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NYN-93027

February 17, 1993

United States Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Document Control Desk

Reference: Facility Operating License No. NPF-86, Docket No. 50-443

Subject: Licensee Event Report (LER) 92-026-00: Voluntary LER 92-026, Bolting Failures in Xomox Tufline Valves

Gentlemen:

Enclosed please find Licensee Event Report (LER) No. 92-026-00 for Seabrook Station. This submittal documents an event which occurred on July 14, 1992. This LER is being submitted as a voluntary LER by North Atlantic Energy Service Corporation.

Should you require further information regarding this matter, please contact Mr. James M. Peschel, Regulatory Compliance Manager, at (603) 474-9521, extension 3772.

Very truly yours,

Ted C. Feigenbaum

TCF:EWM/act

Enclosures: NRC Forms 366, 366A

220062

IE22

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NRC FORM 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 5/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Seabrook Station	05000443	1 OF 4

TITLE (4) Voluntary LER 92-26, Bolting Failures in Xomox Tufline Valves

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
07	14	92	92	026	00	02	12	93	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	100	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	X OTHER
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	(Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Mr. James M. Peschel, Regulatory Compliance Mgr.	(603) 474-9521 Ext 3372

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
B	CB	V	X002	Yes						

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

This LER is being submitted as a voluntary LER by North Atlantic Energy Service Corporation.

On July 14, 1992, Seabrook Station maintenance personnel were performing work on Chemical Volume Control System [CB] demineralizer 2A resin sluice discharge valve, CS-V-93, when it was discovered that three of the four cover bolts had fractured. This bolting configuration caused the valve bonnet to loosen and become cocked. The demineralizer was isolated and a temporary strongback device was installed on the valve to prevent the plug from being ejected. As a result of this failure, plant walkdowns of similar valves were performed. It was discovered that two additional valves, CS-V-252 and CS-V-742, in close proximity to CS-V-93 each had two fractured cover bolts. CS-V-93 and CS-V-252 are safety related, ASME Class 3 valves, and CS-V-742 is a non-nuclear safety valve. All three valves are three inch stainless steel Xomox [V, JO2] Tufline plug valves which are manually operated with remote reach rods. Valves, CS-V-93, CS-V-252, and CS-V-742, are physically located in the Primary Auxiliary Building [NF] demineralizer alley.

There were no adverse safety consequences as a result of this event. No radioactive effluents were released to the environment.

The root cause of the bolting failures was determined to be due to high material hardness which caused the material to become more susceptible to stress corrosion cracking. The station environment provided the necessary moisture for initiation and propagation of the bolt stress cracking. The normal bolt torquing tensile stresses have been determined to be sufficient to contribute to intergranular stress corrosion cracking.

North Atlantic has replaced bolting on a total of 158 Xomox Tufline plug valves which had Grade B6 Type 410 stainless steel cover bolts. This total consists of 64 ASME Safety Class 2 and 3 valves and 94 non-nuclear safety related valves.

EVENT DESCRIPTION

On July 14, 1992, Seabrook Station maintenance personnel were performing work on Chemical Volume Control System [CB] demineralizer 2A resin sluice discharge valve, CS-V-93, when it was discovered that three of the four cover bolts had fractured. This bolting configuration caused the valve bonnet to loosen and become cocked. The demineralizer was isolated and a temporary strongback device was installed on the valve to prevent the plug from being ejected. As a result of this failure, plant walkdowns of similar valves were performed. It was discovered that two additional valves, CS-V-252 and CS-V-742, in close proximity to CS-V-93 each had two fractured cover bolts. CS-V-93 and CS-V-252 are safety related, ASME Class 3 valves, and CS-V-742 is a non-nuclear safety valve. All three valves are three inch stainless steel Xomox Tufline plug valves which are manually operated with remote reach rods. Valves, CS-V-93, CS-V-252, and CS-V-742, are physically located in the Primary Auxiliary Building demineralizer alley.

