October 26, 2000

Mr. Ted C. Feigenbaum
Executive Vice President and
Chief Nuclear Officer
North Atlantic Energy Service Corporation
c/o Mr. James M. Peschel
P.O. Box 300
Seabrook, NH 03874

SUBJECT: SEABROOK STATION, UNIT NO. 1 - ISSUANCE OF AMENDMENT RE: REACTOR COOLANT SYSTEM FLOW MEASUREMENT (TAC NO. MA9301)

Dear Mr. Feigenbaum:

The Commission has issued the enclosed Amendment No. 77 to Facility Operating License No. NPF-86 for the Seabrook Station, Unit No 1, in response to your application dated June 20, 2000, as supplemented on September 25, 2000.

The amendment revises the Technical Specifications (TS) by removing from Surveillance Requirement 4.2.5.3, the prescriptive requirement for determining the reactor coolant system flow rate by a precision heat balance. The change also revises TS Table 2.2-1 to reflect the allowed calibration tolerance of the protection racks and noting that the Trip Setpoint for Functional Unit 12, Reactor Coolant Flow-Low reactor trip is based on an indicated value rather than a measured value.

A copy of the related Safety Evaluation is also enclosed. Notice of Issuance will be included in the Commission's biweekly Federal Register notice.

Sincerely,

/RA/

Robert M. Pulsifer, Project Manager, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-443

Enclosures: 1. Amendment No. 77 to NPF-86
2. Safety Evaluation

cc w/encls: See next page

October 26, 2000

Mr. Ted C. Feigenbaum
Executive Vice President and
Chief Nuclear Officer
North Atlantic Energy Service Corporation
c/o Mr. James M. Peschel
P.O. Box 300
Seabrook, NH 03874

SUBJECT: SEABROOK STATION, UNIT NO. 1 - ISSUANCE OF AMENDMENT RE: REACTOR COOLANT SYSTEM FLOW MEASUREMENT (TAC NO. MA9301)

Dear Mr. Feigenbaum:

The Commission has issued the enclosed Amendment No. 77 to Facility Operating License No. NPF-86 for the Seabrook Station, Unit No 1, in response to your application dated June 20, 2000, as supplemented on September 25, 2000.

The amendment revises the Technical Specifications (TS) by removing from Surveillance Requirement 4.2.5.3, the prescriptive requirement for determining the reactor coolant system flow rate by a precision heat balance. The change also revises TS Table 2.2-1 to reflect the allowed calibration tolerance of the protection racks and noting that the Trip Setpoint for Functional Unit 12, Reactor Coolant Flow-Low reactor trip is based on an indicated value rather than a measured value.

A copy of the related Safety Evaluation is also enclosed. Notice of Issuance will be included in the Commission's biweekly Federal Register notice.

Sincerely,
/RA/
Robert M. Pulsifer, Project Manager, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-443

Enclosures: 1. Amendment No. 77 to NPF-86
2. Safety Evaluation

cc w/encls: See next page

DISTRIBUTION:

PUBLIC	JClifford	OGC	WBeckner
PDI-2 Rdg.	RPulsifer	ACRS	Linville, RGN-I
EAdensam (EGA1)	TClark	GHill(2)	FAkstulewicz

* SE dated October 2, 2000, no major changes made.

ACCESSION NO. ML003757781

OFFICE	PDI-2/PM	PDI-2/LA	SRXB*	OGC	PDI-2/SC
NAME	RPulsifer	TLClark	FAkstulewicz	LClark	JClifford
DATE	10/17/00	10/25/00	10/2/00	10/24/00	10/26/00

OFFICIAL RECORD COPY

Seabrook Station, Unit No. 1
cc:

Lillian M. Cuoco, Esq.
Senior Nuclear Counsel
Northeast Utilities Service Company
P.O. Box 270
Hartford, CT 06141-0270

Mr. Peter Brann
Assistant Attorney General
State House, Station #6
Augusta, ME 04333

Resident Inspector
U.S. Nuclear Regulatory Commission
Seabrook Nuclear Power Station
P.O. Box 1149
Seabrook, NH 03874

