UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO GENERIC LETTER 90-06 RESPONSES

METROPOLITAN EDISON COMPANY
JERSEY CENTRAL POWER & LIGHT COMPANY
PENNSYLVANIA ELECTRIC COMPANY
GPU NUCLEAR CORPORATION

THREE MILE ISLAND NUCLEAR STATION, UNIT NO. 1

DOCKET NO. 50-289

1.0 INTRODUCTION

On June 25, 1990, the staff issued Generic Letter 90-06, "Resolution of Generic Issue 70, 'Power-Operated Relief Valve and Block Valve Reliability,' and Generic Issue 94, 'Additional Low-Temperature Overpressure Protection for Light-Water Reactors,' Pursuant to 10 CFR 50.54(f)." The generic letter represented the technical resolution of the above mentioned generic issues.

Generic Issue (GI) 70, "Power-Operated Relief Valve and Block Valve Reliability," involves the evaluation of the reliability of power-operated relief valves (PORVs) and block valves and their safety significance in pressurized water reactor (PWR) plants. The generic letter discussed how PORVs are increasingly being relied upon to perform safety-related functions and the corresponding need to improve the reliability of both PORVs and their associated block valves. Proposed staff positions and improvements to the plant's technical specifications (TS) were recommended to be implemented at all affected facilities. This issue is applicable to all Westinghouse, Babcock & Wilcox (B&W), and Combustion Engineering designed facilities with PORVs.

Generic Issue 94, "Additional Low-Temperature Overpressure Protection for Light-Water Reactors," addresses concerns with the implementation of the requirements set forth in the resolution of Unresolved Safety Issue (USI) A-26, "Reactor Vessel Pressure Transient Protection (Overpressure Protection)." The generic letter discussed the continuing occurrence of overpressure events and the need to further restrict the allowed outage time for a low-temperature overpressure protection (LTOP) channel in operating Modes 4, 5, and 6. This issue is only applicable to Westinghouse and Combustion Engineering facilities.

GPU Nuclear Corporation (GPUN or the licensee) responded to Generic Letter (GL) 90-06 in a letter dated December 24, 1990, for Three Mile Island Nuclear Station, Unit 1 (TMI-1). The licensee did not adopt the staff position for GI-70. Rather, they proposed an alternative to the staff-suggested (or model) TS and proposed an alternative to in-place stroke testing

of the PORV. The NRC staff reviewed the GPUN response and provided comments and a request for additional information by letter dated October 29, 1992, regarding the incorporation of model TS and testing of the PORV. GPUN responded to the request for additional information on January 29, 1993.

2.0 EVALUATION

Technical resolution of GI-70 resulted in three recommendations as follows:

Recommendation 1

Include PORVs and block valves within the scope of an operational quality assurance program that is in compliance with 10 CFR Part 50, Appendix B. This program should include the following elements:

a. The addition of PORVs and block valves to the plant operational Quality Assurance List.

b. Implementation of a maintenance/refurbishment program for PORVs and block valves that is based on the manufacturer's recommendations or guidelines and is implemented by trained plant maintenance personnel.

c. When replacement parts and spares, as well as complete components, are required for existing non-safety-grade PORVs and block valves (and associated control systems), it is the intent of this GL 90-06 that these items may be procured in accordance with the original construction codes and standards.

Recommendation 2

Include PORVs, valves in PORV control air systems, and block valves within the scope of a program covered by Subsection IWV, "Inservice Testing of Valves in Nuclear Power Plants," of Section XI of the ASME Boiler and Pressure Vessel Code. Stroke testing of PORVs should only be performed during Mode 3 (Hot Standby) or Mode 4 (Hot Shutdown) and in all cases prior to establishing conditions where the PORVs are used for low-temperature overpressure protection. Stroke testing of the PORVs should not be performed during operation. Additionally, the PORV block valves should be included in the licensees' expanded MOV test program discussed in NRC GL 89-10, "Safety-Related Motor Operated Valve Testing and Surveillance," dated June 28, 1989.

Recommendation 3

For operating PWR plants, modify the limiting conditions of operation of PORVs and block valves in the technical specifications for Modes 1, 2, and 3 to incorporate the position adopted by the staff in recent licensing actions. The staff recognizes that some recently licensed PWR plants already have technical specifications in accordance with the staff position. Such plants are already in compliance with this position and need merely state that in

their response. These recent technical specifications require that plants that run with the block valve closed (e.g., due to leaking PORVs) maintain electrical power to the block valves so they can be readily opened from the control room upon demand.

