UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION REPORT

FOR CONTAINMENT PURGING AND VENTING DURING NORMAL OPE. ATION OF THE PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT NOS. 1 AND 2

DOCKET NOS. 50-282 AND 50-306

I. INTRODUCTION

A number of events have occurred over the past several years which directly relate to the practice of containment purging and venting during normal plant operation. These events have raised concerns relative to potential failures affecting the purge penetrations which could lead to degradation of the containment integrity, and, for PWRs, a degradation in ECCS performance. By letters dated November 28, 1978, October 29, 1979 and March 8, 1982 we requested licensees of operating reactors to respond to certain generic concerns about containment purging or venting during normal plant operation. The concerns are as follows:

(1) Events had occurred where licensees overrode or bypassed the safety actuation isolation signals to the containment isolation valves. These events were determined to be abnormal occurrences and were so characterized in our report to Congress in January 1979.

(2) Recent licensing reviews have required tests or analyses to show that containment purge or vent valves would shut without degrading containment integrity during the dynamic loads of a design basis loss of coolant accident (DBA-LOCA).

(3) Licensees who elected to purge (or vent) the containment were requested to demonstrate that the containment purge (or vent) system design met the criteria outlined in our Standard Review Plan (SRP) 6.2.4 and the associated Branch Technical Position (BTP) CSB 6-4, which have effectively classed the purge and vent valves as "active" involving the operability assurance program of SRP 3.9.3.

During the interim period of our review of these generic concerns, the licensee committed to keep and has maintained the isolation valves in the purge and vent system closed whenever the reactor is operated above cold shutdown. This commitment is to remain in effect until we have completed our review of the long term generic concerns which is the subject of this safety evaluation for the Prairie Island Nuclear Generating Plant, Unit Nos. 1 and 2.

II. DISCUSSION AND EVALUATION

By letters dated January 5, April 12, July 10, November 14, 1979; March 17, June 3, November 7, 1980; May 6, December 3, 1981 and April 30, 1982 the licensee responded to our generic concerns of containment purge and venting at the Prairie Island Nuclear Generating Plant Unit Nos. 1 and 2. The licensee's responses have either completed or have committed to complete by certain schedular dates modifications to the purge and vent systems in order to resolve our concerns. Our evaluations of these concerns are as follows.

A. Manual Override of Safety Actuation Signal

Instances have been reported where isolation signals which are required to automatically close the purge and vent valves for achieving containment integrity were manually overridden to allow purging of the containment with a high radiation signal present. Consequently, we developed a position specifying that the design and use of all override circuitry be such that the Prairie Island Nuclear Generating Plant have protection needed during postulated accident conditions. The licensee responded to this concern by letters dated January 5 and April 12, 1979; March 17 and June 3, 1980 and May 6, 1981. As a result of the review of the licensee's submittals by our consultant, EG&G, San Ramon Operations, the attached Technical Evaluation Report (EGG San Ramon Operations Report No. 1183-4166 June 1981) provides their technical evaluation of the design complying with our criteria. During the course of our review, the licensee committed to modifications that would remove the design capability to manually override the containment ventilation isolation actuation signal. These modification have since been completed for both units by the licensee. As part of this review action, the consultant also audited the design of other ESF systems against the same six criteria. The consultant determined that the use of the Safety Injection system reset will not adversely affect other ESF systems such as Containment Spray. However, contrary to the report provided by our consultant, we have determined that the reset features directly associated with the other ESF systems (e.g. containment isolation reset switches) do not fully comply with the NRC criteria. Specifically, we determined that the override/reset design for the Containment Isolations systems (Phase A and Phase B) and the Containment Spray system, do not conform to Criteria 2 and 3. By letter dated August 23, 1982, the licensee committed to modifications that will achieve conformance with these criteria.

In addition, by letter dated June 9, 1980 the licensee responded to our IE Bulletin No. 80-06 in which the safety system schematics were reviewed to assure that safety related equipment remain in the emergency mode after reset. Both units were further tested during refueling outages to verify that the as-built systems met the design criterion as described in the safety system schematics.

Conclusion

Based on the above evaluation, our review of our consultant's technical report, and plant modifications performed by the licensee, we conclude that the electrical control system at the Prairie Island Nuclear Generating Plant, Unit Nos. 1 and 2 meets our criteria for averting the safety actuation signals from actuating equipment associated with Containment Purge during reset modes. The design of the "reset" circuits associated with the containment isolation systems and containment spray system will be modified to achieve conformance with the criteria. We therefore conclude that this matter is satisfactorily resolved. We further find that the licensee has satisfactorly responded to our request in IE Bulletin No. 80-06 which we now consider complete. This evaluation also satisfies our requirements concerning Item II.E.4.2, Position 4, "Design of Control Systems for Automatic Containment Isolation Valve" of NUREG-0737 TMI Action Plan.

