the venting of steam, liquid & non-condensible gases.

6. Based on our review of "Reactor Vessel Head Vent Operation" and "Background Information" attached to our July 6, 1981 submittal in response to NUREG-0737 Item II.B.1, we require the following additional information:

a. Provide operating guidelines for the pressurizer vent.

b. Since the flow rates through your proposed 7/32" flow restriction orifices are considerably less than the flow rates through the 3/8" orifices which were used as a basis for the Appendix B "Venting Time Period" calculation, revise the Appendix B Curve #1 "Hydrogen Flow Rate" to reflect the decreased flow rates.

c. Provide methods which in lieu of venting will assure that sufficient liquid or steam will flow through the steam generator U-tube region so that decay heat can be effectively removed from the reactor coolant system (reference Clarification C.(2)).

Response

a. Draft operating guidelines have been developed by the Westinghouse Owners Group. These guidelines will be reviewed and modified, as necessary, for use at Prairie Island. A copy is attached.

These guidelines are currently being reviewed by the NRC Staff.

b. The attached operating procedure guidelines and figure reflect the orifice size change.

c. Procedures to assure sufficient steam generator heat transfer capability have not been finalized. When such procedures have been completed, they will be submitted for NRC review.

7. Since NUREG-0700 has now been released, verify that all displays (including alarms) and controls, added to the control room as a result of the TMI Action Plan requirement for reactor coolant system vents, have been or will be considered in the human factors analysis required by NUREG-0737 Item I.D.1, "Con`rol-Room Design Reviews."

   Response

   In accordance with NUREG-0700 and Draft NUREG-0801 (8-28-81) a preliminary report (Program Plan Report) will be submitted by August 31, 1982., The program plan report will include:

   1. The schedule to perform the Detailed Control Room Design Review.

   2. Verification of use of NUREG-0700 methodology or exceptions.

   3. Selection of qualified team members.

   4. Discussion of team structure and management.

8. Provide a copy of the final schematics and diagrams referenced on p. 2 of your July 6, 1981 submittal for our evaluation (reference NUREG-0737 Item II.B.1 Documentation Required (3)).

   Response

   One copy of the Unit 1 wiring diragrams and piping isometric are attached (NRR Project Manager's copy).

Number:	Symptom/Title:	Revision No./Date
FR-I.3	RESPONSE TO VOID IN REACTOR VESSEL	Basic 1 Sept. 1981

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
	Caution *Do not stop any running RCPs or start any stopped RCPs until completion of this guideline.*	
1	**Record RCS Pressure - ______ PSIG**	
2	**Verify SI System - NOT IN OPERATION**	IF SI system is in operation, THEN go to step 9.
3	**Check Stable RCS Conditions:**	
	a. Pressurizer level - STABLE BETWEEN 40% AND 60%	a. Manually adjust letdown and charging.
	b. RCS pressure - STABLE	b. Operate heaters and spray.
	c. RCS hot leg temperature - STABLE	c. Adjust steam dump.
4	**Try To Collapse Void In Reactor Vessel:**	
	a. Turn on pressurizer heaters to increase pressure by 50 psi	
	b. Maintain balanced charging and letdown flow	
	c. Maintain pressurizer level - GREATER THAN 20%	c. IF level less than 20%, THEN turn off pressurizer heaters AND return to step 3.
5	**Verify Void Collapse In Reactor Vessel:**	
	a. Reactor vessel level - RISING TO FULL	a. IF level not rising, THEN go to step 6.
	b. Reactor vessel level - FULL	b. IF level not full, THEN go to step 6.
	c. Return to procedures in effect	
6	**Isolate Letdown.**	

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
7	**Check Pressurizer Conditions:**	
	a. Pressurizer level – GREATER THAN 10%	a. Increase charging flow. <u>IF</u> level cannot be maintained above 10% with maximum charging, <u>THEN</u> manually initiate SI and go to E-0, REACTOR TRIP OR SAFETY INJECTION, STEP 5.
	b. Pressurizer level – BETWEEN 20% AND 90%	b. Adjust charging flow.
	c. RCS pressure – GREATER THAN OR EQUAL TO PRESSURE RECORDED IN STEP 1	c. Energize heaters. <u>IF</u> pressure decreasing in an uncontrolled manner, <u>THEN</u> manually initiate SI and go to E-0, REACTOR TRIP OR SAFETY INJECTION, STEP 5.

NOTE *Venting of the RPV may result in RCS pressure decreasing below SI initiation setpoint.*

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
8	**Check Low Pressurizer Pressure SI Signal Status:**	
	a. Pressurizer SI signal – BLOCKED	a. Manually block.
9	**Check RCS Subcooling:**	
	a. RCS subcooling – GREATER THAN ___(1)___ °F	a. <u>IF</u> less than ___(1)___ °F, <u>THEN</u> increase steam dump. <u>IF</u> ___(1)___ °F subcooling cannot be obtained, <u>THEN</u> go to E-0, REACTOR TRIP OR SAFETY INJECTION, STEP 5.

