January 30, 2003

MEMORANDUM TO: Loren R. Plisco, Director
Division of Reactor Projects
Region II

FROM: Ledyard B. Marsh, Deputy Director
Division of Licensing Project Management ***/RA/***
Office of Nuclear Reactor Regulation

SUBJECT: RESPONSE TO TASK INTERFACE AGREEMENT (TIA) 2002-04 - SAFETY/RELIEF VALVE OPERABILITY AT EDWIN I. HATCH NUCLEAR PLANT

In a memorandum dated September 6, 2002, you requested technical assistance from the Office of Nuclear Reactor Regulation (NRR) concerning certain safety/relief valves (SRVs) installed in both units of the Hatch Nuclear Plant (HNP). Specifically, you requested technical support to:

- evaluate the licensee's operability determination of four SRVs installed in both HNP units, and
- provide ongoing technical support to review the licensee's evaluation and corrective actions of the SRVs at HNP.

Technical staff from NRR have worked closely with Region II personnel to address the issues for which you requested technical support. As a result of these interactions, the licensee shut down HNP, Unit 1, in October of 2002 to replace three SRVs that were of concern. These valves were taken to an offsite facility for test and inspection. NRR, with support from Region II, developed an Information Notice (IN) on this issue (NRC IN 2002-03, "Failure of a Boiling Water Reactor Target Rock Main Steam Safety/Relief Valve"). On December 20, 2002, General Electric Nuclear Energy (GE) issued Service Information Letter (SIL) Number 646, "Target Rock Safety Relief Valve Failure To Fully Open." Details of NRR's response to your TIA are provided below.

Background

Each HNP unit has 11 Target Rock, two-stage, main steam SRVs. Each SRV consists of a main stage housing the main disc, stem, and piston, and a pilot stage used to actuate the main piston. HNP Technical Specification 3.4.3 requires that 10 of 11 SRVs shall be operable or the unit shall be in Mode 3 in 12 hours and Mode 4 in 36 hours.

An SRV installed in HNP, Unit 1, was determined to be leaking on April 19, 2002, following restart from a refueling outage. The SRV subsequently failed to seat during an exercise at rated reactor pressure. The unit was shut down, and the SRV was replaced with another SRV that had previously been removed during the refueling outage for planned testing and inspection at an offsite facility. A subsequent inspection of the failed SRV at Wyle Laboratories

(Wyle) revealed that the main disc had not seated properly. The integrity of the main stage piston/stem interface was compromised because the pre-load torque was lost to both the piston and stem nut, and the threaded connection between the piston and stem was found to be severely damaged. Loss of pre-load torque was also noted in a 1999 test failure of a different HNP main steam SRV conducted at Wyle. Details are included in the attached NRC IN.

Operability Determination

The operability determinations provided by HNP were determined by Region II personnel to be inadequate because HNP had not presented a comprehensive or strong enough case to justify concluding that all of the remaining SRVs were operable. Three specific SRVs on Unit 1 and one SRV on Unit 2 were identified as having the greatest concern because torque measurements on the main stage of each SRV had not been documented in at least 6 years. With three main steam SRVs inoperable on Unit 1, HNP would be required by its technical specifications to shut the unit down.

NRR personnel were asked to evaluate the licensee's August 2, 2002, operability determination and reached the same conclusion. As part of Region II's inspection effort, the licensee met with Region II and NRR personnel on August 20, 2002, to discuss the licensee's operability determination further. NRR and Region II staff concluded that the information provided by the licensee and the subsequent discussion at the meeting did not change the NRC's previous conclusion.

After subsequent discussions between Region II and Southern Nuclear Operating Company (SNC) senior management, HNP elected to shut down Hatch, Unit 1, on October 10, 2002, to replace the three SRVs of concern with three spare SRVs. The removed SRVs were transported to Wyle, where they were stroke-tested in their as-found condition. All three SRVs passed their stroke test. Inspections of the three SRVs were observed by Region II and NRR personnel on October 21-22, 2002. These inspections revealed a loss of torque to the main stage piston and stem nut threaded connections similar to the conditions observed previously. In addition, threads on one SRV were damaged, indicating the degradation mechanism that would lead to SRV failure had begun. However, based on the testing and inspection, NRR has concluded that with these minor degraded conditions, the SRVs were operable when they were removed.

