North Atlantic

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The Northeast Utilities System

June 30, 1997

Docket No. 50-443
NYN-97073

United States Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington D.C. 20555

Seabrook Station
Licensee Event Report (LER) 97-009-00
Degraded Fuel Rods Identified in Westinghouse Fuel Assemblies

Enclosed, please find Licensee Event Report (LER) No. 97-009-00 for Seabrook Station for an event that occurred on May 31, 1997. This event is being reported pursuant to 10 CFR 50.73(a)(2)(ii).

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

Very truly yours,

NORTH ATLANTIC ENERGY SERVICE CORP.

Ted C. Feigenbaum
Executive Vice President and
Chief Nuclear Officer

cc: H. J. Miller, Regional Administrator
A. W. De Agazio, NRC Project Manager, Seabrook Station
W. T. Olsen, Senior Resident Inspector, Seabrook Station

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NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98

LICENSEE EVENT REPORT (LER)

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

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TITLE (4)

Degraded Fuel Rods Identified in Westinghouse Fuel Assemblies

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
05	31	97	97	009	00	06	30	97	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9):

POWER LEVEL (10):

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

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)	X 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)	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
X YES (If yes, complete EXPECTED SUBMISSION DATE).	NO		10	30	97

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

On December 10, 1996 Seabrook Station experienced a step increase in Reactor Coolant System (RCS)[AB] activity that was subsequently attributed to fuel cladding degradation. The increased activity levels were within Technical Specification allowable limits. Fuel sipping and ultrasonic testing during the refueling outage in May of 1997 identified five degraded fuel rods in four different fuel assemblies. The degraded fuel assemblies were Westinghouse Vantage 5H, with 128 Integral Fuel Burnable Absorber (IFBA) rods per assembly. The four degraded fuel assemblies had been in the core for one operating cycle. This condition was reported pursuant to 10 CFR 50.72(b)(2)(i) on May 31, 1997.

A root cause team evaluation concluded that there were four factors which contributed to the cladding degradation. The four factors were: core power history, operational strategy, axial offset caused by crud deposition and core design. These four factors are theorized to have combined to result in an interaction between the fuel pellet and cladding which caused the cladding degradation.

The four degraded fuel assemblies were replaced with new assemblies. The new assemblies and similar intact Vantage 5H, 128 IFBA assemblies were relocated to low power regions of the core. An extended Mode 4 RCS clean-up prior to start-up following the fifth refueling outage has been completed, and the RCS chemistry will be modified during Cycle 6. Both the extended cleanup and the RCS chemistry changes will reduce crud deposition on fuel rod cladding surfaces early in core life. The Cycle 6 core loading pattern will prevent long term power peaking in any one set of fuel assemblies.

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

I. Description of Event

On December 10, 1996, Seabrook Station experienced a step fold increase in Reactor Coolant System (RCS)[AB] activity that was subsequently attributed to fuel cladding degradation. Prior to this increase, RCS activity was just above measurable limits (between 1E-4 and 2E-5 microcuries per gram dose equivalent Iodine-131). On December 10, 1996, the Iodine-131 activity increased to greater than 1E-3 and continued to increase to approximately 1E-2 by the end of the operating cycle. The initial increased RCS activity spike was followed by additional spikes (single day increases) during the remainder of the operating cycle. The increased activity levels were within Technical Specification allowable limits.

Seabrook Station operated for the remainder of Cycle 5 and was shut down to conduct the scheduled fifth refueling outage (OR05) on May 10, 1997. During OR05, fuel sipping and ultrasonic testing identified five degraded fuel rods in four different fuel assemblies. Subsequent remote visual examination identified breaches of the cladding between grids 4 and 5 and between grids 6 and 7. There was also circumferential cracking between grids 4 and 5 and axial cracking between grids 6 and 7. The four fuel assemblies experiencing the fuel cladding degradation were Westinghouse Vantage 5H, with 128 Integral Fuel Burnable Absorber (IFBA) rods per assembly. The degraded fuel assemblies had been in the core for one operating cycle.

The five degraded fuel rods were removed from their respective assemblies along with ten intact fuel rods from similar locations in the assembly. Three of the five degraded rods broke near grid 4 when being removed or were broken prior to removal. The degraded fuel rods were reported pursuant to 10 CFR 50.72(b)(2)(i) on May 31, 1997.

II. Cause of Event

North Atlantic assembled a root cause team consisting of personnel from North Atlantic, Westinghouse and Yankee Atomic Electric Company. A final conclusive root cause of the degraded fuel rods is dependent upon further inspections and analysis. However, North Atlantic has concluded that the most likely cause of the fuel cladding degradation is a combination of four factors. These four factors are: power history, operational strategy, crud deposition on the upper regions of the fuel rods and core design. It is theorized that these four factors combined and produced a pellet clad interaction.