(1) Enter sum of temperature and pressure measurement system errors translated into temperature using saturation tables, PLUS 50°F.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
10	**Prepare Containment For Reactor Vessel Venting:**	
	a. Isolate containment: 1) [Enter plant specific list]	
	b. Start containment air circulation equipment: 1) [Enter plant specific list]	
	c. Verify hydrogen control equipment available: 1) [Enter plant specific list]	
11	**Determine Maximum Allowable Venting Period:**	
	a. Containment Hydrogen concentration – LESS THAN (1) %	a. Reduce hydrogen concentration: [Enter plant specific means]
	b. Calculate maximum venting ______. (See graph on page 5)	

Caution *IF ANY vent termination criterion in step 12 is reached or exceeded while venting, immediately stop venting.*

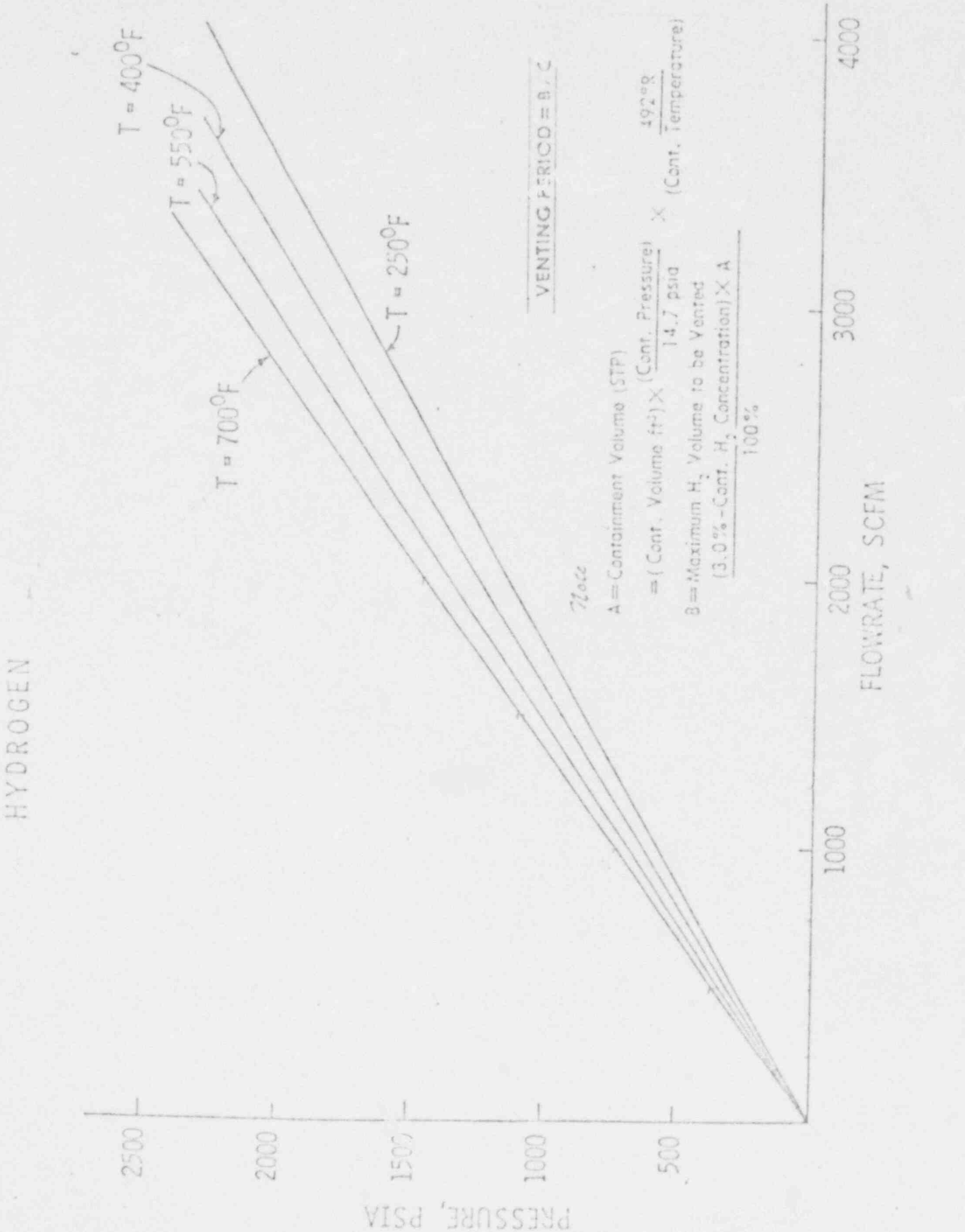
STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
12	**Review RPV Vent Termination Criteria With Control Room Personnel:** • Containment hydrogen concentration – GREATER THAN 3% BY VOLUME • RCS subcooling – LESS THAN (2) °F • Pressurizer level – LESS THAN 20% • RCS pressure – DECREASES BY 200 PSI • Venting period – GREATER THAN PERIOD CALCULATED IN STEP 11.	

(1) Enter plant specific value

(2) Enter sum of temperature and pressure measurement system errors translated into temperature using saturation tables.

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED
13	**Vent Reactor Vessel**	
	a. Open valves in one vent path	a. IF either of series valves in selected path fails to open, THEN close both valves and open valves in second path.
	b. Close both valves when: 1) Reactor vessel level - FULL OR STABLE -OR- 2) Any termination criterion of step 12 is reached	
	c. IF venting stopped because of ANY criteria in step 12, THEN return to step 7.	
14	**Check Pressurizer Level - STABLE**	Adjust injection and letdown, as required.
15	**Return To Guideline In Effect**	

-END-



HYDROGEN
T = 400°F
T = 550°F
T = 250°F
T = 700°F
VENTING PERIOD = B/C
Note
A = Containment Volume (STP)
= (Cont. Volume ft³) × (Cont. Pressure) / 14.7 psia × 492°R / (Cont. Temperature)
B = Maximum H2 Volume to be Vented
(3.0% - Cont. H2 Concentration) × A / 100%
PRESSURE, PSIA
2500
2000
1500
1000
500
FLOWRATE, SCFM
1000
2000
3000
4000