North Atlantic conducted the following investigations to determine the cause of the bolting failures:

Initial Bolting Failure Survey

North Atlantic Energy Service Company (North Atlantic) developed an inspection program to determine the extent of the problem and to make replacement recommendations. This program performed a preliminary inspection of all safety and selected non-safety related Xomox [X002] Tufline plug valves. Specific inspection attributes included a characterization of the valve service environment, cover bolt markings, and as-found condition. A total of 158 valves were visually inspected including 64 ASME Safety Class 2 and 3 valves, and 94 non-nuclear safety valves. The results of this inspection identified a total of 7 bolting failures.

Failure Characterization

The failed cover bolts from CS-V-93 were subjected to an alloy assay and a bench hardness test in the station laboratory and provided to Yankee Atomic Electric Company for supplementary examination. In order to further quantify the bolting material properties one bolt from each selected valve was visually inspected for general surface condition, and tested for hardness and alloy composition. The North Atlantic testing program performed bolt inspection on 94 bolts from both safety related and non-nuclear safety valves. United Engineers & Constructors (UE&C) [U080] was contracted to perform detailed material analysis on some of the Xomox plug valve cover bolts and to confirm the results of the station testing program. The UE&C material evaluation consisted of macroscopic and microscopic examinations, Rockwell C hardness testing, scanning electron microscopy and electron dispersion x-ray analysis on 23 cover bolts.

Bolt Failure Analysis Results

The results from both the North Atlantic and UE&C metallurgical analytical procedures confirmed that the cover bolting is SA/A 193, Grade B6, (Type 410 stainless steel) with a Rockwell-C hardness ranging between 27 and 39. Metallurgical examinations performed by UE&C concluded that in all cases the material failure mechanism was attributed to intergranular stress corrosion cracking (IGSCC). This conclusion is based on the following known conditions; 1) normal bolting torque stresses provided sufficient tensile stress to contribute to IGSCC, 2) high as-found material hardness (Rockwell-C 27 to 39), and 3) the normal service environment in the station provided the necessary combination of factors to cause these bolt fractures.

In addition, the cause or initiating mechanism was in all cases determined to be the high hardness properties of the Type 410 bolting material which most likely resulted from inadequate tempering of the material. AISI Type 410 martensitic stainless steel is sensitive to the tempering process. Increased susceptibility to stress corrosion cracking will result from excessive material hardness if the material is not properly tempered. Inadequate tempering of Type 410 material by itself will not cause bolt failures but in conjunction with applied and or residual internal stresses in certain service environments will greatly increase this materials susceptibility to degradation.

The North Atlantic testing program performed bolt hardness testing on 94 of the 158 affected Xomox Tufline plug valves, where one cover bolt from each valve was hardness tested. Seventy-four of these bolts were found to have high hardness properties in the range of Rockwell-C 27 to 39. The hardness of this Type 410 stainless steel bolt was found to be greater than the Rockwell-C 26 maximum recommended by recent industry reports. These high hardness properties are indicative of Type 410 material which has been tempered between 496 and 579 degrees Celsius (925 and 1075 degrees Fahrenheit). These tempering temperatures were below the minimum 593 degrees Celsius (1100 degrees Fahrenheit) tempering temperature required by the SA/A 193 material specification.

CORRECTIVE ACTIONS

Cover Bolting Replacement Program

The original plug valve purchase specification and the Xomox vendor manual required that the valve cover bolting meet SA or A 193 Grade B5 AISI Type 410 stainless steel material requirements depending if the material was being supplied as safety related or non-safety related respectively. North Atlantic evaluated alternate cover bolting materials that would be more resistent to stress corrosion cracking given the station service environment and system stress conditions. Alternate bolting material SA 564, Type 630 condition 1150 stainless steel was selected as the replacement bolting for installed Xomox Tufline plug valves. This material would provide the required mechanical properties and improved resistance to stress corrosion cracking. Since the initial bolt failure mechanism was identified as condition induced, all Xomox plug valves that met similar plant conditions and perform a safety related function were identified for cover bolt replacement.