The first factor contributing to the fuel rod degradation was the power history of the assemblies with degraded fuel rods. These assemblies carried a higher power load relative to the average assembly power load. The fuel assemblies with degraded rods operated at power levels as much as 35% higher than the average assemblies and maintained their higher power level for most of the operating cycle.

The second factor contributing to the fuel rod degradation was the operational strategy employed in Cycle 5. The degraded assemblies were loaded in a pattern to allow for a longer operating cycle. This strategy was discussed with and agreed with by the fuel vendor. The vendor fuel operating limitations and Technical Specifications were complied with during the cycle. It is theorized that the power peaking effect caused by the proximity of the degraded rods to fuel assembly guide tubes resulted in increased localized power peaking in certain fuel rods within the degraded assemblies.

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The third factor contributing to the fuel rod degradation was the axial offset caused by crud deposition on the upper regions of the fuel rods. This axial offset caused the affected rods to heat up in the upper region of the fuel and produce additional power in the grid 4 to grid 5 region of the degraded fuel rods.

The final factor contributing to the fuel rod degradation was the Cycle 5 core design. The rods that experienced the cladding degradation are IFBA fuel rods. IFBA fuel rods have a thin zirconium diboride coating applied directly to the fuel pellets and are manufactured with approximately 4.5 mills clearance between the fuel pellet and the cladding. Non IFBA rods have approximately 5.5 mills between the fuel pellet and the cladding. It is theorized that the reduction in symmetric clearance combined with the other three factors resulted in a pellet clad interaction which caused the cladding degradation.

North Atlantic is continuing to investigate the cladding degradation to reach a final determination on the degradation mechanism. At this time, debris induced degradation and grid to rod fretting are not considered to be causes of the degradation. Potential causes being investigated include crud induced subcooled boiling, internal fuel rod contamination and manufacturing defects.

III. Analysis of Event

The extent of fuel degradation from this event was less than the design values for the assumed failed fuel fraction as stated in Seabrook Station's Updated Final Safety Analyses Report (UFSAR) The degraded fuel is nearly ten times less than the lowest of the design values of failed fuel in the UFSAR. As such there were no safety consequences associated with the routine operation of the plant with the degraded fuel rods. The amount of the source term released from the degraded fuel into the RCS was within the capabilities of the radioactive waste management systems to collect and process without exceeding the radioactive release limits of 10 CFR 20 and within the guidelines of 10 CFR 50, Appendix I. Additionally, any hypothetical release following any postulated accident while the plant was operating with the degraded fuel rods would have been less than the 10 CFR 100 limits for radioactive releases.

IV. Corrective Action

The Cycle 6 core load design reduces long term power peaking in any one set of fuel assemblies. Some assemblies will see approximately the same level of power as the degraded fuel assemblies, but none will see this level of power for the extended time that the degraded fuel assemblies did in Cycle 5.

1. The four degraded fuel assemblies were replaced with four new assemblies with an enrichment appropriate for the next two cycles. The four new fuel assemblies as well as eight other once burned, Vantage 5H, 128 IFBA fuel assemblies were located in core regions where their average power will be lower than the assemblies which experienced the fuel cladding degradation during Cycle 5.

2. The fuel conditioning process was reevaluated prior to power operation following OR05. The Cycle 6 fuel pre-conditioning ramp rate was changed from 3% per hour to 2% per hour above 20% Rated Thermal Power.

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3. The Reactor Coolant System chemistry guidelines were modified to allow the Cycle 6 minimum beginning of life (BOL) pH to be increased from 6.9 to approximately 7.1. This value is within Westinghouse and EPRI guidelines and will minimize crud deposition on fuel rod cladding surfaces early in core life.

4. Prior to start-up following OR05, an extended Mode 4 Reactor Coolant System cleanup was completed to minimize crud deposition on fuel rod cladding surfaces early in core life.

5. The investigation of the cladding degradation will continue. A supplemental LER will be submitted providing the final evaluation of the cladding degradation.

V. Additional Information

None

Similar Events

None

Manufacturer Data

At the request of North Atlantic, Westinghouse's Fuel Operational Experience Group prepared a summary of the various fuel designs, enrichments, product features and fuel performance information over the last several years for Westinghouse fuel. Westinghouse compared Seabrook Station's core Hot Channel Factor ($F\Delta H$), maximum design hot full power, all rods out $F\Delta H$ and core average temperature to determine Seabrook's Cycle 5 fuel duty. Westinghouse concluded that by this measure, there are several cores that have operated at a combination of conditions that are comparable to those present in the Seabrook core during Cycle 5 without cladding degradation.