North Atlantic
Energy Service Corporation

SEABROOK STATION UNIT 1

Facility Operating License NPF-86
Docket No. 50-443

License Amendment Request No. 92-14
Incore Detector System

This License Amendment Request is submitted by North Atlantic Energy Service Corporation pursuant to 10CFR50.90. The following information is enclosed in support of this License Amendment Request:

- Section I - Introduction and Description of Proposed Changes
- Section II - Markup of Proposed Changes
- Section III - Retype of Proposed Changes
- Section IV - Safety Evaluation of Proposed Changes
- Section V - Determination of Significant Hazards for Proposed Changes
- Section VI - Proposed Schedule for License Amendment Issuance and Effectiveness
- Section VII - Environmental Impact Assessment

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Sworn and Subscribed
to before me this
25th day of November, 1992

Beverly E. Settergren
Notary Public

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Executive Director - Engineering & Licensing

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I. Introduction and Description of Proposed Changes

A. Introduction

The purpose of License Amendment Request (LAR) 92-14 is to revise the Seabrook Station Technical Specifications to allow the fixed incore detectors to be utilized to perform Technical Specification Surveillances. The Seabrook Station Incore Instrumentation System utilizes movable incore detectors, fixed incore detectors, and core exit thermocouples. The system consists of 58 thimble assemblies, each containing five fixed incore detectors, one chrome-alumel thermocouple, and a thimble tube for the movable incore detector.

These detectors and thermocouples provide information on the neutron flux distribution and fuel assembly temperatures at selected core locations. The data obtained from the Incore Instrumentation System, in conjunction with previously determined analytical information, is used to confirm the reactor core design parameters and calculate the hot channel factors.

The Seabrook Station Incore Instrumentation System is comprised of two complete and independent incore detector systems. The first, are the movable incore detectors which use movable fission chambers designed by Westinghouse for reactors similar to Seabrook Station. The second, are the fixed incore detectors which are self-powered fixed platinum detectors. The fixed and movable incore detectors were installed during plant construction.

Currently, incore power distribution measurements at Seabrook Station are required by Technical Specifications to be performed using the movable incore detectors. The movable incore detectors are movable fission chambers that are remotely positioned to provide flux mapping of the reactor core. The fission chambers are positioned in retractable guide thimbles inserted into the reactor core through conduits extending from the bottom of the reactor vessel. A total of 58 reactor core locations contain instrument thimbles. Each thimble is traversed by one or more of six movable fission chambers. The fission chambers consist of highly enriched uranium-oxide clad in stainless steel. Incoming thermal neutrons induce fission in the uranium-oxide producing an output signal proportional to the neutron flux.

The drive system for the movable incore detectors consists of the drive motor, mechanical transfer devices, and detector position transmitter. These components work together to route the movable incore detectors from their storage locations through the selected instrument thimble in the reactor core.

The measurement of incore flux, using the movable incore detectors, requires the six movable fission chambers to be passed through the reactor core at least 12 times. As the detector is passed through the reactor core the signals are collected and stored on the main plant computer as a neutron flux trace. Each detailed axial trace consists of 61 relative axial neutron flux measurements. These traces, which make up a flux map, are then processed by the INCORE-3 computer code[1] along with analytical predictions of detector reaction rates and the core-wide power distribution, to infer the measured power distribution and corresponding local peaking factors. The results from this processing are then compared to established limits to determine if the reactor core is operating within the limits specified in the Technical Specifications. The movable incore detectors are utilized during power ascension testing, and monthly to perform Technical Specification surveillances.

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[1]The INCORE-3 Program, WCAP-8402, March 1975, A.J. Harris and H.A. Jones

The fixed detectors used at Seabrook Station are self-powered, using platinum emitters, and yield a signal proportional to the incident gamma and neutron flux. The fixed incore detectors provide information on the gamma and neutron flux levels in the same 58 instrumented assembly locations within the reactor core utilized by the movable incore detectors. The fixed incore detectors consist of 58 detector strings. Each detector string contains five self-powered platinum detectors for a total of 290 detectors in the reactor core. Each detector string also has one thermocouple to measure core exit temperatures. The fixed incore detectors are spaced along the thimble to provide an axial representation of the reactor core power distribution. The strings are an integral part of the instrument thimble and are located in the same radial locations as the movable fission chambers. The radial locations of the instrument thimbles are shown in Figure 1. Figure 2 provides a depiction of an instrument thimble displaying the five fixed incore detectors, the thermocouple, and the path for the movable incore detector. The axial position of the fixed incore detectors in a typical detector string are depicted in Figure 3.

