UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20655

September 28, 1992

Docket No. 50-333

Mr. Ralph E. Beedle
Executive Vice President - Nuclear Generation
Power Authority of the State of New York
123 Main Street
White Plains, New York 10601

Dear Mr. Beedle:

SUBJECT: HARDENED WETWELL VENT CAPABILITY AT THE JAMES A. FITZPATRICK NUCLEAR POWER PLANT (TAC NOS. M74868 AND M82364)

As a part of a comprehensive plan for closing severe accident issues, the NRC staff undertook a program to determine if any actions should be taker, on a generic basis, to reduce the vulnerability of BWR Mark I containments to severe accident challenges. At the conclusion of the Mark I Containment Performance Improvement Program, the NRC staff identified a number of plant modifications that substantially enhance the plant's capability to both prevent and mitigate the consequences of severe accidents. One of the modifications recommended was improved hardened wetwell vent capability. After considering the proposed Mark I Containment Performance Program (described in SECY 89-017, January 1989), the Commission directed the staff to pursue Mark I enhancements on a plant-specific basis in order to account for possible unique design differences that may bear on the necessity and nature of specific safety improvements. Accordingly, the Commission concluded that the recommended safety improvements, with one exception, that is, hardened wetwell vent capability, should be evaluated by licensees as part of the Individual Plant Examination (IPE) Program. With regard to the recommended plant improvement dealing with hardened vent capability, the Commission, in recognition of the circumstances and benefits associated with this modification, directed the staff to facilitate installation of a hardened vent under the provisions of 10 CFR 50.59 for licensees, who on their own initiative, elect to incorporate this plant improvement. On September 1, 1989, the staff issued Generic Letter 89-16, "Installation of a Hardened Wetwell Vent," which encouraged licensees to implement a hardened wetwell vent capability under the provisions of 10 CFR 50.59.

By letters dated October 27, 1989, and July 25, 1990, the Power Authority of the State of New York (PASNY) notified the NRC staff that it would defer making a decision on whether to install a hardened wetwell vent until the FitzPatrick Individual Plant Examination (IPE) was completed. In those letters, PASNY provided "plant specific" design information and engineering analyses that justified this approach on the hardened vent issue. The NRC staff reviewed the information provided by PASNY in the stated letters. Additionally, on August 22, 1990, the staff inspected the existing wetwell vent path at the FitzPatrick plant. As a result of the staff's review of PASNY's submittals, the inspection of the FitzPatrick wetwell vent path, and a

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review of the existing venting procedures and training, the NRC, by letter dated January 24, 1991, approved PASNY's approach to defer its decision to fully implement the industry's hardened vent general design criteria until completion of the IPE.

By letter dated December 6, 1991, PASNY provided the NRC with its final position regarding implementation of the hardened vent design criteria along with insights gained from performing the IPE and the status of investigations into accident management strategies associated with severe accidents. In a letter dated August 14, 1992, PASNY provided additional information on the hardened vent capability. PASNY determined that the current design of the FitzPatrick hardened wetwell vent meets many of the Boiling Water Reactor Owners Group (BWROG) design criteria and represents an acceptable deviation from the remainder. Furthermore, PASNY concluded that hardware modifications needed to fully meet the BWROG design criteria are not necessary to ensure that the vent performs its decay heat removal and scrubbing functions and would not produce significant public benefits.

Based on the information provided by PASNY and the results of the NRC inspection of the FitzPatrick hardened wetwell vent path, the NRC staff has determined that the current vent path meets the hardened vent design criteria or their intent. Furthermore, the NRC staff finds that the plant procedures and training are adequate to provide the information and guidance necessary for operators to effectively use the FitzPatrick hardened wetwell vent capability. Therefore, the NRC staff concludes that the existing wetwell vent capability at the FitzPatrick plant is acceptable.

A copy of the staff's evaluation of the plant-specific features, procedures, and training related to the FitzPatrick hardened wetwell vent capability is enclosed. This action completes our review activities associated with GL 89-16 and closes TAC Nos. M74868 and M82364.

