North Atlantic

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The Northeast Utilities System

May 7, 1997

Docket No. 50-443
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United States Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, D.C. 20555

Seabrook Station
Licensee Event Report (LER) 97-006-00
Non-Conservative Fuel Handling Accident Analysis Assumptions

Enclosed, please find Licensee Event Report (LER) No. 97-006-00 for Seabrook Station which was identified on April 7, 1997. This event is being reported pursuant to 10 CFR 50.73(a)(2)(v).

Should you require further information regarding this matter, please contact Mr. Terry L. Harpster, Director of Licensing, at (603) 773-7765.

Very truly yours,

NORTH ATLANTIC ENERGY SERVICE CORP.

Ted C. Feigenbaum
Executive Vice President and
Chief Nuclear Officer

IE22

cc: H. J. Miller, Regional Administrator
A. W. De Agazio, NRC Project Manager, Seabrook Station
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NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

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

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TITLE (4)

NON-CONSERVATIVE FUEL HANDLING ACCIDENT ANALYSIS ASSUMPTIONS

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
04	07	97	97	006	00	05	07	97	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	100	20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)
		20.2203(a)(1)	20.2203(a)(3)(i)	50.73(a)(2)(ii)	50.73(a)(2)(x)
		20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
		20.2203(a)(2)(ii)	20.2203(a)(4)	50.73(a)(2)(iv)	OTHER
		20.2203(a)(2)(iii)	50.36(c)(1)	X 50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
		20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Allen L. Legendre, Jr., Nuclear Licensing Supervisor	(603) 773-7773

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

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION	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)

On April 7, 1997, North Atlantic Energy Service Corporation (North Atlantic) initially determined that a potential fuel handling accident in Containment could result in radiological consequences to Control Room personnel being more severe than currently described in the Seabrook Station Updated Final Safety Analysis Report (UFSAR). The current UFSAR assumption for a fuel handling accident inside containment assumes that the accident takes place near the center of the refueling cavity or approximately 10 feet from the Containment Air Purge (CAP) exhaust duct. However, irradiated fuel assemblies are routinely moved in close proximity to the CAP exhaust ducts. Under these circumstances the CAP containment isolation valves may not have sufficient time to close before contaminated gas was released from Containment. A dropped fuel assembly adjacent to the CAP exhaust duct and operating exhaust fan would essentially result in the activity being released prior to the automatic isolation of the 36 inch butterfly valves. North Atlantic reported this condition to the NRC on April 7, 1997, pursuant 10CFR50.72(b)(1)(ii)(B) as "a condition that is outside the design basis of the plant." Subsequent evaluations concluded that doses to control room personnel remained within UFSAR and General Design Criteria 19 limits. However, this more limiting fuel assembly drop location could represent "a condition that alone could have prevented the fulfillment of the safety function of structures or systems that are needed to control the release of radioactivity." This condition is reportable pursuant 10 CFR 50.73 (a)(2)(v)(C).

The apparent cause of this event was determined to be due a non-conservative assumption in the Fuel Handling Accident analysis. This is a knowledge-based error that is due to insufficient site-specific knowledge of fuel handling operations.

North Atlantic has reevaluated the Control Room Makeup Air and Filtration System (CBA) Chapter 15 accident analysis and concluded the projected dose rates to control room personnel will remain less than GDC 19 and UFSAR limits. North Atlantic reviewed the Fuel Handling Accident Analysis for the Fuel Storage Building for potential similar non-conservative assumptions. Additionally, North Atlantic is evaluating corrective action options to be implemented prior to refueling operations during Seabrook Station's upcoming refueling outage.

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TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

I. Description of Event

On April 7, 1997, North Atlantic Energy Service Corporation (North Atlantic) initially determined that a potential fuel handling accident in Containment could result in radiological consequences to Control Room personnel being more severe than currently described in the Seabrook Station Updated Final Safety Analysis Report (UFSAR). North Atlantic reported this condition to the NRC on April 7, 1997, pursuant 10CFR50.72(b)(1)(ii)(B) as "a condition that is outside the design basis of the plant." Subsequent evaluation concluded that the doses to control room personnel remained within UFSAR and General Design Criteria (GDC) 19 limits. However, this more limiting fuel assembly drop location could represent "a condition that alone could have prevented the fulfillment of the safety function of structures or systems that are needed to control the release of radioactivity. " This condition is reportable pursuant 10 CFR 50.73 (a)(2)(v)(C).

The Fuel Handling Accident analyses for Seabrook Station are described in Section 15.7.4 of the UFSAR. The UFSAR describes the most limiting fuel handling accident as a dropped spent fuel assembly in containment that results in the rupture of all 180 fuel rods in the assembly. This accident assumes the Containment personnel air lock doors and a steam generator sludge lance penetration are open during the event, with all activity from the ruptured fuel assembly being released over a two hour period. The current UFSAR assumption for a fuel handling accident inside containment assumes that the accident takes place near the center of the refueling cavity or approximately 10 feet from the Containment Air Purge (CAP) [VA] exhaust duct. The analysis calculates that the gases from the damaged fuel assembly take approximately 30 seconds to reach the CAP exhaust ducts at the sides of the cavity. Considering this assumption, the CAP containment isolation valves are credited as closing before a radiation release can occur.