The bolts in 158 Xomox Tufline plug valves with Grade B6 (Type 410 stainless steel) cover bolts were replaced with SA 564 Type 630 condition 1150 stainless steel bolts. In addition, non-nuclear safety Xomox Tufline plug valves with similar bolting material have been identified. The replacement of these valve cover bolts will be based on failure trending, and field inspections.

Future Material Procurement

Since the susceptibility of the Type 410 material to IGSCC is directly related to the hardness of the material, future procurements will require the material to be furnished and certified with a maximum Rockwell-C hardness of 26.

Training

During quarterly Engineering Support Training sessions, the topic of stress corrosion cracking mechanism as it relates to AISI Type 410 stainless steel material will be discussed.

ADDITIONAL INFORMATION

A review of other relevant information regarding IGSCC was performed. The Nuclear Resources and Management Council (NUMARC) presented a report which contains concerns associated with stress corrosion cracking of Type 410 stainless steel material in nuclear power plant environments. The report concluded that this type stainless steel is more susceptible to stress corrosion cracking and is sensitive to heat treating temperatures. This material has a definite relationship between heat treatment temperature and the materials hardness.

Northeast Utilities reported to the NRC, on May 11, 1990 (Millstone Nuclear Power Station #3 Findings and Potential Concerns Regarding Tufline Plug Valves) similar bolting failures at Millstone Unit 3 regarding Xomox Tufline plug valves. The failures were identified in non-safety related systems also which used Type 410 stainless steel bolting material. It was hypothesized that external contamination and wetting of the lubricant may have been responsible for the cracking. The lubricant identified was not tested or certified for low halogen content.

Both of these references were previously reviewed, and were rereviewed subsequent to the failures addressed in this LER. Neither of these reports provided any new information.

SAFETY CONSEQUENCES

There were no adverse safety consequences as a result of this event. However, a breach of the pressure boundary of CS-V-93 resulting from fractures of all four cover bolts potentially existed. Consequences of this breach would have resulted in emptying spent resin contents of the demineralizer on to the floor of the Primary Auxiliary Building. Given the system breach a dose rate determination was performed by the Health Physics Department. It was determined that radiation exposure to personnel in the Primary Auxiliary Building would be in excess of 25 rem. The resin spill would be contained within the Primary Auxiliary Building which has general area ventilation and radiation monitoring systems. The exhaust air from this area would be routed through a high efficiency cleaning filter before being discharged through the unit plant vent. Area radiation monitors would alarm to alert operators and personnel of this condition.

ROOT CAUSE

The root cause of all the cover bolt failures was determined to be due to high material hardness. This caused the material to become more susceptible to intergranular stress corrosion cracking. The Station service environment provided the necessary atmosphere for initiation and propagation of the bolt failures. The normal tensile stresses resulting from bolt torquing have been determined to be sufficient to contribute to intergranular stress corrosion cracking.

PLANT CONDITIONS

At the time of the identification of this condition the plant was in MODE 1 and operating at 100% power.

PREVIOUS OCCURRENCES

In 1987, SA 193 Grade B6 (Type 410) stainless steel cover bolts for two safety related Xomox Tufline plug valves in the Service Water System [BI] were found broken. The bolt failure was determined to be caused by severe rusting and the bolts were replaced with Grade B8 (Type 304) stainless steel cover bolts as recommended by the Xomox Corporation. The failure was determined to be an isolated case.

In 1992, during normal maintenance activities on the spent fuel pool pump 10A [DA] one of the casing studs fractured during tightening operations. The stud was found to be made from SA 193 Grade B6 (Type 410) stainless steel and was initially found covered with boric acid. A laboratory analysis of the stud found that the bolt exhibited a Rockwell-C hardness of 31 and concluded that the stud fracture mechanism was IGSCC which caused from boric acid contamination from the system process fluid. All of the casing studs were replaced with SA 564 Grade 630 Condition H1100 studs. This case is still under investigation.