Ongoing Technical Support

Based on the information obtained during the inspections at Wyle, NRR and Region II prepared an NRC IN, which is attached. All Target Rock two-stage and three-stage SRVs have similarly designed main stage components. Currently, there are 22 boiling water reactor plants in the U.S. that have two-stage and three-stage SRVs. The IN highlights the importance of periodic inspection of SRVs' main stage components to identify minor degradations early and to take any necessary corrective actions before the valve is rendered inoperable.

The industry is also responding to the findings at Wyle. SNC contracted for an independent evaluation by MPR Associates. This evaluation determined the root cause of the torque loss and thread damage to be manufacturing tolerances of the stem threads that prevent the piston from being adequately attached to the valve stem. GE has issued SIL Number 646 on this

issue. Target Rock has implemented design and manufacturing changes to address the root cause of the torque loss and thread damage.

Conclusions

The operability determination provided to Region II personnel did not provide a definitive justification to conclude that the SRVs were operable. Subsequent testing and inspection by the licensee were able to support a conclusion that the SRVs in question were operable. The NRC has issued IN 2003-01 on this issue. The industry provided information to affected facilities via GE SIL No. 646. Therefore, the issues raised in TIA 2002-04 have been addressed. Licensees with affected facilities should be aware of this issue and monitor actions at their facilities as appropriate.

Please contact Joe Colaccino at (301) 415-2753, if you have any questions.

Docket Nos. 50-321 and 50-366

Attachment: NRC IN 2002-03

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Docket Nos. 50-321 and 50-366

Attachment: NRC IN 2002-03

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, DC 20555-0001

January 15, 2003

NRC INFORMATION NOTICE 2003-01: FAILURE OF A BOILING WATER REACTOR TARGET ROCK MAIN STEAM SAFETY/RELIEF VALVE

Addressees

All holders of operating licenses or construction permits for nuclear power reactors, except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to a recent failure of a main steam safety/relief valve on a boiling water reactor (BWR). The NRC anticipates that recipients will review the information for applicability to their facilities and consider taking appropriate actions. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

In April 2002, following a Unit 1 refueling outage at the Hatch Nuclear Plant, the safety/relief valve (S/RV) in the 1J location began leaking. In an effort to stop the assumed pilot valve leakage, the licensee cycled the S/RV at rated pressure and temperature. The valve failed to fully open and then failed to reseat. The licensee continued the startup to allow identification of potential balance-of-plant leakage. During the balance-of-plant startup, the associated S/RV vacuum breaker failed due to repeated cycling**,** resulting in high unidentified drywell leakage. The plant was shut down when the leakage exceeded the technical specification allowable leakage (reference LER 50-321/2002-002).

The S/RVs installed in Unit 1 are Target Rock two-stage S/RVs. The main stage valve internals (shown in attached Figure 1) are assembled by screwing the main piston onto the main stem so that the piston moves inside the guide, installing a locking tab washer, and installing the stem nut against the washer's locking tab. The piston is torqued to 100 ft-lbs, the stem nut is torqued to 50 ft-lbs, and the locking tab is bent to capture the stem nut. During the S/RV inspection after the April 2002 shutdown, the failed valve was found to have a .003-inch clearance between the main disc and its seat. When the valve was disassembled, the stem nut and the

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Attachment

piston were found to be loose. The stem nut was removed by hand and the piston was also unthreaded by hand from the stem. However, the threads on the stem were severely damaged. The piston was unthreaded by working it up to the good threads under the stem nut and threading it onto this portion of the stem. The inside of the guide was heavily grooved and was also worn by the piston edge wearing on the guide. The piston was visibly cocked on the valve stem.

