U. S. NUCLEAR REGULATORY COMMISSION
REGION I

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LICENSEE: Public Service Electric and Gas Company
P.O. Box 236
Hancocks Bridge, New Jersey 08038

FACILITY: Hope Creek Nuclear Generating Station

INSPECTION AT: Hancocks Bridge, New Jersey

INSPECTION DATE: May 23-26, 1995

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Summary: From May 23 through May 26, 1995, the NRC staff conducted an inspection of Hope Creek's hardened wetwell vent to determine the licensee's compliance with commitments made in response to NRC Generic Letter (GL) 89-16, "Installation of a Hardened Wetwell Vent."

The torus vent system was found to be: 1) designed and evaluated in accordance with the requirements of 10 CFR 50.59 and the NRC-approved Boiling Water Reactor Owners' Group (BWROG) guidelines, 2) installed as per the design modification package, and 3) appropriately tested. Comprehensive emergency operating procedures (EOPs) were available to direct the initiation and termination of venting. Operators were trained on and knowledgeable of the design and function of the system.

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DETAILS

1.0 INTRODUCTION

As part of a comprehensive plan for closing severe accident issues, the NRC staff undertook a program to determine if any actions should be taken, 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 staff identified a number of plant modifications that would substantially enhance the plants' capability to both prevent and mitigate the consequences of severe accidents. Recommended improvements included improved hardened wetwell vent capability. On September 1, 1989, the NRC issued Generic Letter (GL) 89-16, "Installation of a Hardened Wetwell Vent," requesting licensees with Mark I containments to consider installation of hardened wetwell vent systems under the provisions of 10 CFR 50.59. In an October 30, 1989, letter, the licensee committed to install a hardened wetwell vent at Hope Creek Generating Station (HCGS). This inspection was conducted to verify the licensee's implementation of commitments made in response to GL 89-16 and was based on guidance provided in Temporary Instruction (TI) 2515/121, "Verification of Mark I Hardened Vent Modifications (GL 89-16)."

2.0 INSPECTION FINDINGS

2.1 Plant Modification Review

The hardened vent path was installed at HCGS during the 1992/93 refueling outage to provide beyond-design-basis protection for the Mark I primary containment. The hardened torus vent takes a suction from the wetwell airspace, thereby taking advantage of the radiological scrubbing provided by the torus water. The vent path continues through a 12-inch pipe installed between two previously-existing containment isolation valves (CIVs) on the 24-inch containment prepurge cleanup line of the Containment Atmoshpheric Control System. A new solenoid-operated outboard containment isolation valve was installed in the 12-inch piping upstream of an inline rupture disc. The new outboard CIV is normally closed with control power removed (pulled fuse). Control room position indication for the CIV is provided independent of control power availability. The capability to terminate venting from the control room by closing the CIVs is a positive feature of the HCGS hardened vent design. The vent path discharges outside the containment building and provides an elevated release of the primary containment atmosphere to the environment. A radiation monitor installed upstream of the rupture disc provides local and control room indication of radiological conditions in the vent path.

The inspectors reviewed several documents in the modification package for the hardened torus vent including the two applicable design change packages (DCPs), 4EC-3121 nos. 1 and 2, and the associated safety evaluations. The 10 CFR 50.59 evaluations conformed to the requirements of 10 CFR 50.59 and licensee requirements and addressed the appropriate questions to determine that no unreviewed safety question existed. The DCPs were complete and contained appropriate document reviews and recommendations for changes to plant procedures and the Final Safety Analysis Report (FSAR). Inspector sampling verified procedures and the FSAR were consistently updated.

The inspectors verified that all components in direct communication with the hardened vent path are periodically tested commensurate with their function. All containment isolation valves are tested in accordance with the requirements of the licensee's inservice testing (IST) program. The rupture disc in the vent path was certified by the vendor and is inspected to verify integrity following the local leak rate tests (LLRTs) of the inline valves. The rupture disc is removed during the integrated leak rate test (ILRT) since the hardened vent is used to depressurize containment following the test.

Since the hardened vent has direct communication with the environment, a drain valve was installed immediately downstream of the rupture disc. This valve is currently on a quarterly surveillance schedule and is opened to drain condensation formed in the line to prevent water hammer in the event of vent actuation. A table with significant testing requirements for the hardened vent system components follows.