Town of Exeter
10 Front Street
Exeter, NH 03823

Regional Administrator, Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Office of the Attorney General
One Ashburton Place
20th Floor
Boston, MA 02108

Board of Selectmen
Town of Amesbury
Town Hall
Amesbury, MA 01913

Mr. Dan McElhinney
Federal Emergency Management Agency
Region I
J.W. McCormack P.O. &
Courthouse Building, Room 401
Boston, MA 02109

Mr. Stephen McGrail, Director
ATTN: James Muckerheide
Massachusetts Emergency Management Agency
400 Worcester Road
Framingham, MA 01702-5399

Philip T. McLaughlin, Attorney General
Steven M. Houran, Deputy Attorney General
33 Capitol Street
Concord, NH 03301

Mr. Woodbury Fogg, Director
New Hampshire Office of Emergency Management
State Office Park South
107 Pleasant Street
Concord, NH 03301

Mr. Roy E. Hickok
Nuclear Training Manager
Seabrook Station
North Atlantic Energy Service Corp.
P.O. Box 300
Seabrook, NH 03874

Mr. James M. Peschel
Manager - Regulatory Programs
Seabrook Station
North Atlantic Energy Service Corp.
P.O. Box 300
Seabrook, NH 03874

Mr. W. A. DiProfio
Station Director
Seabrook Station
North Atlantic Energy Service Corporation
P.O. Box 300
Seabrook, NH 03874

Mr. Frank W. Getman, Jr.
President and Chief Executive Officer
BayCorp Holdings, LTD
20 International Drive, Suite 301
Portsmouth, NH 03801-6809

NORTH ATLANTIC ENERGY SERVICE CORPORATION, ET AL.*

DOCKET NO. 50-443

SEABROOK STATION, UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 77
License No. NPF-86

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment filed by the North Atlantic Energy Service Corporation, et al. (the licensee), dated June 20, 2000, as supplemented on September 25, 2000, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance: (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

---

*North Atlantic Energy Service Corporation (NAESCO) is authorized to act as agent for the: North Atlantic Energy Corporation, Canal Electric Company, The Connecticut Light and Power Company, Great Bay Power Corporation, Hudson Light & Power Department, Massachusetts Municipal Wholesale Electric Company, Little Bay Power Corporation, New England Power Company, New Hampshire Electric Cooperative, Inc., Taunton Municipal Light Plant, The United Illuminating Company, and has exclusive responsibility and control over the physical construction, operation and maintenance of the facility.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. NPF-86 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 77 , and the Environmental Protection Plan contained in Appendix B are incorporated into Facility License No. NPF-86. NAESCO shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of its date of issuance and shall be implemented at commencement of Cycle 8 operation (scheduled for November 2000).

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

James W. Clifford, Chief, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: October 26, 2000

ATTACHMENT TO LICENSE AMENDMENT NO. 77

FACILITY OPERATING LICENSE NO. NPF-86

DOCKET NO. 50-443

Replace the following pages of the Appendix A, Technical Specifications, with the attached revised pages as indicated. The revised pages are identified by amendment number and contain marginal lines indicating the area of change.

Remove	Insert
2-5	2-5
B 2-6	B 2-6
3/4 2-10	3/4 2-10
B 3/4 2-4	B 3/4 2-4

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 77 TO FACILITY OPERATING LICENSE NO. NPF-86