However, irradiated fuel assemblies are routinely moved in close proximity to the CAP exhaust ducts. In addition, dropped fuel assemblies could conceivably rest against the refueling cavity walls and release gas directly into the exhaust ducts. Under these circumstances the CAP containment isolation valves may not have sufficient time to close before contaminated gas releases from Containment. A dropped fuel assembly adjacent to the CAP exhaust duct and operating exhaust fan would essentially result in the activity being released prior to the automatic isolation of the 36 inch butterfly valves. Thus, a dropped fuel assembly in a refueling cavity location adjacent to a CAP system exhaust duct results in an instantaneous unfiltered radiological release via the plant vent system.

North Atlantic's initial evaluation of this more limiting drop location concluded that the radiological consequences to Control Room personnel were more severe than currently analyzed in UFSAR Section 15.4.7. The UFSAR currently specifies the containment fuel handling accident Control Room thyroid dose as 6.7 REM and whole body dose as 0.3 REM. North Atlantic engineering personnel initially estimated that the Control Room thyroid dose would approach 100 REM and the whole body dose would approach the General Design Criterion (GDC) 19 limit of 5 REM. The Exclusion Area Boundary (EAB) thyroid and whole body doses were estimated to increase slightly but would still remain well within 10 CFR Part 100 limits.

The Control Room Makeup Air and Filtration System (CBA) [VI] Chapter 15 accident analysis assumed the initial bypass of the CBA filtration system. It was thought that the CBA radiation monitors, located in each of the remote air intakes, would not initiate the CBA isolation prior to the release being drawn into the Control Room. Further analyses were performed which took credit for actual ductwork configurations and radiation detector response times. It was concluded that the Control Room will be isolated prior to the release entering the Control Room, resulting in filtration of radioactive release. Based on this, the projected dose rates to control room personnel will remain less than GDC 19 and UFSAR limits. This conclusion is supported by Yankee Atomic

Electric Company calculation and documented in YAEC memorandum dated May 6, 1997. The memorandum concludes that the CBA system remains within its GDC design basis. However, this more limiting fuel assembly drop location could represent "a condition that alone could have prevented the fulfillment of the safety function of structures or systems that are needed to control the release of radioactivity. " During refueling operations, the safety function of the CAP isolation valves is to limit the potential release from the containment following a postulated accident. This condition is reportable pursuant 10 CFR 50.73 (a)(2)(v)(C).

II. Cause of Event

The non-conservative assumption in the fuel handling accident analysis (Ref. Calculation SBC-669, UFSAR Section 15.7.4.3) has existed since at least 1977. A memo from Yankee Atomic Electric Company (YAEC) memo, dated Aug. 12, 1977, responded to concerns by Westinghouse and the NRC with respect to the hypothetical fuel handling accident in Containment. The memo states that, "Since the majority of fuel handling operations will be conducted at the center of the refueling cavity, it is valid to assume that radiological releases occur near the center of the refueling cavity."

The majority of fuel handling operations take place along the west side of the refueling cavity, in close proximity to the CAP exhaust ducts. Since this is the area where fuel assemblies are moved in close proximity to underwater structures associated with the upender, and the area where fuel assemblies are routinely lowered out of and released from the grippers in the refueling machine mast, the potential for an accident here cannot be excluded from consideration.

The apparent cause of the non-conservative assumption in the Fuel Handling Accident analysis is a knowledge-based error, due to insufficient site-specific knowledge of fuel handling operations. The extent of the condition is limited to the accident analysis for the Containment building.

III. Analysis of Event

North Atlantic has performed an evaluation of the more limiting drop location and has concluded that the radiological consequences to Control Room personnel are within the limits currently analyzed in UFSAR Section 15.4.7. The UFSAR currently specifies the containment fuel handling accident Control Room thyroid dose as 6.7 REM and whole body dose as 0.3 REM. Dose estimates of the Exclusion Area Boundary thyroid and whole body increase slightly but would still remain well within 10 CFR Part 100 limits.

A dropped fuel assembly within the refueling canal would most likely be caused by a malfunction of the refueling machine. The refueling machine is used to transport fuel back and forth between the fuel transfer system and the reactor vessel core. Design features specific to the refueling machine provide sufficient reliability and safety margin makes a dropped spent fuel assembly a highly unlikely event. The refueling machine design includes several provisions to ensure safe handling of fuel assemblies. Operations that could endanger the operator or damage the fuel are prohibited by mechanical or fail-safe electrical interlocks, or by redundant electrical interlocks.