B. Containment Purge and Vent Valves Operability During Design Basis Accident

Introduction

By letters dated November 28, 1978 and October 29, 1979, we requested all licensees to provide test results or analyses to demonstrate the adequate capability of the purge isolation valves to close against the dynamic forces of a design basis Loss of Coolant Accident (LOCA). The licensee transmitted test results and analyses for the purge valves by letters dated June 5, November 14, 1979, December 3, 1981 and April 30, 1982. These submittals include a description of the purge systems, how the purge systems are used during plant operations and the analysis of the valve operability during accident conditions for the Prairie Island Nuclear Generating Plant Unit Nos. 1 and 2.

Discussion and Evaluation

Two containment purge systems are installed in each unit at the Prairie Island Nuclear Generating Plant for containment purging and venting. The high volume purge and ventilation system (33,000 CFM) is used to ventilate containment following reactor shutdown to permit access for inspection and maintenance. Two 36 inch butterfly valves are provided on each supply and exhaust line. The licensee's submittal dated December 3, 1981 indicates that the results of an analysis performed by the valve manufacturer showed these valves are not capable of withstanding LOCA-induced loads from the full open position. Based on these results the licensee committed to keep the two 36 inch butterfly valves closed for both units for all operating modes above cold shutdown. In addition, the licensee has also committed to install double gasketed blind flanges on the containment side of the penetrations of the large volume purge and vent system so that valve's resilient seals are not needed to perform an isolation function during plant operations above cold shutdown. We are requesting that the licensee submit

a proposed change to the Technical Specification within 90 days from the issuance date of this safety evaluation related to these commitments.

The low volume (4,000 CFM) purge system provides charcoal absorption and particulate filtration of containment air prior to release. This system is used to assist the internal cleanup system in permitting containment access when airborne radioactivity levels preclude entry and is not needed to maintain an acceptable containment temperature, pressure or humidity.

The licensee expects to use this system "on as low as achievable" basis. Thus, the licensee expects to use this system above cold shutdown for short periods totaling not more than approximately 90 hours per calendar year per unit.

Two 18 inch containment isolation valves are provided on each supply exhaust line for this low volume purge system. The licensee submitted, by letter dated December 3, 1981, an analysis prepared by Henry Pratt Company (the valve manufacturer) on the operability of the 18 inch valves during accident conditions. The 18 inch valves are Pratt Model 2FII butterfly valves with a 2.25 inch shaft. The valves are Class 150B (pressure rating) with either 744-1SR or 746A-25R Bettis operators. The 18 inch valve operators are air open - spring close type. The 18 inch valves included in this review are as follows,

Unit 1		Unit 2	
Exhaust:	CV-31310	Exhaust:	CV-31314
	CV-31311		CV-31315
Supply:	CV-31633	Supply:	CV-31635
	CV-31634		CV-31636

By teleconference on March 1, 1982 the licensee confirmed the following installation details for the 18 inch valves:

a. The inlet of the valve located inside containment opens directly to the containment with no ductwork including elbows or bends upstream of the valve.

b. The second valve in series is separated from the first valve by 21" to 30" of straight pipe.

On August 20, 1981 we and our consultants (Brookhaven National Laboratory Staff) met with the staff of the valve manufacturer to discuss the test results to determine the maximum torque value from the dynamic torque coefficients, media differences and size factors as they apply to the 18 inch

valves at the Prairie Island Nuclear Generating Plant, Unit Nos. 1 and 2. The valve manufacturer's valve test program which established these parameters consisting of testing a 5 inch model valve representing in shape and aspect ratio of the product line of disc designs. Torque data were recorded in order to establish torque coefficients. The test installation was configured to establish straight line approach flow to the valve. This method of testing is applicable to the Prairie Island straight line piping configurations as identified above. The manufacturer determines the maximum torque at the critical angle (i.e., 72° for these valves with symmetric disc at initial sonic flow), in order to determine the maximum dynamic torque resulting from flow through the valve. The dynamic torque equation for sonic flow is used with the appropriate dynamic torque coefficient, media difference, and size factors to determine the maximum value of dynamic torque under accident conditions for the subject valve. We find the valve manufacturer's valve testing program for determining the torque is acceptable; and for the 18 inch valves in straight pipe, this value is 18,302 in-lbs.