NORTH ATLANTIC ENERGY SERVICE CORPORATION

SEABROOK STATION, UNIT NO. 1

DOCKET NO. 50-443

1.0 INTRODUCTION

By letter dated June 20, 2000, (Ref. 1), as supplemented by a letter dated September 25, 2000, (Ref. 2), North Atlantic Energy Service Corporation (NAESCO), the licensee for Seabrook Station, submitted a License Amendment Request (LAR) for changes to the Seabrook Station Technical Specifications (TS). The proposed TS changes are related to Reactor Coolant System (RCS) flow measurement surveillance requirement (SR) 4.2.5.3 contained in TS 3/4.2.5, "DNB Parameters," and the "Reactor Coolant Flow - Low" reactor trip function contained in TS Table 2.2-1, "Reactor Trip System Instrumentation Trip Setpoints." The change to SR 4.2.5.3 would (1) remove the prescriptive requirement for determining the RCS total flow rate by precision heat balance, and (2) incorporate a time limit for completion of the surveillance requirement for the reactor power exceeding 90 percent of the rated thermal power (RTP). This time limit request (item (2)) was removed by NAESCO in their letter dated September 25, 2000. The changes to the "Reactor Coolant Flow-Low" reactor trip include (1) a change from a five-column to a two-column approach in specifying the trip function, (2) a change to the "Allowable Value" to reflect the allowed calibration tolerance of the protection rack due to instrumentation uncertainty calculations, and (3) a change to specify that the trip setpoint and allowable values are based on an indicated value rather than a measured value. The supplemental letter provided clarifying information within the scope of the original application and did not change the staff's initial proposed no significant hazards consideration determination.

2.0 BACKGROUND

Limiting Condition for Operation (LCO) 3.2.5 requires the RCS flow to be maintained greater than or equal to a specified limit value (the thermal design flow or the minimum measured flow) during MODE 1 operation. This LCO limit flow rate is an input value in the design basis transients safety analyses to demonstrate that the departure from nucleate boiling ratio (DNBR) limit is not violated during normal operation and anticipated operational occurrences (AOO). The thermal design flow is used in the deterministic method, and the minimum measured flow is used in the Revised Thermal Design Procedure (Ref. 3). SR 4.2.5.3 requires that the RCS total flow be determined by a precision heat balance measurement to be within its limit prior to

operation above 95 percent of RTP after each fuel loading. The proposed amendment to this SR would delete the reference to a precision heat balance measurement.

In the precision heat balance measurement, calorimetric measurements are made on the steam generator (SG) secondary side with the feedwater flow rates measured by venturi meters. The RCS flow rate is calculated from the calorimetric measurements in conjunction with the enthalpy rise across the reactor vessel as indicated by the hot- and cold-leg resistance temperature detectors (RTDs). Each hot leg has three thermowell RTDs installed around a cross-section to determine the bulk hot-leg temperature. However, due to the deployment of low leakage core fuel loading patterns that result in changes in the core radial power distribution, the phenomenon of increased hot-leg temperature streaming has been observed in many plants, including Seabrook Station, Unit 1. As a result of the increased temperature streaming, the bulk hot-leg temperature as measured by the three RTDs in each hot-leg is erroneously high, resulting in a calculated RCS flow lower than the actual value. Because of this inherent limitation of the calorimetric-based method, the use of the cold-leg elbow tap differential pressure (ΔP) measurements as an alternate method for the RCS flow surveillance after each fuel loading has been approved by the Nuclear Regulatory Commission (NRC) for many Westinghouse 3- and 4-loop pressurized water reactors (PWRs). The staff also accepted the Westinghouse Owners Group topical report, WCAP-14750-P-A (Ref. 4), for generic application to Westinghouse 3-loop PWRs of using elbow taps for RCS Flow verification.

3.0 EVALUATION

NAESCO has proposed to remove from SR 4.2.5.3 the prescriptive requirement for determining the RCS flow rate by a precision heat balance. NAESCO has proposed an alternate test method as described in licensing report WCAP-15415 (and proprietary version WCAP-15404, Ref. 5). The WCAP-15415 describes a methodology of using the cold leg elbow tap ΔP measurements for the RCS flow rate surveillance verification. The staff evaluation of the topical report is discussed in the following sections.

3.1 Use of Elbow Tap ΔP for RCS Flow Measurement

Cold leg elbow tap flow meters are used by Westinghouse-designed pressurized water reactor (PWR) plants, including Seabrook Station, for surveillance verification (SR 4.2.5.1) of the RCS flow through the control board indication every 12 hours. The purpose of the 12-hour elbow tap surveillance reading is to verify that the full-power steady-state flow has not decreased below its limit during the fuel cycle.