Additionally, plant operation in Modes 1, 2, and 3 with PORVs and block valves inoperable for reasons other than seat leakage is not permitted for periods of more than 72 hours.

GPUN Response to GI-70 Recommendations and Staff Evaluation

Recommendation 1:

a. The PORV and block valve are included on the GPUN Component Quality Classification List and safety classified as Nuclear Safety Related. The GPUN Operational Quality Assurance (QA) Plan identifies that Nuclear Safety Related items are within the scope of the QA Plan.

b. PORV maintenance and refurbishment are handled by a contract through Dresser Industries. The contract imposes the appropriate QA requirements and QA surveillance of Dresser activities. Typically, during each refueling the inplace PORV is swapped with the spare, refurbished valve and the valve that was removed is sent to Wyle Laboratory for testing under a GPUN contract. All work is performed by Dresser Industries at Wyle Laboratory facilities. Appropriate QA requirements are also imposed in the Wyle Laboratory contract with testing also under QA surveillance.

   The PORV block valve was repacked in 1987 as part of the Chesterton valve repacking program. A schedule for repacking the valve has been established in accordance with the Chesterton recommendations.

   All maintenance/refurbishment work performed on the PORV or block valve at TMI-1 would be in accordance with the manufacturer's recommendations by maintenance personnel trained in accordance with GPUN's Maintenance Training Program which is fully accredited by the Institute of Nuclear Power Operation (INPO).

c. TMI-1 has non-safety grade PORV and block valves. PORV and block valve parts are procured in accordance with the original construction codes and standards.

The staff finds that the response to this recommendation meets the intent of the generic letter and is, therefore, acceptable.

Recommendation 2:

The PORV (RC-RV2), a 2½" Dresser Electromatic Relief Valve, does not use control air. The PORV block valve (RC-V2) is a 2½" Velan motor operated gate valve.

The PORV and block valve are tested in accordance with Section XI, Subsection IWV of the ASME Boiler and Pressure Vessel Code, as required by 10 CFR 50.55a. The Inservice Testing (IST) program requirements for the PORV and block valve were approved by the NRC's Safety Evaluation (SE) for the second ten year interval, dated March 19, 1987. Testing of the PORV block valve will be in accordance with the Motor Operated Valve Test Program in response to NRC GL 89-10.

Surveillance requirements for the PORV and block valve include:

1. Quarterly stroke time cycling of the block valve in accordance with Surveillance Procedure (SP) 1300-3Q, "Quarterly Inservice Testing of Valves During Normal Plant Operation."

2. Monthly testing in accordance with SP 1303-11.45, "PORV Setpoint Check" as required by TMI-1 TS 4.1-1, Item 48.

3. Refueling interval PORV setpoint calibration in accordance with SP 1302-6.16, "PORV Setpoint & Remote Position Check," as required by TMI-1 TS 4.1-1, Item 48.

4. Refueling interval testing of the PORV in accordance with SP 1300-3V, "PORV IST," which requires:

   a. Actuation during shutdown conditions, or

   b. Removal and bench testing, or

   c. Removal and replacement with a spare valve previously tested (typically by Dresser at Wyle Laboratory) within the last 3 years.

The TMI-1 design does not require the PORV to be operable to achieve feed and bleed core cooling. Because the plant has high capacity, high head, Makeup/High Pressure Injection (HPI) Pumps, feed and bleed core cooling can be accomplished at TMI-1 using only the pressurizer code safety valves.

The safety function of the TMI-1 PORV is to protect the Reactor Coolant System (RCS) from overpressure during low temperature RCS conditions. Because the PORV provides a safety function, stroke testing is required by the TMI-1 IST Program. Stroke testing of the TMI-1 PORV is normally performed during refueling at Wyle Laboratory in accordance with GPUN Specification (SP) 1101-12-087. This test is performed at conditions that are representative of the PORV operating environment. TMI-1 General Maintenance Procedure 1401-2.1, "Pressurizer Relief Valve Removal/Installation," provides verification of proper reinstallation of the PORV and controls. TMI-1 experience has shown satisfactory results.

Laboratory bench testing each refueling interval (up to 24 months) is the method preferred by GPUN for performing a stroke test of the PORV to meet ASME Section XI and Technical Specification IST requirements; however, the IST procedure does permit actuation of the PORV in place as an alternative test method. In place stroke testing of the PORV using steam with RCS temperature >332°F and RCS pressure at 500-600 psig is an acceptable alternative. The test is performed at conditions equivalent to or greater than those of Mode 3 and Mode 4. Stroke testing of the PORV during Cold Shutdown conditions (Mode 5) would not fulfill TMI-1 IST requirements.