This method of determining torque is independent of the specific pressure-time ramp curves for a LOCA event for each plant. Operability of the valves is therefore independent of closure time.

The report showed a stress analysis for the critical valve parts being subjected to the maximum dynamic loads, the maximum pressure loads under accident conditions and the seismic load of 5 g simultaneously. The critical valve parts considered in the analysis are the valve body and trunnion, disc, stem, pin bearing and mounting bolts. The analysis is based on ASME Boiler and Pressure Vessel Code methods (where applicable) and on textbook equations.

In all cases, the results of the analysis shows the stress levels of these valve parts are below the allowable stress values for the material permitted by the ASME Code. We have reviewed the licensee's stress analysis and agree with these results.

Our review of the purge and vent valve operability includes the capability of the valve operators to close the valves under accident conditions. The information provided for the operators showed them to be Bettis Model 744A-1SR and Model 746A-2SR.

Operator torque ratings were given as follows:

Model	Full Open or Full Closed	Intermediate
744A-1SR	152,400 in-lbs	101,600 in-lbs
746A-2SR	143,200 in-lbs	94,500 in-lbs

These ratings indicate the operators have sufficient torque margin potential to stroke and seat the valve discs from a 90° (full open) position without the operator rating being exceeded by the maximum 18,302 in-lbs torque predicted. On this basis we conclude that the valve operators are adequately sized to close the purge and vent valves under accident conditions.

In addition, for the valves inside containment the licensee examined and addressed the containment pressure rise effect on the backpressure of the operator bleed. The design used includes a bleed port on the spring side of the piston as well as a solenoid valve on the opening side. This design precludes the existence of a pressure differential from piston opening to closing side as a result of the containment pressure.

Conclusion

In conclusion, the methods used by the valve manufacturer to determine loads for the Prairie Island valves are conservative. The valve manufacturer determines the worst-case straight line approach flow dynamic torque from choked flow for the critical angle. In addition, a pressure load of 150 psig (rated valve pressure load) is well above the maximum predicted containment pressure of 43 psig for LOCA condition.

Therefore based on this evaluation we conclude that the 18 inch containment isolation purge valves for Prairie Island Units 1 and 2 are capable of closing against the buildup of containment pressure from the full open (90°) position in the event of a LOCA.

C. Conformance to Standard Review Plan Section 6.2.4 Revision 1 and Branch Technical Position CSB 6-4

1. High Volume Purge and Vent System

By letter dated April 30, 1982, the licensee committed to installing double gasketed blind flanges sealing the 36 inch purge and vent penetrations on the containment side of the purge and vent valves. As described above, the purge and vent valves in the high volume purge system are not needed to perform an isolation function when the units are operated above cold shutdown. Therefore, these valves will no longer be required to be operable in the event of accident. The flange seals will be subjected to a type B leak test as specified in 10 CFR Part 50 Appendix J prior to the unit being returned to operating condition above cold shutdown, when the blind flanges are removed during cold shutdown and during each refueling outage.

On this basis we conclude that the licensee meets the requirement of sealed closed valves as defined in SRP 6.2.4 Item II.6.F of NUREG-0800 for operating conditions above cold shutdown for the purge and vent valves of the high volume purge and vent systems at the Prairie Island Nuclear Generating Plant Unit Nos. 1 and 2. In addition, the leak testing frequency prescribed in BTP CSB 6-4 is not applicable since the valves are not needed to perform the isolating function during plant operating conditions above cold shutdown. However, these valves will be leak tested every refueling outage as prescribed in the inservice valve testing program and 10 CFR Part 50 Appendix J.

2. Purging with the Low Volume Purge System

Similarly, when the low volume purge system is not used during plant operations above cold shutdown, the purge and vent valves are not required to perform an isolation function since this function is performed by the double sealed blind flanges installed at the outboard side of containment penetration. The licensee committed to purge with the low volume system on a basis of "as low as achievable"; that is only when it is necessary to reduce airborne radioactivity levels that preclude containment entry. Based on past experience, the licensee expects to use the purge system for short periods in that the total time should not exceed more than approximately 90 hours per calendar year per unit. However, a purging limit for inclusion into the Technical Specifications cannot be accurately determined since the limit depends on the time required to reduce future radioactivity levels in containment which are unknown and difficult to predict. On this basis we consider that a goal be established based on safety related needs. We will shortly be advising all licensees of our proposals for cooperative effort to establish such a goal. By letter dated April 30, 1982 the licensee also committed that during purging periods, the purge valves will be protected with a debris screen that meets the design guidelines provided in our letter dated March 8, 1982. In addition, each time purging is completed, the blind flanges will be reinstalled and the seals subjected to a type B leak test as specified in 10 CFR Part 50 Appendix J.