The principle of operation of an elbow meter is based on the centrifugal force of a fluid flowing through an elbow creating a ΔP between the outer and inner radii of the elbow. The relationship between the volumetric flow rate through an elbow, Q, and ΔP between the pressure taps at the outer and inner radii of the elbow can be expressed as $Q = C\ \Delta P^{1/2}$. The elbow meter coefficient C is a function of elbow bend and cross-section radii, and is affected by the location of pressure taps, upstream and downstream piping, and other factors. The cold-leg elbow tap-flow element is not calibrated in advance in a laboratory, but the measurement is typically normalized against the established RCS flow rate from the precision heat balance calorimetric flow measurement at the start of each fuel cycle. The cold-leg elbow taps are typically used as an indication of relative changes in the RCS flow, rather than a measurement of absolute value of the RCS flow. The cold-leg elbow tap ΔP also provides a measure of the reduced RCS flow rate for the low flow reactor trip.

Figure 4-1 in WCAP-15404 shows the elbow tap locations in the RCS piping. The elbow taps are installed in a plane 22.5° around the 90° crossover elbow in each of the cold legs. Each elbow has three low-pressure taps spaced 15° apart on the inside pipe radius and one high-pressure tap on the outside pipe radius used as the common tap. The pressure taps are connected to three ΔP transmitters to obtain ΔP data. As the elbow taps in the cold legs are fixed, the elbow meter coefficients in each elbow tap configuration should remain unchanged. An American Society of Mechanical Engineers (ASME) publication (Ref. 6) states that hydraulic tests have demonstrated that elbow tap flow measurements have a high degree of repeatability, and are not affected by changes in the elbow surface roughness.

To confirm elbow tap flow measurement repeatability, Sections 4.1 of WCAP-15404 provides an evaluation of comparisons between the RCS flow measurement data using the elbow taps and ultrasonic leading edge flow meters (LEFM) from the Hydraulic Test Program at Prairie Island Unit 2 (PI-2). The PI-2 Hydraulic Test Program was put in place in 1973 and the test data covered 11 years of plant operation, during which a significant change in system hydraulics was made. The data showed that the elbow tap measurements agree to within 0.3 percent of the LEFM flow measurements. Another comparison performed before and after a reactor coolant pump replacement shows that the LEFM and elbow tap measurements agreed to within an average of 0.2 percent on the ratio of flows when one and two pumps were operating.

In addition, an evaluation of various processes or phenomena for possible effects on the elbow tap flow measurements, including the effects of fouling, erosion, upstream velocity distribution, and SG tube plugging, concluded the following:

- The conditions for fouling process are not present in the cold-leg elbow since there is no change in cross section to produce a velocity increase and ionization.

- Stainless steel elbow surface erosion is unlikely and the flow velocities are not large relative to the conditions that cause erosion.

- The upstream velocity distribution, including the distribution in the elbow tap flow meter, remains constant so the elbow tap flow meter ΔP versus flow relationship does not change.

- The plenum velocity head approaching the outlet nozzle is small compared to the piping velocity head; therefore, SG tube plugging does not affect elbow tap flow measurement repeatability.

Based on the above evaluation, the staff concludes that as the elbow meter coefficients remain constant, the relative changes of flow rate through the cold-leg elbows can be correlated with the relative changes in the elbow tap ΔP.

3.1.1 Elbow Tap Flow Measurement Procedure

Section 4.2 of WCAP-15404 describes the procedure for determining the RCS flow from elbow tap ΔP measurements based on their repeatability. This elbow tap flow measurement procedure relies on the total baseline calorimetric flow, which is based on the calorimetric flow measurements from early fuel cycles before the deployment of the low leakage fuel loading pattern. The procedure correlates the current cycle flow (CCF) with the elbow tap ΔP ratio of the current and the baseline cycles and the baseline calorimetric flow (BCF). The CCF will be determined from the BCF multiplied by the elbow tap flow ratio (R).

The elbow tap flow ratio (R) is defined as $R = (K/B)^{½}$, where B is the baseline elbow tap flow coefficient defined as $B = \Delta P_B \times v_B$; ΔP_B is baseline average elbow tap ΔP; v_B is average cold leg specific volume; K is the current cycle elbow tap flow coefficient, defined as $K = \Delta P \times v$; and v is the cold leg specific volume.