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The mast on the refueling machine consists of an outer stationary mast with a retractable inner mast. Grippers on the end of the inner mast engage on the inside rim of a fuel assembly top nozzle and draw the entire fuel assembly up inside the stationary outer mast. The inner mast, also called the gripper mast, is aligned and guided inside the stationary mast by a series of guide rollers mounted inside the stationary mast. When transporting a fuel assembly, the gripper assembly at the end of the gripper mast is seated on top of the fuel assembly to be moved. The gripper fingers, which are normally retracted into the gripper assembly, reach out and engage on the inside rim of the fuel assembly top nozzle. The guide tube and the entire fuel assembly are then raised up into the stationary mast. The gripper actuators operate by air cylinders located on the top of the gripper mast. Air is supplied to the grippers to disengage, which ensures fail safe operation. The air cylinders cannot supply sufficient force to disengage the grippers while supporting the weight of a fuel assembly. In addition, an electrical interlock prevents air from being supplied when the gripper is supporting the weight of a fuel assembly.

Furthermore, thorough operational checks and periodic inspections ensure continuing equipment operability. Although the refueling machine is not "safety related," close controls exist for its maintenance, checkout and operation. Additionally, strict administrative controls are maintained over refueling activities, including having a senior reactor operator present during all fuel movements whose sole responsibility is to control the refueling operation. This combined with procedural control and training should greatly reduce the possibility of such an event at Seabrook Station.

IV. Corrective Action

North Atlantic reevaluated the Control Room Makeup Air and Filtration System (CBA) Chapter 15 accident analysis which credited the initial bypass of the CBA filtration system. This evaluation concluded the projected dose rates to control room personnel will remain less than GDC 19 and UFSAR limits. This conclusion is supported by Yankee Atomic Electric Company calculation and is documented in YAEC memorandum dated May 5, 1997.

Furthermore, North Atlantic reviewed the Fuel Handling Accident Analysis for the Fuel Storage Building, as described in UFSAR Section 15.7.4.3.b, for potential similar non-conservative assumptions. This review of the analysis for the Fuel Handling Accident Analysis for the Fuel Storage Building concluded that there were no non-conservative assumptions concerning the physical arrangement of ductwork, or air mixing mechanisms.

North Atlantic is currently evaluating corrective action options to be implemented prior to refueling operations during Seabrook Station's upcoming refueling outage that is scheduled to commence on May 10, 1997. These options may involve physical modifications to the CAP system and/or analysis changes.

V. Additional Information

The containment pre-entry purge and refueling purge and heating (CAP) system functions to reduce airborne activity limits in containment below 10 CFR Part 20, Appendix B limits within 24 hours of a reactor shutdown and maintains tritium levels and containment minimum temperature within acceptable limits during refueling operations. A continual supply of 40,000 cfm of outdoor air is supplied to containment during these periods.

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TEXT CONTINUATION

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The CAP system is not required or permitted to be operated during plant operational Modes 1,2,3,or 4. During all modes of plant operation, both penetrations are provided with inside and outside containment isolation valves in accordance with the requirements of General Design Criterion 56 of 10 CFR Part 50, Appendix A.

CAP-V1, CAP-V2, CAP-V3 and CAP-V4 are located in the system piping to effect containment closure during Modes 5 and 6, when required. The valves are ASME Code Class 2, Seismic category I, and are vital to the integrity of the containment structure. All four isolation valves will automatically close immediately following a containment ventilation isolation signal, or a containment high radiation signal from the plant Protection System. Currently the required isolation stroke time for these valves is 3 seconds.

The basis for the existing containment isolation design is discussed in the Seabrook Station Safety Evaluation Report (SER) section 15.7.4.1, 'Fuel Handling Accident in Containment' is as follows:

> " Redundant radiation monitors located on the manipulator crane will alarm on high radioactivity and automatically secure the containment purge. Therefore, any radioactive gases released from the surface of the refueling pool inside containment will initiate closure of the containment purge valves. Because (1) the response time of the containment isolation valves is less than 10 seconds (in accordance with the Technical Specifications), (2) the travel time from the surface of the pool to the monitors is less than 10 seconds, and (3) the monitor response time is 0.6 seconds, the estimated time for the purge system isolation is assumed to be about 21 seconds. The estimated time available from the release of radioactive gas at the pool surface to the closure of purge system isolation valves is approximately 31 seconds; this estimate is based on air flow velocities and the fact that there is 90 ft of ductwork between the inlets and isolation valves."

The Fuel Handling manipulator crane is provided with radiation detectors RM-RM-6535A & RM-RM-6535B, which are located immediately above the surface of the refueling pool. The detectors are of the Geiger-Mueller type and are sensitive to gamma radiation. Since the radiation monitors measure gamma radiation, the travel time from the pool surface to the detectors is instantaneous. In the event of a fuel handling accident, gamma radiation would reach the detectors before the radioactive gas released by the damaged fuel assembly reached the pool surface.

Similar Events

This is the third LER at Seabrook Station associated with errors in UFSAR Chapter 15 accident analyses. North Atlantic reported similar design issues in LER 96-07-01 and LER 96-08.

Manufacturer Data

Not Applicable