The containment isolation valves of the low volume purge are required to be leak tested during each refueling outage by the Technical Specifications and meets the requirements of Appendix J of 10 CFR Part 50. In addition, in order to assure the isolation function of the purge valves when purging is required, the licensee has committed by letter dated April 30, 1982 and by telephonic discussions to leak test the valves prior to removing the blind flange when purging is required during plant operations above cold shutdown. Furthermore the licensee has committed to a type C leak test as prescribed by 10 CFR Part 50 Appendix J each time the valves are tested. By these commmitments the licensee does meet the provisions for testing the isolation function of the purge and vent valves of the Branch Technical Position CSB 6-4 for the low volume purge system. Furthermore this commitment will be included in the licensee's Technical Specification change request.

The licensee has further committed to submit appropriate Technical Specification change requests covering the use of the blind flanges as described above and the type B seal leakage test as prescribed in 10 CFR Part 50 Appendix J. In addition the licensee has scheduled the completion of the modifications on the high volume purge and vent systems during the next

refueling outage for each unit (i.e., summer of 1982 for Unit 2 and fall of 1982 for Unit 1). Modification to the low volume system is scheduled for completion by the 1982 refueling outage for Unit 1 and the 1983 refueling outage for Unit 2 (Summer 1983). The licensee has also committed to perform a type C leak test of the low volume purge valves on Unit 2, which will be performed once during the interim period until the modifications are completed (Summer 1983). This leak test will be performed only if the plant is in a cold shutdown for 72 hours or longer.

The licensee indicated that the effect of the containment atmosphere being released at containment pressure that would exist during a design basis LOCA has been bounded by two extreme cases (air and steam alone). The total mass released during the time period that the valves are presumed open is calculated at 1553 lbs. of air or 1123 lbs. of steam. The impact on containment pressure resulting from this loss of air or steam is less than 0.35 psi in either case. The effect of a containment pressure reduction of this magnitude on the calculated peak clad temperature is expected to be minor (less than 20°F). On this basis we agree with the licensee that a degradation in ECCS performance due to a reduction in containment pressure is not expected.

3. Radiological Consequences of Containment Purging and Venting during Design Basis Accident (DBA)/Loss of Coolant Accident (LOCA)

The NRC staff has reviewed the radiological consequences of containment venting and purging during reactor operation by estimating the incremental offsite doses resulting from the release of steam (primary coolant) via the purge valve prior to its closure following a loss of coolant accident (LOCA).

Our evaluation is based on the release of 1123 lbs steam from a large break during the closure of the purge valves at the maximum Standard Technical Specification concentration of 60 Ci/gm dose equivalent I-131. We estimate that this release would result in incremental doses of 22 rems to the thyroid at exclusion area boundary (EAB) and 3 rems to the thyroid at the low population zone (LPZ) boundary. These incremental doses when added to the NRC staff Safety Evaluation Report LOCA doses of 210 rems to the thyroid at EAB and 55 rems to the thyroid at the outer LPZ boundary lead us to conclude that the LOCA doses, including the contribution of the venting or purging while the reactor is pressurized, meet the applicable guidelines of 10 CFR 100.

By way of validation of the assumptions in the analysis of the valve closure and the use of a Standard Technical Specification value, it is noted that the license has implemented the following provisions:

(1) A radiation monitor in the vent/purge line which generates a vent/purge isolation signal.

(2) Limiting conditions for operating on primary coolant iodine concentrations which correspond to the Standard Technical Specifications for Westinghouse Plants (NUREG-0452) which assures that the LOCA dose increment is small.

Conclusi-

On the ba.. s of our evaluation we conclude that the licensee has satisfactorily addressed our concerns related to the radiological consequences of a DBA/LOCA occurring during purging through the low volume purge system at the Prairie Island Nuclear Generating Plant, Unit Nos. 1 and 2 and such operations do not endanger the health and safety of the public. Therefore, purging and venting at the Prairie Island Nuclear Generating Plant Unit Nos. 1 and 2 may be permitted on a limited basis for safety related reasons during plant operations above cold shutdown from the standpoint of the radiological consequences. The resumption of limited purging is predicated upon the licensee completing the modification described in this safety evaluation and having the appropriate Technical Specification changes in place. In addition, we agree with the licensee that purging be limited to as low as achievable in order that a safe working environment is maintained when containment entry is necessary for safety reasons. The licensee does meet the provisions of the Standard Review Plan Section 6.2.4 Revision 1 and the Branch Technical Position CSB 6-4. We therefore find the licensee's response regarding the matter of purging and venting is acceptable. This evaluation also satisfies our concerns described in Item II.E.4.2, Position 6 for Containment Isolation Dependability of NUREG-0737, the TMI Action Plan.