Once-per-minute, the Fixed Incore Detector Data Acquisition System (FIDDAS) collects and stores the signals from the 290 detectors. This information is utilized in conjunction with analytical predictions of the fluxes, to determine the incore three dimensional power distribution. Once the power distribution has been determined, the maximum local power peaking and hot channel factors can be derived and compared to established limits in a manner similar to the method used with the movable incore detectors.

An analysis of the fixed incore detectors was performed for North Atlantic by Yankee Atomic Electric Company (YAEC). The attached YAEC report, YAEC-1855P, "Seabrook Station Unit 1 Fixed Incore Detector System Analysis" provides the calculational method and uncertainty analysis for the fixed incore detectors. The calculational method includes the conversion of signal to power and the determination of Technical Specification surveillance parameters. The uncertainty analysis considers contributions from reproducibility, analytical methods and signal processing. The report also addresses detector operability and signal replacement. The conclusion of the report is that the fixed incore detectors are acceptable for performing power distribution surveillances currently performed by the movable incore detectors.

The proposed revision to the Technical Specifications will continue to require that the Incore Detector System be OPERABLE with at least 75% of the detector locations and a minimum of two detector locations per core quadrant OPERABLE. An OPERABLE incore detector location shall consist of a fuel assembly containing a fixed detector string with a minimum of three OPERABLE detectors or an OPERABLE movable incore detector.

Like the movable incore detectors, the fixed incore detectors will be verified to be OPERABLE in accordance with Station procedures. The Fixed Incore Detector Code (FINC), described in YAEC-1855P, will be utilized to determine which detectors are OPERABLE or inoperable based upon the predicted detector signal and the signal from the detectors symmetric partner (if any). A complete detector string will be declared inoperable when three out of the five detectors on that string are inoperable. The status of each detector is an output from the FINC computer code which informs the user which detectors were declared inoperable.

The movable incore detectors rely upon mechanical switching devices to route the detectors into the various reactor core locations. The movable incore detectors require a significant amount of corrective maintenance. During Seabrook Station's first two fuel cycles, greater than four hundred thousand dollars, 600 man-hours and 1 man-rem were expended in maintaining the mechanical portions of the system. The majority of the work, on the

movable incore detectors, involved replacing movable incore detectors which had failed and clearing blockages from the movable incore detector paths. In comparison, the fixed incore detectors are an integral part of the instrument tube and are not mechanically inserted into and removed from the reactor core each time they are used. To date, through two cycles of operation, the fixed incore detectors have been relatively maintenance free. Therefore, Incore Detector System maintenance will be significantly decreased which will result in savings of time and man-rem exposure.

In addition, the fixed incore detectors are operationally superior the movable incore detectors. The fixed incore detectors have the capability of providing almost continuous reactor core flux monitoring. The fixed incore detectors provide flux map data every minute. Using the movable incore detectors it takes greater than two hours to obtain equivalent data.

In conclusion, it has been determined that the fixed incore detectors are acceptable for determining reactor core power distribution and for performing surveillances currently performed by utilizing the movable incore detectors. Use of the fixed incore detector system will greatly reduce the time spent maintaining the movable incore detectors and will result in a reduction in the radiation exposure to plant personnel. In addition, personnel safety will be improved by reducing the time spent in the high temperature environment of containment. Use of the fixed incore detectors may also reduce the potential for a plant shutdown caused by inoperable movable incore detectors and the corresponding inability to perform required surveillances.

B. Description of Proposed Changes

The following changes are proposed to the Technical Specifications and their Bases:

1. The Movable Incore Detectors are being renamed as the Incore Detector System on page iv of the Technical Specification index. The proposed Technical Specification revision will permit either the fixed incore detectors or the movable incore detectors to be used for surveillance testing. This change is continued in the title of Technical Specification 3.3.3.2 on page 3/4 3-40 of the Technical Specifications. The Incore Detector System is comprised of the movable and fixed incore detectors. In addition, a typographical error is corrected in the title.

2. Technical Specification 3.1.3.1, ACTION b.3c) is being revised by replacing "movable incore detectors" with "Incore Detector System". This will allow the fixed incore detectors to be used to verify that the Heat Flux Hot Channel Factor and Nuclear Enthalpy Rise Hot Channel Factor are within limits whenever a shutdown or control rod is inoperable.