Component/ Designation	Type of Testing	Frequency (Once per)	Required per
Inbd CIV HV-4964	Stroke Time	Refueling	Tech Specs
New Outbd CIV HV-11541	Exercise	18 Months	IST
Outbd CIV HV-4962	Stroke Time	Refueling	Tech Specs
Rupture Disc PSE-11541	Integrity Check	Refueling	LLRT
		ILRT	ILRT
Drain Valve 1GSV-203	Open/Close	Quarter	Surveillance

2.2 Replacement of Failed Rupture Disc

During the 1994 refueling outage, the hardened torus vent rupture disc was replaced due to perforations/cracks found in the disc. This was discovered during performance of the 10 CFR 50, App. J, local leak rate testing (LLRT) for containment isolation valves (as part of the LLRT, the rupture disc is removed and inspected for integrity). The ruptured disc was sent to a laboratory for examination, where it was determined that the disc failed due to chlorine and sodium-induced corrosion on the outlet side of the rupture disc (which is in communication with outside enviromental conditions). Also, pressure fluctuations on the outlet side of the disc caused it to flex, contributing to its failure. Due to these failure mechanisms, the original disc made of solid 316 stainless steel (SS) was replaced with a new disc made of Monel 400 material, which has better corrosion characteristics than 316 SS. Additionally, a vacuum support piece was installed to prevent the disc from flexing due to slight pressure variations in the vent discharge piping.

The inspectors reviewed the design change package (DCP) No. 4HO-0903, equivalent replacement evaluation, and seismic qualification documentation for the rupture disc. The design change documentation reviewed was detailed and technically sound. The inspectors verified that the replacement disc was manufactured to the same specifications as the original. The inspectors also reviewed the rupture disc installation procedure and found it was in accordance with vendor installation instructions. The inspectors verified that changes were made to the appropriate documents to reflect the new rupture disc specifications. Overall, the inspectors concluded that the licensee controls for both the evaluation and installation of the new rupture disc were good.

2.3 Comparison to Approved Boiling Water Reactors Owners' Group (BWROG) Recommendations

The inspectors verified that the licensee's hardened vent design complied with the NRC-approved BWROG criteria. An evaluation of the HCGS hardened vent design relative to these criteria follows.

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

The licensee performed a pipe line sizing calculation which considered the vented fluid in one case as saturated steam and in another as a steam/air mixture in order to model both the initial venting of the containment and also the cycling of the vent to prevent re-pressurization, respectively. The sizing calculation also reviewed the capability of the pathway as a vent path following an integrated leak rate test. The new 12-inch hardened vent path was determined to be capable of accepting a constant heat load of at least 1% rated thermal power (rated at 3359 MWt) at the PCPL of 65 psig without an increase in containment pressure. The inspectors concluded that Criterion (a) was 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 vent is capable of operation at the primary containment pressure limit of 65 psig. Most of the initial portion of the hardened vent path uses previously installed piping of the containment atmospheric control system and meets the design basis of the plant. The newly installed piping, up to and including the second containment isolation valve, is designed to the same specifications as the original piping and is ASME Class 2 and Seismic Category I. The remaining piping downstream of the second CIV was designed to II/I criteria and will not fail during a seismic event. Peak transient pressure in this pathway is approx 27.5 psig. The rupture disc will blow out at approximately 35 psig. The hardened vent piping can withstand internal pressures of up to 150 psig. Also, all valves in communication with the vent line were designed to withstand and/or operate under, as applicable, pressures up to 65 psig and temperatures up to 340 degrees Fahrenheit. These are the expected conditions for vent use. The vent is capable of operating up to the PCPL and does not compromise the containment design basis. Therefore, the inspectors considered Criterion (b) met.

Criterion (c): The hardened vent shall be designed to operate during conditions associated with the TW (loss of containment cooling) sequence. The need for station blackout (SBO) venting will be addressed during the individual plant examination (IPE).

Hardened vent is designed to operate during the conditions of the TW sequence, as described in Criterion (b). The need for station blackout venting was addressed in the licensee's IPE and numerous calculations supporting that document. The hardened torus vent was designed to operate during SBO conditions. The vent containment isolation valves are solenoid-operated butterfly valves. If a failure of the normal pneumatic supply occurs, such as under SBO conditions, a nitrogen backup supply is provided to operate automatically. In addition, manual operation capability exists through the use of locally mounted hydraulic hand pumps. The capability to operate the hardened vent during SBO conditions is considered a strength. The inspectors considered Criterion (c) met.