GPUN has taken the position that it prefers laboratory bench testing to testing in-place on the pressurizer for several reasons. Bench testing is performed at normal steam inlet conditions and verifies both setpoints; 2450 psig for power operation and 485 psig for LTOP. Bench testing allows use of a cleaner fluid environment (i.e., no boron)as opposed to RCS fluid which may cause deleterious effects on the valve internals and reduce PORV reliability. The measurement of the PORV stroke time and actual main disc movement can be verified easily under laboratory bench testing conditions whereas stroke time and main disc movement are inferred by indirect indications during in-situ testing.

The TMI-1 PORV is an Electromatic, solenoid actuated, pilot operated relief valve that requires a minimum pressure of 50 psig under the main disc for the PORV to open. As a result, there are several disadvantages to in-place testing of the PORV during hot standby (Mode 3) or hot shutdown (Mode 4). To test the PORV in-place, the upstream PORV Block Valve must be open to supply the necessary fluid pressure (RCS pressure) through the pressurizer to open the valve. The PORV design does not provide direct stem position indication. Therefore valve lift must be inferred from alternate indications (tailpipe ΔP, tailpipe ΔT, acoustic monitor, RCS pressure decrease, or Reactor Coolant Drain Tank (quench tank) pressure, temperature, or level rise).

In-situ testing of the PORV would also result in an insurge of cooler water from the hot leg into the pressurizer. The resulting thermal cycle on the pressurizer surge line would not be expected to contribute to the effects of thermal stratification and thermal striping of the surge line as described in NRC Bulletin 88-11. However, thermal cycles of the surge line, even those of low magnitude, are considered undesirable and should be avoided.

Safety measures have been taken to reduce the challenges to the PORV. The power operation setpoint of the PORV was raised to 2450 psig; i.e., above the high pressure reactor trip setpoint (2355 psig). TMI-1 also has two anticipatory reactor trips: "reactor trip on turbine trip with reactor power greater than 45% power" and "reactor trip on loss of both feedwater pumps with reactor power greater than 7% power." It was a consideration in choosing setpoints for the anticipatory trips to avoid actuation of the PORV. These measures have been successful in reducing challenges to the PORV. Requiring that the PORV be tested in-place at Hot Standby or Hot

Shutdown conditions would unnecessarily increase the number of challenges to the PORV. On this basis, the licensee considers in-place testing of the PORV would result in an overall reduction in plant safety.

Unless there is a need to reestablish the operability of the PORV, performing an in-place PORV test would not be necessary because the valve will have satisfactorily completed a bench test prior to its installation during an outage. Performing a bench test under controlled conditions allows the opportunity for accomplishing repairs to the valve while there is sufficient time for any needed repairs or additional testing without these activities affecting the unit's operating schedule and without the additional dose that could result unnecessarily by having to remove or perform work on the valve while it is attached to the RCS. If a test failure during plant startup were to require cold shutdown conditions, this would result in an additional thermal cycle on the unit and additional personnel exposure that could otherwise be avoided. For these reasons, the licensee feels it is not desirable from a plant safety perspective to perform in-place testing of the PORV instead of or in addition to the current method of bench testing. In-place testing also increases the likelihood that the valve will develop seat leakage during the operating cycle.

In summary, GPUN has concluded that, although the PORV does not have a safety related function during power operation, the current TMI-1 procedures for stroke testing of the PORV in a laboratory under controlled conditions that simulate the temperature and pressure conditions of Mode 3 or Mode 4 provide adequate assurance of PORV reliability for operating as well as shutdown conditions.

The staff has reviewed this position and agrees with the licensee's argument that bench testing of the PORV provides reliability assurance equivalent to that intended by GL 90-06. The staff, therefore, finds the licensee's response acceptable.

Recommendation 3:

TMI-1 TS Amendment No. 78, dated October 20, 1982 incorporated PORV and block valve operability requirements in response to certain of the TMI-2 Lessons Learned Category "A" requirements and other short-term requirements identified in the Commission Order of August 9, 1979.

In accordance with TS 3.1.12.4, whenever the PORV is determined to be inoperable, the associated block valve must be shut and electrically isolated to allow continued operation. Likewise if the PORV block valve is inoperable, the PORV shall be closed and electrically isolated. The staff's Safety Evaluation (SE) supporting Amendment No. 78 stated that continued operation is permitted with the PORV and/or block valve shut since no credit is taken for these valves in the safety analyses (except for plant low-temperature overpressure protection which was addressed in Amendment No. 56, dated July 28, 1980). The staff's SE also stated the

requirements incorporated by Amendment No. 78 are consistent with the Standard TS for these valves and are thus acceptable.