Sincerely,

Steven A. Varga, Director
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosure:
Safety Evaluation

cc w/enclosure:
See next page

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

SAFETY EVALUATION REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

POWER AUTHORITY OF THE STATE OF NEW YORK

HARDENED WETWELL VENT CAPABILITY

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

DOCKET NO. 50-333

1.0 INTRODUCTION

Generic Letter (GL) 89-16 encouraged licensees to implement a hardened wetwell vent capability under the provision of 10 CFR 50.59. By letter dated July 25, 1990, the Power Authority of the State of New York (PASNY, the licensee) submitted an analysis of the potential benefits of a hardened wetwell vent at the James A. FitzPatrick Nuclear Power Plant (FitzPatrick). The analysis indicated that the existing wetwell vent is hardened and capable of withstanding anticipated venting pressures, except for the interface with the standby gas treatment system (SGTS). The SGTS is located in a building adjacent to the reactor building. PASNY affirmed its willingness to make cost beneficial modifications to fully meet the approved hardened vent general design criteria; however, it wanted to defer such actions until completing its individual plant examination (IPE) program.

By letter dated January 24, 1991, the NRC staff approved the licensee's request to integrate the results of its IPE program into its decision to make any modifications to the existing vent design to fully implement the approved hardened vent general design criteria. Upon completion of the IPE program, the licensee was to: (1) provide the NRC with its final position regarding implementation of the hardened vent design criteria, and (2) use the results of the IPE to re-examine the venting procedures and training of operators. By letter dated December 6, 1991, the licensee provided this information along with insights gained from performing the IPE and the status of investigations into accident management strategies associated with severe accidents. In a letter dated August 14, 1992, the licensee provided additional information on the hardened vent capability.

2.0 EVALUATION

The FitzPatrick plant has a hardened vent system that originates at the primary containment suppression chamber and terminates at the inlet to the SGTS. The hardened vent system is located in the reactor building while the SGTS is located in a building adjacent to the reactor building. The SGTS consists, in part, of a series of filters connected by sheet metal ducting with an expected rupture pressure of a few psig. Outlet piping of the SGTS is routed through the building and to the plant stack. The hardened vent piping is rated for 150 psig internal pressure. As the vent system is already hardened up to the SGTS, the licensee performed an analysis to determine whether additional hardened piping should be added to bypass the SGTS and any

additional modifications were necessary to meet the hardened vent design criteria.

Through completion of the IPE, the licensee gained several insights for post-accident venting. For the TW (loss of decay heat removal) accident sequence, the containment pressure approaches the primary containment pressure limit (PCPL) of 44 psig in approximately 20 hours. The emergency operating procedures (EOPs) then direct the operators to vent the containment to maintain pressure below the PCPL. If the containment is not vented, the pressure will continue to rise leading to failure due to overpressurization. The licensee calculated the core damage frequency (CDF) with venting (1.92 E-6/yr) and without venting (2.72 E-5/yr). These calculations demonstrated a reduction in CDF by a factor of 14 due to venting.

For the station blackout (SBO) accident scenario, decay heat is transferred to the suppression pool causing an increase in containment pressure. Depletion of station batteries after about 8 hours causes failure of the remaining core cooling systems and core damage ensues. Core damage occurs approximately 13 hours into the scenario with containment pressure remaining below the PCPL vent setpoint pressure of 44 psig. Therefore, the licensee has concluded that venting cannot be considered as a mitigative concept for an SBO event, under the guidance of the existing Emergency Operating Procedures. During SBO sequences, core damage is calculated to occur around 13 hours whereas the pressure necessary to reach the primary containment pressure limit (PCPL) venting pressure occurs at approximately 20 hours.

The January 24, 1991, NRC staff evaluation of plant-specific features, procedures, and training related to the hardened wetwell vent capability at the FitzPatrick plant concluded that the existing venting capability was expected to achieve the desired reduction in core damage frequency; however, the hardened vent path did not completely meet the hardened vent design criteria. As a result, FitzPatrick was allowed to integrate the results of its IPE program into its decision to fully implement the hardened vent design criteria. The following is an evaluation of the FitzPatrick position relative to the hardened vent design criteria.

Criterion (a): The vent shall be sized such that under conditions of: (1) constant heat input at a rate equal to 1 percent of rated thermal power (unless lower limit justified by analysis), and (2) containment pressure equal to the PCPL, the exhaust flow through the vent is sufficient to prevent the containment pressure from increasing.