Section 4.3 of WCAP-15404 describes baseline parameters for elbow tap flow measurements, including the BCF, and the baseline elbow tap flow coefficient B. The procedures for defining the BCF, including the criteria for the choice of early cycle flow measurements and the determination of the BCF from the chosen cycle data, and the calculation of elbow tap flow coefficient B from the baseline cycle elbow tap ΔP measurements are consistent with the approved processes described in WCAP-14750-P-A, Rev. 1 (Ref. 4), and, therefore, are acceptable.

3.1.2 Best Estimate Flow Confirmation

The elbow tap flow measurement procedure includes a cross check process by using a best estimate (BE) hydraulics analysis to confirm the RCS flow determined from the elbow tap flow measurement. The RCS flow BE calculation is based on the flow resistance of various components in the reactor coolant loops and the reactor coolant pump performance characteristics. Therefore, changes in the RCS flow rate can be evaluated based on plant system hydraulic changes, such as plugging and sleeving of SG tubes, reactor coolant pump wear, and fuel design changes. In the BE hydraulic analysis cross check process, the elbow tap flow ratio R is compared to an estimated CCF ratio (R'), which is defined as the ratio of the current cycle BE RCS flow (CEF) to the baseline cycle BE flow (BEF) based on the flow analysis of known RCS hydraulics changes. If the measured R is greater than (1.004 x R'), R will be limited to (1.004 x R'). The multiplier 1.004 applied to R' is a measure to provide an allowance of 0.4 percent for elbow tap flow measurement repeatability. This cross check process is consistent with the process described in WCAP-14750-P-A, Rev. 1.

Section 5.0 of WCAP-15404 describes a BE RCS flow analysis procedure developed by Westinghouse in 1974 to estimate RCS flow at all Westinghouse-designed plants. The analysis uses BE values of the RCS component flow resistance and pump performance with no margins applied. The flow resistance of the RCS loops (i.e., the reactor vessel, RCS piping, and SGs) are used in conjunction with the reactor coolant pump head-flow performance to define individual loop and total RCS flows. The component hydraulic design data and hydraulic coefficients are determined from analyses of the test data. The flow resistance of the reactor vessel, consisting of the reactor core, vessel internals, and vessel nozzle, is determined from the ΔP measurements of a full-size fuel assembly hydraulic test, and hydraulic model test data for each type of reactor vessel. The RCS piping flow resistance combines the resistance of the hot leg, crossover leg, and cold leg piping. The flow resistance is based on analyzing the

effects of upstream and downstream components on elbow hydraulic loss coefficients, using the results of industry hydraulic tests. The flow resistance is defined in five parts; inlet nozzle, tube inlet, tubes, tube outlet, and outlet nozzle. Section 5.1 of WCAP-15404 indicates that numerous component flow resistance tests and analyses (including the overall flow resistance confirmed by the PI-2 Hydraulics Test Program) have confirmed that this hydraulic analysis procedure has an uncertainty of 2 percent flow. This indicates that actual flow is expected to be within 2 percent of the calculated BE flow.

The BE flow analysis defines the expected change in flow for a new cycle. The BE hydraulic analysis will be used merely as a cross check of the elbow tap flow measurement in which the elbow tap flow measurement result is limited to the BE flow with an allowance for the elbow tap repeatability uncertainty. The BE flow will not be used as a substitute for the TS SR for a flow measurement. Based on the above, the staff has determined that the BE hydraulic flow analysis does provide analytical assurance of the RCS flow determined from the elbow tap flow measurement.

3.1.3 Seabrook RCS Flow Performance Evaluation

Section 6 of WCAP-15404 describes the evaluation of Seabrook RCS flow performance. BE RCS flow predictions are made based on the known hydraulic changes. The analyses determined the baseline BE flows based on the baseline hydraulic designs. Hydraulic changes during subsequent cycles, including pump impeller smoothing, steam generator plugging (74 tubes through the first 7 cycles), and fuel design change (from Westinghouse standard fuel design to Vantage 5H fuel design since Cycle 4), are modeled to determine BE flow rates of various cycles. The resulting baseline BE flow rates for various fuel cycles are provided in Table 6-1 of WCAP-15404.

The baseline elbow tap flow coefficient B is determined using the precision elbow tap ΔP measurements obtained during the pre-operational tests of first fuel cycle. The elbow tap ΔP measurements are corrected for the effects of the reactor power on RCS flow and the RTD bypass system removal.