Because the application of model TS is a generic issue that affects all B&W operating plants, the BWOG Technical Specification Committee undertook an initiative to respond as an owners group. The BWOG effort to address the model TS issue resulted in a letter to the NRC from the BWOG (OG-1128) dated January 18, 1993. In their letter, the BWOG stated that their members do not believe the shutdown requirements for an inoperable PORV or block valve are appropriate measures. Enclosure A to GL 90-06 discusses the reasons that most PWRs licensed before 1979 do not classify their PORVs as safety-related components. Nevertheless, the NRC has examined the role of PORVs to perform certain safety-related functions including the following:

1. Mitigation of a design-basis steam generator tube rupture (SGTR) accident.

2. Low-temperature overpressure protection (LTOP) of the reactor vessel during startup and shutdown.

3. Plant cooldown in compliance with Branch Technical Position RSB 5-1 to Standard Review Plan (SRP) 5.4.7, "Residual Heat Removal (RHR) System."

The BWOG letter states that LTOP is not an issue with B&W plants as discussed in GL 90-06 and that the BWOG maintains that use of equipment other than the PORV to manage a steam generator tube rupture (SGTR) and plant cooldown is an appropriate basis for not requiring plant shutdown for an inoperable PORV. The Emergency Operating Procedures (EOPs) for a SGTR, which are based on the BWOG Abnormal Transient Operating Guidelines, give first priority to use of equipment other than the PORV and only resort to use of the PORV if the other equipment is unavailable. To depressurize the RCS following an SGTR, the preferred method is use of the normal pressurizer spray, the auxiliary pressurizer spray (if the design includes one), and/or the pressurizer vent line. Use of the auxiliary pressurizer spray or the vent line results in a smoother, more controllable depressurization than use of the PORV. In addition, use of the PORV to depressurize creates a much greater risk of rupturing the reactor coolant drain tank (quench tank) rupture disc. Steaming the (unaffected) steam generator to remove heat and reduce pressure is also required by the emergency operating procedures (EOPs).

The staff has recognized that most of the safety enhancement for the proposed backfit (TS revision) is derived from the increase in feed and bleed capability. The BWOG position letter states that the B&W design does not require the PORV to be operable to achieve feed and bleed core cooling because the plants (with the possible exception of Davis-Besse) have high capacity, high head, Makeup/High Pressure Injection (HPI) Pumps, feed and bleed core cooling can be accomplished using only the pressurizer

code safety valves. The Individual Plant Examinations (IPEs) required by the NRC in response to the Commission's Severe Accident Policy Statement have shown for B&W plants, at least, that the reduction in core damage frequency estimates would be insignificant (≈ 10E-7/RY) if the shutdown requirement proposed by GL 90-06 as compared to the potentially high cost of a plant shutdown (in the range of 7-10 million dollars according to the BWOG).

Finally, the BWOG position letter states that the TSs that presently exist, and which were incorporated into the BWOG Standard TS in September 1992, exist for prevention of a small break LOCA in the event of a failed open PORV. The letter argues that prevention of a small break LOCA via the PORV does not require PORV operability for opening control.

The staff has reviewed the information provided by GPUN on this recommendation, including the BWOG position, and agrees that a TS to require plant shutdown because of an inoperable PORV is not justified. The staff, therefore, finds the GPUN response to this recommendation acceptable.

3.0 CONCLUSION

The staff has reviewed the GPUN December 14, 1990 response, as supplemented on January 29, 1993, to GL 90-06, "Resolution of Generic Issue 70, 'Power-Operated Relief Valve and Block Valve Reliability,' and Generic Issue 94, 'Additional Low-Temperature Overpressure Protection for Light-Water Reactors,' Pursuant to 10 CFR 50.54(f)." The generic letter made three recommendations for B&W plants aimed at enhancing the reliability of PORVs and PORV block valves. The GPUN response provided information on how those recommendations are satisfied at TMI-1 or, in the case of revising the plant TS to require plant shut down in the event of an inoperable PORV, provided justification why changes are not necessary. The staff has concluded that the TMI-1 response to GL 90-06 is acceptable and that measures to assure PORV reliability at TMI-1 are commensurate with safety functions associated with the PORV and block valve.

Principal Contributor: Ronald W. Hernan

Date: May 9, 1994