The FitzPatrick vent path will relieve pressure through parallel 6 and 12-inch lines. Based on the licensee analysis, one percent decay heat (24.36 MW) produces 25.183 lbm/sec of steam at the PCPL of 44 psig or a volumetric rate of 269.964 ft^3/sec. Since the initial flow of gases through the vent will consist of nitrogen and steam, the licensee concluded that a conservative vent mass flow rate of 44.21 lbm/sec was required to limit the primary containment pressure to the PCPL level. The 6-inch line is capable of passing 17 lbm/sec and the 12-inch line is capable of passing 71 lbm/sec.

Based on these results, FitzPatrick meets the vent criteria through use of the 12-inch line or combination of the 6 and 12-inch line. The NRC staff concludes that criterion (a) has been met.

Criterion (b): The hardened vent shall be capable of operating up to the PCPL. It shall not compromise the existing containment design basis.

The PCPL at FitzPatrick is 44 psig. The hardened vent piping has a design pressure rating of 150 psig, with the exception of the SGTS which is located in a building adjacent to the reactor building. The SGTS room contains sheetmetal ductwork and filters which are assumed to fail under most venting scenarios. After ductwork failure, high pressure venting will pressurize the SGTS room until failure of the access doors to the outside. They are double doors that normally open to the environment thereby providing a large release path for the steam mixture. As a result, the pressurization on the reactor building wall will be limited to relatively low pressures which will be well within the wall structural capability.

Although failure of the sheetmetal ductwork will render the SGTS inoperable, this failure should not affect any safety equipment located within the reactor building. The SGTS building is adequately isolated from the systems within the reactor building by the reactor building wall. Further, the containment design pressure is 56 psig and the PCPL is 44 psig. Both values are well below the piping design pressure of 150 psig. The NRC staff concludes that criterion (b) has been met.

Criterion (c): The hardened vent shall be designed to operate during conditions associated with the TW sequence. The need for SBO venting will be addressed during the IPE.

The FitzPatrick hardened vent is capable of relieving at least one percent of rated thermal power and withstanding the associated pressures, with the exception of the SGTS piping which is assumed to fail. The containment isolation valves in the vent path are also capable of operation at the PCPL. In the event electrical or pneumatic power is not available to operate the vent valves, manual operation from the reactor building is possible. The IPE determined that the PCPL would be reached after 20 hours into a TW sequence, which should provide sufficient time for any manual vent actuations, if required. The PASNY also provided preliminary insights into the need and feasibility of venting during SBO sequences and was examining several new accident management strategies. However, since core damage would occur long before venting was needed, venting was not credited in the IPE for an SBO event. The NRC staff concludes that criterion (c) has been met.

Criterion (d): The hardened vent shall include a means to prevent inadvertent actuation.

Inadvertent actuation of the hardened vent at FitzPatrick is prevented through several mechanisms. The emergency operating procedures are specific as to when venting is to be performed. Venting involves operation of several valves

from the relay room, which is physically separated from the control room. The TW sequence most likely would involve loss of some emergency power, and therefore, some manual vent valve operation would be required. Containment isolation signals from high drywell pressure and possibly high containment radiation would have to be bypassed. Therefore, either the need for manual operation or deliberate bypass actions makes the potential of inadvertent venting a remote possibility. As a result, the NRC staff concludes that the intent of criterion (d) has been met.

Criterion (e): The vent path up to and including the second containment isolation barrier shall be designed consistent with the design basis of the plant.

The NRC staff concluded, in its January 24, 1991, evaluation of the hardened vent design, that the vent path meets the design basis of the plant. The NRC staff concludes that criterion (e) has been met.

Criterion (f): The hard vent path shall be capable of withstanding, without loss of functional capability, expected venting conditions associated with the TW sequence.

The NRC staff concluded, in its January 24, 1991, evaluation of the hardened vent design, that the vent piping, with the exception of the SGTS piping, was capable of withstanding, without loss of functional capability, all expected venting conditions. In addition, the NRC staff concluded that the damage to the SGTS may be an acceptable deviation pending completion of the IPE. The licensee evaluated loss of the SGTS based on the IPE and performed a cost-benefit analysis for providing a hardened pipe bypass around the SGTS for SBO scenarios. The licensee concluded that loss of the SGTS was an acceptable consequence of venting and that modifications to the piping configuration were not justified. Modifications to the piping configuration could reduce the offsite dose but would not decrease the core damage frequency. The NRC staff concludes that the existing design is sufficient and that the intent of criterion (f) has been met.