D. Other Containment Isolation Positions in Items II.E.4.2 of NUREG-0737

In regard to Items II.E.4.2 Positions 1, 2 and 3 we find that the licensee has satisfactorily responded to these positions and our safety evaluation issued by our letter dated April 18, 1980 finds that the licensee meets the provisions of these positions. Furthermore, our acceptance of Prairie Island Units 1 and 2 with respect to Item II.E.4.2 position 5 is documented in our letter of December 2, 1981.

Item II.E.4.2 Position 7 of NUREG-0737 provides our position that containment purge and vent isolation valves must close on a high radiation signal. By letter dated November 20, 1979 the licensee described the diverse containment isolation control that, upon a high radiation level in the containment or ventilation ducting, is used as a diverse parameter to automatically close the purge and vent isolation valves. The isolation valves are in a full closed position within 3 seconds from the time the radiation signal is activated (i.e. at the radiation monitor). This parameter is checked during each refueling outage as part of the Inservice Test Program of pumps and valves (IST). The high radiation level signal is set so that the 10 CFR Part 20 limits are not exceeded. In addition, this automatic

closed signal to the purge and vent valves can in no way be defeated by overriding the setpoint (note Part A of this SER) in the control room nor can the inadvertent loss of air to the valve operator result in spuriously opening the valves.

On this basis, we conclude that the purge and vent valve closure on a high radiation signal for the Prairie Island Nuclear Generating Plant Unit Nos. 1 and 2 meets our position of Item II.E.4.2 (Position 7) of NUREG-0737. Therefore, the licensee has adequately responded to this issue.

E. Conclusion

As a result of this safety evaluation and our review of the licensee's submittals, we conclude that the licensee adequately responded to our long term generic concerns as detailed in our letters dated November 28, 1978, October 29, 1979, November 2, 1981 and March 8, 1982 on the containment purge and ventilation systems for the Prairie Island Nuclear Generating Plant Unit Nos. 1 and 2. Our review of the licensee's submittal indicates that containment purge limited to the low volume purge and ventilation systems (4,000 CFM) for both units on a limited time for safety related reasons is acceptable. Purging on a limited basis by the low volume system is predicated upon the licensee completing plant modifications committed to by his letter dated April 30, 1982, and having plant procedures and amendments to the Technical Specification in place as a prerequisite to commencing purge and vent operation. Using the sample Technical Specifications provided as enclosure 3 of our letter dated March 8, 1982 as a guide, the licensee's proposed change to the Technical Specifications is to adequately address (based on the applicable contents of this safety evaluation) the following provisions:

1. The containment penetrations of the high volume (33,000 CFM) purge and ventilation systems will be sealed shut isolating the purge and vent valves from the containment atmosphere by means of blind flanges when the units are operated above cold shutdown.

2. The double gasketed seals of the blind flanges of the high volume purge and ventilation system will undergo a type B leak test as prescribed by 10 CFR Part 50 Appendix J prior to operating the units above cold shutdown if the flanges have been removed during cold shutdown or during a refueling outage.

3. The containment penetrations of the low volume purge and ventilation systems will be sealed shut by means of blind flanges during plant operations above cold shutdown when purging is not required.

4. As a prerequisite to purging with the low volume purge and ventilation systems (4,000 CFM), the containment isolation valves will undergo a type C leak test as prescribed by 10 CFR Part 50 Appendix J to assure the isolation function of the purge and vent valves during purging operations.

5. The double gasketed seals of the blind flanges at the containment penetrations of the low volume purge and ventilation systems will undergo a type B leak test as prescribed in 10 CFR Part 50 Appendix J each time the blind flanges are installed as a prerequisite to operating the plant above cold shutdown and after purging operation is complete when the reactor is above cold shutdown.

6. Purging by the low volume purge and ventilation system (4,000 CFM) shall be minimized and shall be limited to safety related reasons.

This safety evaluation also addresses the positions identified with Item II.E.4.2 of NUREG-0737 TMI Action Plan because of their similarity with our long-term generic concerns with containment purging. We have completed our review of the licensee's submittals that address the positions of Item II.E.4.2 of NUREG-0737 TMI Action Plan and as discussed in this safety evaluation we find the responses adequately address these positions. On this basis Item II.E.4.2 of NUREG-0737 is resolved for Prairie Island Nuclear Generating Plant Units 1 and 2.

Attachment: Technical Evaluation Report

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