In an earlier event in 1999, the licensee had a different S/RV fail on the test stand. This failure occurred during the fourth valve actuation when the stem nut fell off the stem and jammed in the preload spring coils. The resulting uneven force caused the piston to cock in the guide. The stem nut had lost torque and came unscrewed from the stem threads in spite of the locking tab. Following this failure, the licensee instituted a program to check the torque on both the stem nut and the piston. The licensee found in most cases, both the stem nut and the piston had lost torque.

Following the failure of the 1J S/RV, the licensee closely examined three valves which had been removed during the April 2002 refueling outage. The stem nuts and pistons of all three valves had lost torque, the stems of two of the valves showed significant wear on the valve threads, and one valve exhibited some thread wear. All three valves showed signs of damage on the stem shoulder, which is designed to contact the piston. In October 2002, the licensee removed three additional S/RVs from Unit 1 for testing, disassembly, and inspection. All three valves successfully stroked with steam pressure but when disassembled and inspected, were found to have lost torque on both the stem nut and the piston. Two valves had fairly good threads and the final valve (1F) had significant thread damage and a visibly cocked piston. All three valve stems showed varying degrees of damage in the shoulder area.

The licensee believes the loss of torque and damage of the valve internals can be attributed to the manufacturing tolerances of the valve stem and piston and to the lengthy service time without adequate inspection and maintenance. The valve is designed so the valve stem screws into the piston. The stem has a shoulder that seats against the piston shoulder. For the valves that show little to no thread damage, the stem apparently seats properly against the piston and most of the valve actuation force is carried by the stem and piston shoulders. For the valves with thread damage, the licensee believes that the end of the lead thread of the piston contacts the fillet that is machined into the shoulder of the valve stem. As shown in Figure 1, when this occurs, the shoulder of the stem does not properly seat against the shoulder of the piston. Thread damage starts with the first actuation on the test stand, resulting in a loss of torque. Over time, vibration from normal plant operations causes fretting and wear of the valve stem shoulder and threads. The piston rocks in the guide and wears grooves where the piston rings contact the guide. Eventually the piston could significantly cock on the stem and wedge in the guide during valve actuation, which would prevent proper opening or closing of the valve. The licensee has not been able to determine the time in operation required to damage a valve to the point of failure. The licensee believes the failed 1J valve and the damaged 1F valve were in service for approximately 20 years without maintenance. The licensee is currently removing several S/RVs during each plant outage to ensure that all installed S/RVs are inspected and maintained at least every 6 years. There are 11 S/RVs installed in each unit.

Discussion

As the result of the 1J valve failure, the licensee performed a root cause analysis following the event and contracted an independent engineering firm to perform a separate root cause analysis. The licensee believes that the failure of the S/RV is related to the manufacturing tolerances of the valve stem and piston assembly and to the lengthy service time without adequate inspection and maintenance. The independent root cause analysis determined that the lead thread of the piston was contacting the fillet of the shoulder, preventing shoulder-to-shoulder contact. Since the piston was not adequately attached to the stem, operational vibration and valve actuation caused thread damage and eventual valve failure. The valve vendor (Curtiss Wright Flow Control Corporation) has developed changes to the inspection and refurbishment procedures to ensure proper shoulder-to-shoulder contact during valve assembly. The BWR vendor (GE Nuclear Energy) is issuing a Service Information Letter (SIL) to address the degradation found in the Hatch S/RVs.

The above-described circumstances emphasize the importance of periodic inspection of S/RV main stage components to identify deficiencies and necessary corrective actions. All Target Rock two-stage and three-stage S/RVs have similarly designed main stage components. Currently 11 BWR plants in the U.S. have two-stage S/RVs, and 11 BWR plants have three-stage S/RVs.

The above described problems found in the main stages of Target Rock S/RVs are not related to the problems found previously in the pilot stages of the S/RVs that were discussed in Regulatory Issue Summary 2000-12, “Resolution of Generic Safety Issue B-55.”

