Public Service
Electric and Gas
Company

Stanley LaBruna

Vice President - Nuclear Engineering

Public Service Electric and Gas Company P.O. Box 236, Hancocks Bridge, NJ 08038 609-339-1700

JUL 25 1994

NLR-N94132

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Gentlemen:

10CFR21 NOTIFICATION, POWER OPERATED RELIEF VALVE (PORV) PLUG AND STEM MATERIAL
SALEM GENERATING STATION UNIT NO. 1
DOCKET NO. 50-272

Pursuant to the notification requirements of 10CFR21, Public Service Electric and Gas Co. (PSE&G) hereby provides the attached report regarding the valve stem and plug connection pinning collar area of Salem Unit 1 Power Operated Relief Valves (PORV) 1PR1 and 1PR2. This deficiency was reported to the NRC Operations Center on July 14, 1994.

Should you have any questions regarding this notification, please contact us.

Sincerely,

S. LaBruna

Attachment (1)

280104

JE19

JUL 25 1994

C Mr. T. T. Martin, Administrator - Region I
U. S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Mr. J. C. Stone, Licensing Project Manager - Salem
U. S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Mr. C. Marschall (S09)
USNRC Senior Resident Inspector

Mr. K. Tosch, Manager, IV
NJ Department of Environmental Protection
Division of Environmental Quality
Bureau of Nuclear Engineering
CN 415
Trenton, NJ 08625

ATTACHMENT 1

Introduction

The following is a summary of the results of PSE&G'S evaluation in accordance with 10CFR21 concerning a deficiency due to the cracking identified in the valve stem and plug connection pinning collar area on Unit 1 PORVs 1PR1 & 1PR2. The cause of this cracking has been attributed to either Intergranular Stress Corrosion Cracking (IGSCC) or hydrogen assisted cracking. The cracking in the pinning collar area could continue to propagate eventually resulting in the plug separating from the stem rendering the PORVs inoperable. The Unit 2 PORVs currently are provided with internals manufactured from 17-4 PH material, and therefore Unit 2 is not within the scope of this 10CFR21 evaluation.

Background

The reactor trip and inadvertent SI initiation that occurred on April 7, 1994 at Salem Unit 1 resulted in the two (2) pressurizer Power Operated Relief Valves (PORV) to cycle multiple times during the event. Subsequent inspection of the valve internals (plug, stem and cage) revealed cracks in the pinning collars of each of the two plugs, and significant unexpected wear and galling on the 1PR2 stem and plug. Following identification of the cracking, the 10CFR21 evaluation process was initiated on May 9, 1994. Inspection of spare valve internals located in the warehouse also revealed cracks in the pinning collar. The three sets of valve internals were examined by Westinghouse to determine the cause of the cracking. The subsequent investigation and examinations revealed that the cracks originated and grew primarily as a result of either intergranular stress corrosion cracking or hydrogen assisted cracking. It is noted that a fourth set of internals that had been installed in the plant for 1 week also revealed cracking.

The cause of the stress corrosion cracking was attributed to the following factors. The plug was manufactured from type 420 stainless steel and subjected to a 975°F tempering heat treatment. This caused the material to become sensitized reducing its corrosion resistance, and caused the material to become less ductile reducing its fracture toughness. A tapered fit between the stem and the plug caused hoop stresses to be exerted on the plug at the pinning collar. The combination of

the material condition and the hoop stresses were such that stress corrosion cracking occurred in a relatively short period of time, especially for the spare valve internals which had not seen actual service but only leak testing and environmental humidity while in storage. The investigation was unable to determine if the cracking would have arrested itself after some period of operation or continued to propagate.

The PORVs at Salem are 2" air operated-spring return valves supplied by Copes Vulcan, Inc.. The valves have a working pressure rating of 2485 psig at 680°F per ANSI B16.5 for 1500 lb. rating. The normal operating pressure for the PORVs is 2235 psig at 650°F. The PORVs are set to open at a pressure of 2335 psig and close at 2315 psig. The valve internals are comprised of the plug, stem and cage. The cage is a hollow cylinder surrounding the plug, and is provided with a number of flow ports which evenly distribute flow through the valve. The plug/stem assembly moves within the cage cylinder in response to open or close control signals to the actuator either opening or closing the cage flow ports. The plug is joined and secured to the stem through a conical threaded connection. At the top of the plug is an integral pinning collar. Following assembly of the plug/stem, a pinning hole is drilled through the plug collar and stem and a roll pin is inserted. In most cases, the pinning hole is drilled prior to heat treatment. It is at the pinning collar location where stress corrosion cracking occurred. Since both of the PORV plugs installed at Unit 1 (as well as the third and fourth plug assemblies utilized as spares) were constructed using the SS 420 material, a common mode type failure due to the plug cracks identified may have affected both PORVs. It is believed that should the cracks have continued to propagate through the plug, both PORVs could have been rendered inoperable in either the open or closed position.

Safety Evaluation

During design basis transients, the PORVs are utilized to prevent challenges to the pressurizer safety valves and provide RCS overpressure protection. The PORV(s) are assumed to be available or made available in the event of (a) the Inadvertent Safety Injection (SI) at Power transient and (b) the Low Temperature Overpressure Protection (LTOP) transient during shutdown. With the exception of these two transients, the pressurizer safety valves would be available to provide RCS overpressure protection

should the PORVs fail. Should the PORVs open and fail to close, the failed PORVs would be manually isolated by the PORV Block Valves to prevent a loss of reactor coolant.

The Inadvertent SI at Power transient [(a) above] credits the availability of the PORVs should the pressurizer become water solid to provide RCS overpressure protection. Since the pressurizer safety valves are not designed to relieve water under saturated conditions, and could potentially fail in the open position if the PORVs are unavailable during this transient, the transient could degrade from a Condition 2 event to a Condition 3 event. However, even in the event of a pressurizer safety failing in the open position, the consequences of this accident would still be bounded by the Small Break LOCA analysis results. Should the PORVs fail in the open position, PORV Block Valves can be closed to isolate the RCS and prevent coolant loss.

During (b) above, the PORVs lift setting is adjusted to a setpoint equal to or less than 375 psig when the RCS cold leg temperatures are less than 312°F during Mode 4 and Mode 5 to provide Low Temperature Overpressure Protection. The setpoint for the PORVs has been developed such that in the event of a mass input transient (i.e., the inadvertent start of a SI pump) or a heat input transient (i.e., the start of an idle RCP) with the RCS water solid, the Pressure-Temperature (P-T) limits calculated in accordance with 10CFR50, Appendix G and contained in Technical Specification 3.4.9.1 would not be exceeded. A minimum of one PORV should be available to mitigate these types of overpressure transients and maintain RCS pressure within P-T limits. Therefore, the failure of the PORVs to open due to the stress corrosion cracking identified could result in exceeding the P-T limits. It is based on this function of the PORVs that PSE&G has concluded that this deficiency could result in a substantial safety hazard, and is therefore reportable in accordance with 10CFR21.

Corrective Action

Prior to restart following the April 7 event, the Unit 1 PORV internals (plug and stem) were replaced with internals manufactured from SS 316 material with the plug stellited. The replacement cages were manufactured from 17-4 PH stainless steel.