3. Technical Specification 3.1.3.2, ACTION a.1 is being revised by replacing "movable incore detectors" with "Incore Detector System". This will allow the fixed incore detectors to be used to indirectly determine the position of any non-indicating control rod.

4. Technical Specification Surveillance Requirement 4.2.2.2a is being revised by replacing "movable incore detectors" with "Incore Detector System". This will permit the fixed incore detectors to be used to verify that the Heat Flux Hot Channel Factor is within limits. YAEC-1855P, "Seabrook Station Unit 1 Fixed Incore Detector System Analysis", demonstrated that the fixed incore detectors are acceptable for verifying

power distribution surveillance compliance that is presently performed using only the movable incore detectors.

5. Technical Specification Surveillance Requirements 4.2.2.2b and 4.2.2.3 are being revised to specify the measurement uncertainty for the fixed incore detectors. The measurement uncertainty for the fixed incore detectors is slightly higher than the measurement uncertainty for the movable incore detectors. YAEC-1855P, "Seabrook Station Unit 1 Fixed Incore Detector System Analysis", Section 6.5 discusses the measurement uncertainty associated with the fixed incore detectors.

6. Technical Specification Surveillance Requirement 4.2.3.2a is being revised by replacing "movable incore detectors" with "Incore Detector System". This will permit the fixed incore detectors to be used to verify that the Nuclear Enthalpy Rise Hot Channel Factor is within limits. YAEC-1855P, "Seabrook Station Unit 1 Fixed Incore Detector System Analysis", demonstrated that the fixed incore detectors are acceptable for verifying power distribution surveillance compliance that is presently performed using only the movable incore detectors.

7. Technical Specification Surveillance Requirement 4.2.4.2 is revised as follows:

   - "movable incore detectors" is replaced with "Incore Detector System",
   - "thimble" is replaced with "detector" and,
   - "movable incore detection system" is replaced with "Incore Detector System".

   These changes will permit the fixed incore detectors to be used to verify that the QUADRANT POWER TILT RATIO (QPTR) is within limits. YAEC-1855P, "Seabrook Station Unit 1 Fixed Incore Detector System Analysis", demonstrated that the fixed incore detectors are acceptable for verifying power distribution surveillance compliance that is presently performed using only the movable incore detectors.

8. Technical Specification Limiting Condition For Operation 3.3.3.2 is being revised by replacing "Movable Incore Detection System " with "Incore Detector System", and by replacing the word "thimbles" with "locations" in two places.

   In addition, Limiting Condition For Operation 3.3.3.2c is being deleted and a note is added. The note states that: "An OPERABLE incore detector location shall consist of a fuel assembly containing a fixed detector string with a minimum of three OPERABLE detectors or an OPERABLE movable incore detector capable of mapping the location". An OPERABLE movable incore detector is one that possesses sufficient drive and readout equipment to map a location. This change will permit the fixed incore detectors to be included as part of the Incore Detector System. As such, the fixed incore detectors will be permitted to be used for:

   - recalibration of the excore Neutron Flux Detection System
   - monitoring the QUADRANT POWER TILT RATIO
   - measurement of the Nuclear Enthalpy Rise Hot Channel Factor, the Heat Flux Hot Channel Factor, and the Planar Radial Peaking Factor

The present requirements of Technical Specification 3.3.3.2 regarding an OPERABLE Incore Detector System remains unchanged. At least 75% of the detector locations and a minimum of two locations per core quadrant are required to be OPERABLE. The only change, other than terminology, is that the proposed revision allows either the fixed incore detectors or the movable incore detectors to be utilized to meet the Technical Specification requirements.

In addition, "Movable Incore Detection System" is being replaced with "Incore Detector System" in the Applicability, Action, and Surveillance Requirements sections of Technical Specification 3.3.3.2. Other than these consistency changes, no other changes are made to any of these sections.

9. The Bases of Technical Specification 3/4.2.2 and 3/4.2.3 are revised to reflect the changes in nomenclature and to specify the measurement uncertainty for the fixed incore detectors. The measurement uncertainty for these detectors is slightly greater than the measurement uncertainty for the movable incore detectors. YAEC-1855P, "Seabrook Station Unit 1 Fixed Incore Detector System Analysis", Section 6.5 discusses the measurement uncertainty associated with the fixed incore detectors.

10. The Bases of Technical Specification 3/4.2.4 and 3/4.3.3.2 are being revised to reflect the changes in nomenclature and to delete redundant wording.

II. Markup of Proposed Changes

See attached markup of proposed changes to Technical Sp

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