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

/RA/
William D. Beckner, Program Director
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Office of Nuclear Reactor Regulation

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Attachments: 1. Figure 1 - Target Rock Safety/Relief Valve
2. List of Recently Issued NRC Information Notices

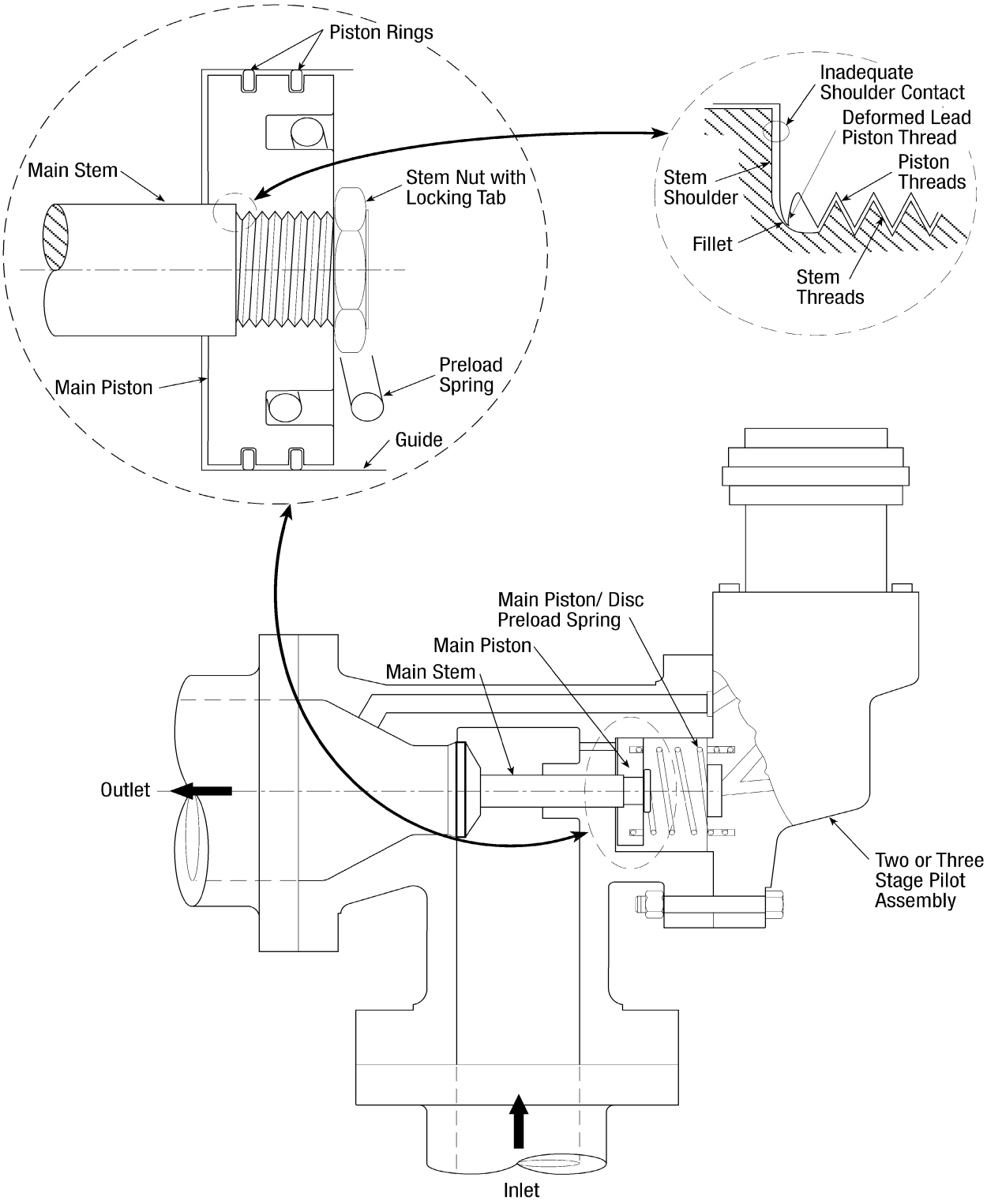

Figure 1 Target Rock Safety/Relief Valve