The calculation of the Seabrook baseline calorimetric flow is made in accordance with the BCF determination procedure described in Section 4.3 of WCAP-15404. Tables 6.1 and Figure 6-1 of WCAP-15404 compare the measured calorimetric flows with the BE and elbow tap flows of the first seven fuel cycles. The comparisons indicate that the calorimetric-measured flows after Cycle 2 were apparently biased by the hot leg temperature streaming and should not be used to determine the baseline calorimetric flow, accordance to the BCF selection criteria. Therefore, the BCF is developed based on the precision RCS flow calorimetrics performed at the beginning of Cycles 1 and 2 (BOC 1 and BOC 2) where the resulting effect of hot leg temperature streaming on baseline flow is minimal. The final determination of the BCF is shown in Table 6.2 of WCAP-15404.

The final normalized, baseline value for the elbow tap flow coefficient is based on the average of the BOC 1 and BOC 2 precision flow calorimetrics and the BOC 1 elbow tap measurement. The baseline elbow tap flow coefficient need not be adjusted to the future calorimetrics. The RCS flow surveillance will be performed by using future elbow tap ΔP indications. This is consistent with the elbow tap flow measurement procedure described in Section 3.1.1 of this safety evaluation (SE), and is, therefore, acceptable.

3.1.4 Flow Measurement Uncertainties

The determination of the RCS flow via the cold leg elbow taps ΔP measurements, which are no longer normalized at each refueling interval, requires an evaluation of the effects on the instrument uncertainties, such as the uncertainties usually considered to be zeroed out by a normalization performed each cycle.

Section 7.2 of WCAP-15404 states that the uncertainty calculation is consistent with that described in WCAP-13181 (Ref. 7), which was submitted by the licensee in March 1992 in support of its LAR 92-01 related to RTD bypass system elimination for Seabrook Station (Ref. 8). The uncertainty calculation is based on the standard Westinghouse methodology previously approved for other plants associated with RTD bypass elimination or the use of the Westinghouse Improved Thermal Design Procedure (Ref. 9). The uncertainty methodology uses a statistical uncertainty combination technique, i.e., those groups of components which are statistically and functionally independent are statistically combined, and those errors which are not independent are combined arithmetically to form independent groups, which can then be statistically combined.

With the elbow tap methodology, the RCS elbow tap ΔP measurements are correlated to the precision calorimetric measurements performed during earlier fuel cycles when the hot leg streaming effects were minimal. The RCS flow measurement uncertainties include uncertainties associated with the following:

- calorimetric measurement of the RCS total flow for the baseline cycle
- ΔP transmitters
- plant process computer indication for the current cycle RCS flow measurements using the cold leg elbow taps

The calculations account for the plant instrumentation, test equipment, and procedures which were in place at the time the calorimetric was performed. The calculations also include additional instrumentation drift uncertainties to reflect the correlation between the elbow tap ΔP measurements and the calorimetric flow measurements. Uncertainty calculations are performed for the indicated RCS flow (computer) and the RCS low-flow reactor trip.

Appendix A of WCAP-15404 provides the results of the uncertainty calculations reflecting the use of elbow tap flow measurement, with Tables A-1 through A-5 of WCAP-15404 corresponding to Table 3.1-2 through 3.1-6 of WCAP-13181, respectively. Tables A-1, A-2, and A-3, respectively, provide the values of the baseline calorimetric flow measurement instrumentation uncertainties, flow calorimetric sensitivities, and calorimetric flow measurement uncertainties. Tables A-4 and A-5, respectively, provide the cold-leg elbow tap flow measurement uncertainties for the process computer, and low-flow reactor trip uncertainties. The uncertainties for a calorimetric measurement or the elbow tap measurement consist of uncertainties from all components in the measurement channel. These include non-instrument-related measurement errors (such as temperature stratification of a fluid in a pipe) and instrument-related errors (such as errors due to metering devices, calibration accuracies of sensors, process rack, and readout devices, drift, temperature and pressure effects, etc.). The calculations are consistent with those in WCAP-13181.