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

Inadvertent actuation was prevented through the use of the rupture disc which is a passive component. Although the capability exists to manually pressurize a portion of the line and blow out the rupture disc, no formal procedure exists for doing so and inadvertent pressurization is not feasible. Also, the path's two containment isolation valves are normally closed and the outboard CIV has its fuse removed. This valve is controlled by tagging and requires use of a keylock and fuse replacement to operate. The inspectors considered Criterion (d) 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 vent path is designed consistent with the design basis of the plant. Portions of the hardened piping up to and including the second CIV are ASME Class 2 and Seismic Category I. Remaining sections are designed to II/I criteria and will not fail during a seismic event. Also a torus attached piping penetration calculation was performed to re-qualify the penetration and to demonstrate ASME Code compliance. Criterion (e) was met.

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

As stated in Criteria (b) and (c), the vent piping and components have been designed to remain functional under pressures of 65 psig and temperatures of 340°F, the conditions associated with the TW sequence. Criterion (f) was met.

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

A radiation monitor was installed surrounding the piping upstream of the rupture disc, providing a monitorable release path. The radiation monitor feeds the plant radiation monitoring system (RMS) computer in the control room, providing an audible alarm to operators. There is also local radiation indication. The inspectors considered Criterion (g) satisfied.

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

The hardened vent path includes or interfaces with solenoid-operated isolation valves and a rupture disc. None of these components introduces an ignition source into the pathway. Therefore, no ignition sources are contained in the hardened vent path and Criterion (h) was satisfied.

2.4 System Walkdown

The inspectors were accompanied by the system engineer and a reactor operator during a plant walkdown of the accessible portions of the hardened vent system in the reactor building and control room. The emergency operating venting procedure was referenced during the walkdown and provided detailed instruction on the outboard CIV fuse location for its installation prior to vent use. The fuse cabinet was in good condition, free of combustible materials, and correctly tagged. A system mimic on the control panel in the control room provided flow path information as well as CIV position indication independent of control power to the valves. The RMS computer located in the control room provided operators with an audible alarm to alert them if radiation is present in the vent path. The accessible portions of the vent system in the reactor building were properly configured and labeled as indicated in system isometric drawings and P&IDs. The newly installed backup nitrogen supply was appropriately installed with seismic support and a missile shield. Inspectors noted normal values for radiation levels and backup nitrogen supply pressures. The inspectors confirmed that the system was installed in accordance with system design specifications, applicable Code requirements, and plant procedures and drawings.

2.5 Operator Interviews and Training

The inspectors interviewed three senior reactor operators and two reactor operators to assess their level of knowledge regarding the hardened torus vent. Each operator demonstrated a comprehensive understanding of the system including system function, flow path, relevant control room indications, and pertinent system parameters. The inspectors also questioned the operators regarding vent initiation and termination. All operators correctly responded that these actions would be directed by emergency operating procedures, as described in Section 2.6.

The inspectors reviewed the "Containment Systems" operator lesson plan which included the hardened vent modification and found it to be acceptable. The lesson plan covered topics related to system design basis, appropriate system parameters, and changes made to plant emergency operating procedures. Operators were also instructed on the use of the hardened vent during simulator training. The inspectors considered this a strength. In addition the inspectors verified that all licensed operators had received both classroom and simulator instruction during initial or requalification training.

2.6 Emergency Operating Procedures (EOPs)

The inspectors reviewed Emergency Operating Procedures OP-EO.ZZ-0318, "Containment Venting," and OP-EO.ZZ-0102, "Containment Control," which describe conditions under which the hardened torus vent would be used. In the event that drywell pressure cannot be maintained below 65 psig, and drywell pressure is above rupture disc burst pressure of 35 psig, OP-EO.ZZ-0102 directs the operators to vent the containment via the hardened torus vent using OP-EO.ZZ-0318. The inspectors verified that this action is in accordance with the licensee's emergency plan and the Boiling Water Reactor Owners Group (BWROG) Emergency Procedure Guidelines for containment venting.

3.0 MANAGEMENT MEETINGS

Licensee representatives were informed of the scope and purpose of this inspection at an entrance meeting conducted on May 23, 1995. The inspectors met with the principals listed below to summarize preliminary findings on May 26, 1995. The licensee acknowledged the preliminary findings and conclusions, with no exceptions taken. Further, the bases for the preliminary conclusions did not involve proprietary information, nor was any such information included in the written inspection report.

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