Criterion (g): Radiation monitoring shall be provided to alert control room operators of radioactive releases during venting.

FitzPatrick will use the existing containment high range monitor (CHRM) and postaccident sampling system (PASS) to assess the radiological consequences of venting. These monitoring systems are capable of assessing severe accident conditions and will be operable under the environmental conditions associated with venting. The CHRM provide indication of radiation levels with the drywell. The PASS can take samples from the drywell, wetwell, suppression pool, and reactor coolant. The results from a PASS sample are available within the 3-hour criterion of NUREG-0737. The NRC staff concludes that the intent of criterion (g) has been met.

Criterion (h): The hardened vent design shall ensure that no ignition sources are present in the pipeway.

In the January 24, 1991, evaluation, the NRC staff indicated that there was a potential for a hydrogen deflagration upon rupture of the SGTS ducts. Large amounts of hydrogen could be produced during a core melt scenario; however, the TW sequence is prevented from progressing to a core melt by relieving both mass and energy through the containment vent. Therefore, large amounts of hydrogen are not expected for the TW sequence. However, the EOPs are symptom based, not sequence based procedures. In the event that hydrogen is released into the SGTS room, the vent flow will also consist of nitrogen and steam which will provide some amount of natural inerting. In addition, the barrier between the SGTS room and the reactor building is a 2-foot thick reinforced concrete wall which provides a barrier against the adverse consequences of a hydrogen deflagration.

A hard pipe bypass around the SGTS could prevent any hydrogen deflagration within the SGTS room. The licensee estimated the cost of this modification at $680,000. The licensee concluded that combustion in the existing vent path is not risk significant and does not plan to modify the vent design. Based on the uncertainty as to whether a combustible mixture could develop, the prevention potential of steam and nitrogen to suppress a hydrogen deflagration, the mitigation potential of the concrete wall between the SGTS room and the safety related equipment, and the costs associated with modifications, the NRC staff concludes that the existing design is acceptable and the intent of criterion (h) has been met.

As stated in the January 24, 1991, evaluation, the NRC staff identified several weaknesses in the technical and human factors aspects of F-AOP-35, "Post Accident Venting of the Primary Containment," which could prove detrimental to effective operator use of the procedure. Subsequent to the issuance of that evaluation, F-AOP-35 was revised to provide significant improvements including: step clarification, more detailed instructions, enhanced caution statements, and standardized phraseology and format. Also noted in the January 24, 1991, evaluation were several deficiencies in the operator training pertaining to containment venting. Subsequently, the licensee has committed to integrate the results of the IPE into the operator training program. This training will provide operators with guidance regarding severe accident phenomena such as the consequences of venting during severe accidents. Other improvements to the operator training program which have already been implemented include:

1. Training which provided clarification of procedural references to the FitzPatrick PCPL, containment failure pressure, and alternative methods of heat removal; and

2. Training which provided guidance on use of the 2" bypass line flowpath to protect the SGTS, unless flow is insufficient to counteract the decay heat addition to the containment thus requiring the main vent line to be used.

The NRC staff has reviewed the revised venting procedure and enhancements to the operator training as they relate to conformance to the human factor issues

of the Standard Review Plan (NUREG-0800) Sections 13.2.1, "Reactor Operator Training," and 13.5.1, "Operating and Maintenance Procedures." The NRC staff finds the revised procedural guidance and operator training acceptable.

The licensee has identified several accident management strategies associated with operation of the vent which may be beneficial. These venting strategies include venting until containment pressure is reduced to near atmospheric pressure and initiating venting early for certain circumstances. The NRC staff agrees with the licensee's approach of bringing these issues to the attention of the Boiling Water Reactor Owners Group (BWROG) for future generic consideration. However, the NRC staff has concluded that the design and procedures currently implemented at the FitzPatrick plant are sufficient to satisfy the hardened vent design criteria and ensure adequate plant safety.

3.0 CONCLUSION

Based on the above evaluation, the NRC staff concludes that PASNY either meets the hardened vent design criteria or its intent at the FitzPatrick plant. Furthermore, the NRC staff finds the revised procedural guidance and operator training regarding containment venting acceptable. Therefore, the staff has determined that existing containment vent path capability at the FitzPatrick plant is acceptable.

Principal Contributors:
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