One significant difference from the WCAP-13181 is the added values of certain instrument uncertainties, which were previously considered zeroed out by the assumption of normalization

to a calorimetric performed each cycle. Since the elbow taps ΔP measurements used for the RCS flow measurements are no longer normalized at each fuel cycle, the instrument uncertainties that were previously zeroed out must now be included. This is shown in Tables A-4 and A-5 of WCAP-15404, where instrument uncertainty values for the sensor calibration accuracy, sensor pressure effect, and sensor temperature effect are included.

Table A-4 of WCAP-15404 shows an overall RCS flow uncertainty of 2.3 percent for the process computer. This uncertainty is slightly less than the current NRC-licensed value of 2.4 percent flow. Table A-5 of WCAP-15404 shows the calculated channel statistical allowance for the reactor trip function is lower than the total allowance flow span assumed for the low-flow reactor trip function. Therefore, even though the instrument uncertainties have increased due to the normalization, the difference between the nominal trip setpoint of 90.0 percent flow specified in Table 2.2-1and the current safety analysis limit (87% flow) is sufficient to allow for increased instrument uncertainties due to the normalization.

Based on the above, the staff has determined that the proposed cold-leg elbow tap ΔP measurement methodology for RCS flow rate measurements, as described in WCAP-15404, is an acceptable alternative to a precision heat balance measurement.

3.2 Technical Specification Changes

NAESCO has proposed changes to SR 4.2.5.3 and Table 2.2-1. The staff evaluation of the proposed TS changes is discussed in the following sections.

3.2.1 Changes in SR 4.2.5.3 for Reactor Coolant Flow Verification

SR 4.2.5.3 requires that the RCS total flow be determined by a precision heat balance measurement to be within its limit prior to operation above 95 percent of RTP after each fuel loading. In its letter dated September 25, 2000, (Ref. 2) NAESCO proposed to revise SR 4.2.5.3 to read: “The RCS total flow rate shall be determined by an approved method to be within its limit prior to operation above 95 percent of RATED THERMAL POWER.” Therefore, the proposed amendment for this SR would replace “a precision heat balance measurement” with “an approved method.” The TS BASES 3/4.2.5 is also revised to reflect the proposed changes by stating that the measurement of RCS total flow rate is performed with either a precision calorimetric heat balance or the normalized cold leg elbow tap ΔP measurement methods described in WCAP-15404. Since the proposed SR would require that an approved method such as the elbow tap flow measurement be used for the RCS flow surveillance verification, the staff found this change acceptable.

3.2.2 Changes in TS Table 2.2-1, Reactor Trip System Instrumentation Trip Setpoints

TS Table 2.2-1 is a five-column format in that each trip function is specified with five values, i.e., Total Allowance (TA), statistical summation of errors assumed in the analysis excluding errors associated with sensor and rack drift and the accuracy of their measurement (Z), Sensor Error (S), Trip Setpoint, and Allowable Value. NAESCO proposed to revise the reactor trip Functional Unit 12, “Reactor Coolant Flow - Low,” in this table from the five-column approach to a two-column approach with only the values for the columns “Trip Setpoint” and “Allowable Value” specified, and the columns of TA, Z, and S marked “N/A.” This proposed change is consistent with the format outlined in NUREG-1431, Rev. 1, “Standard Technical Specifications, Westinghouse Plants.” With a two-column approach, channel operability is based on the

Allowable Value/Trip Setpoint relationship as determined by the plant setpoint methodology (including process rack allowances) and confirmed through plant surveillances. A channel must be declared inoperable when its bistable setpoint is found exceeding the allowable value. As a result, the RCS flow values for Z, S, and TA in the five-column approach will no longer be applied to the trip functional operability determination. With the NRC-approved Westinghouse instrument uncertainty methodologies, the TA, Z, and S values are rendered meaningless. Therefore, the deletion or the NA indication, of these parameters for the low-flow reactor trip function is acceptable. The two-column approach verifies all the information necessary to define the proposed trip setpoints and, therefore, is acceptable to the staff.

The licensee also proposed to revise the low-flow "Trip Setpoint" from "≥90 percent measured loop flow" to "≥90 percent indicated loop flow," and the "Allowable Value" from "≥89.3 percent of measured loop flow" to "≥89.6 percent of indicated loop flow." The licensee has proposed to change the word "measured" to "indicated" flow. This more clearly reflects how RCS flow is determined in Section 3.1 of this SE. Also, the reactor trip setpoint of 90 percent is 3 percent higher than the current safety analysis limit of 87 percent flow, hence, it provides sufficient margin to allow for the increased instrument uncertainties due to the normalization of elbow tap, as shown in Table A-5 of WCAP-15404, where the total allowance for the low flow trip setpoint is shown to be larger than the statistical channel allowance. The staff, therefore, finds the proposed change acceptable.

Bases Section 2.2.1, "Reactor Coolant Flow" was revised to state that "an automatic Reactor trip will occur if the flow in more than one loop drops below 90% of indicated loop flow." The word "indicated" replaced "nominal full." The staff has no objection to this change.

The change in the Allowable Value from 89.3 percent to 89.6 percent loop flow is made to be consistent with the allowable value, including the allowed drift for the process rack, as shown in Table A-5 of WCAP-15404. This is acceptable as it is consistent with NRC-approved Westinghouse instrument uncertainty methodologies, based on the "As Left" calibration tolerance defined in the uncertainty calculation for the trip.

3.3 Summary

The staff has reviewed the use of cold-leg elbow tap flow measurement methodology for RCS flow verification described in WCAP-15415 (WCAP-15404, proprietary version), and the licensee-proposed changes to the Seabrook TSs regarding the RCS flow surveillance and low flow reactor trip function.

The cold leg elbow tap ΔP measurements in conjunction with the baseline calorimetric RCS flow measurements provides an appropriate RCS flow surveillance verification. The procedures for the determination of baseline calorimetric flow is consistent with the approved method described in WCAP-14750. Because the elbow tap measurements are no longer normalized at each refueling interval, proper adjustment is made to the portion of flow measurement uncertainties usually considered to be zeroed out by a normalization performed each cycle. Based on its review of the technical bases regarding the cold-leg elbow tap RCS flow measurement procedure and the measurement uncertainty calculation, the staff concludes that the proposed TS changes as well as the use of the cold leg elbow tap ΔP method described in WCAP-15404 for the RCS surveillance are acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the New Hampshire and Massachusetts State officials were notified of the proposed issuance of the amendment. The State officials had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and changes surveillance requirements. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (65 FR 48753). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

7.0 REFERENCES

1. Letter, Ted C. Feigenbaum (North Atlantic Energy Service Corporation) to U.S. Nuclear Regulatory Commission, “Seabrook Station, License Amendment Request 00-04, ‘Reactor Coolant System Flow Measurement’,” June 20, 2000, Docket No. 50-443, NYN-00059.

2. Letter, Ted C. Feigenbaum (North Atlantic Energy Service Corporation) to US Nuclear Regulatory Commission, “Seabrook Station, Supplement to License Amendment Request 00-04, ‘Reactor Coolant System Flow Measurement’,” September 25, 2000, Docket No. 50-443, NYN-00083.

3. WCAP-11397-P-A, “Revised Thermal Design Procedure,” Westinghouse Electric Corporation, April 1989.

4. WCAP-14750-A, Revision 1, WCAP-14750-P-A, Revision 1 (proprietary), “RCS Flow Verification Using Elbow Taps at Westinghouse 3-Loop PWRs,” September 1999.

5. WCAP-15415, WCAP-15404 (Proprietary), “Justification of Elbow Taps for RCS Flow Verification at the Seabrook Station,” May 2000.

6. “Fluid Meters, Their Theory and Application,” 6th Edition, Howard S. Bean, ASME, New York, 1971.

7. WCAP-13193, WCAP-13181 (Proprietary), “RTD Bypass Elimination Licensing Report for Seabrook Nuclear Station,” January 1992.

8. Letter from T. C. Feigenbaum (New Hampshire Yankee) to U.S. Nuclear Regulatory Commission, “License Amendment Request 92-01; RTD Bypass System Elimination,” Docket No. 50-443, March 20, 1992.

9. WCAP-8567-P-A, “Improved Thermal Design Procedure,” February 1989.

Principal Contributor: Y. Hsii

Date: October 26, 2000