May 30, 2003

Mr. Mark E. Warner, Site Vice President
c/o James M. Peschel
Seabrook Station
PO Box 300
Seabrook, NH 03874

SUBJECT: SEABROOK STATION, UNIT NO. 1 - RELIEF FROM ASME CODE OPERATIONS AND MAINTENANCE CODE ISTB 4.3(e)(1) TEN-YEAR INTERVAL INSERVICE TEST FOR CONTAINMENT SPRAY PUMPS CBS-P9A AND CBS-P9B (TAC NO. MB6676)

Dear Mr. Warner:

By letter dated October 28, 2002, North Atlantic Energy Service Corporation (NAESCO, or the licensee) submitted revised pump relief request PR-1 associated with their second 10-year interval inservice testing (IST) program plan for pumps and valves. Originally, the licensee submitted its second 10-year interval IST program plan for pumps and valves in a letter dated March 21, 2000, as supplemented by letters dated August 18 and September 8, 2000. The NRC staff authorized all the relief requests, except relief request PR-1 which was authorized for an interim period of 2 years, as discussed in an NRC letter to North Atlantic dated November 1, 2000. In its October 28, 2002, letter, the licensee submitted its revised relief request PR-1 proposing additional requirements to its original submittal.

On November 1, 2002, the U.S. Nuclear Regulatory Commission (NRC) approved the transfer of the license for Seabrook Station, to the extent held by NAESCO, and certain co-owners of the facility, on whose behalf NAESCO was also acting, to FPL Energy Seabrook, LLC (FPLE Seabrook). By letter dated December 20, 2002, FPLE Seabrook requested that the NRC continue to review and act upon all requests before the Commission that had been submitted by NAESCO. Accordingly, the staff has reviewed the licensee's request and, based on the information provided, concludes that the proposed alternative will provide an acceptable level of quality and safety for the second 10-year interval IST program for containment spray pumps CBS-P9A and CBS-P9B. Therefore, the proposed alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the remainder of the second 10-year IST program.

If you have any questions, please contact Victor Nerses at (301) 415-1484.

Sincerely,

***/RA/***

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

Docket No. 50-443

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REVISED PUMP RELIEF REQUEST PR-1

SEABROOK STATION, UNIT NO. 1

FPL ENERGY SEABROOK, LLC

DOCKET NO. 50-443

## 1.0 INTRODUCTION

By letter dated October 28, 2002, North Atlantic Energy Service Corporation (NAESCO), as the then licensee for Seabrook Station, Unit No. 1 (Seabrook Station), submitted a revised pump relief request PR-1 associated with their second 10-year interval inservice testing (IST) program plan for pumps and valves. On November 1, 2002, the U.S. Nuclear Regulatory Commission (NRC or Commission) approved the transfer of the license for Seabrook Station, to the extent held by NAESCO, and certain co-owners of the facility, on whose behalf NAESCO was also acting, to FPL Energy Seabrook, LLC (FPLE Seabrook or the licensee). By letter dated December 20, 2002, FPLE Seabrook requested that the NRC continue to review and act upon all requests before the Commission that had been submitted by NAESCO. Originally, the licensee submitted its second 10-year interval IST program plan for pumps and valves in a letter dated March 21, 2000, as supplemented by letters dated August 18, and September 8, 2000. The NRC staff authorized all the relief requests, except relief request PR-1, which was authorized for an interim period of two years as discussed in a letter to NAESCO from the NRC dated November 1, 2000. In its October 28, 2002, letter, the licensee submitted its revised relief request PR-1.

## 2.0 REGULATORY EVALUATION

Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a, requires that IST of certain American Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3 pumps and valves be performed at 120-month intervals in accordance with specified ASME Code and applicable addenda, except where alternatives have been authorized or relief has been requested by the licensee and granted by the NRC pursuant to Paragraphs (a)(3)(i), (a)(3)(ii), and (f)(6)(i) of 10 CFR 50.55a. In accordance with 10 CFR 50.55a(f)(4)(ii), licensees are required to comply with the requirements of the latest edition and addenda of the ASME Code, incorporated by reference in the regulations, 12 months prior to the start of subsequent 120-month IST program intervals. Licensees whose IST program reaches its 120-month interval after November 22, 2000, are required to implement the 1995 Edition, with the 1996 Addenda, of the ASME *Code for Operation and Maintenance of Nuclear Power Plants* (ASME OM Code). In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety; (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance is impractical for the facility. Section 50.55a authorizes the

NRC to approve alternatives to, or grant relief from, ASME Code requirements upon making the necessary findings. NRC guidance in Generic Letter (GL) 89-04, “Guidance on Developing Acceptable Inservice Testing Program,” provides acceptable alternatives to the Code requirements. Further guidance is given in GL 89-04, Supplement 1, and NUREG-1482, “Guidelines for Inservice Testing at Nuclear Power Plants.”

The second 10-year IST interval for Seabrook Station began on August 18, 2000, and is scheduled to end August 17, 2010. The licensee developed the Seabrook IST program in accordance with the requirements of the 1995 Edition, including the 1996 Addenda, of the ASME OM Code.

As stated in 10 CFR 50.55a(f)(4)(ii), inservice tests must comply with the requirements of the latest edition and addenda of the Code, incorporated by reference in the regulations, 12 months prior to the start of the 120-month interval. For Seabrook Station, this would be the 1989 Edition of the Code. However, the licensee requested approval to implement the IST program in accordance with the 1995 Edition and 1996 Addenda of the OM Code. The staff’s Safety Evaluation dated May 8, 2000, approved the request.

The staff’s evaluation of the acceptability of the proposed alternatives in revised relief request PR-1 are discussed below.

## 3.0 TECHNICAL EVALUATION

The licensee’s regulatory and technical analyses in support of its relief request PR-1 for relief from ASME OM Code IST requirements are described in the licensee’s submittal dated March 21, 2000, as supplemented by its letters dated August 18, and September 8, 2000. The staff authorized relief request PR-1 for an interim period of 2 years, as documented in an NRC letter to NAESCO dated November 1, 2000, to allow the licensee additional time to consider other practical alternatives and/or compensatory measures in order to meet the comprehensive pump testing requirements. In a letter dated October 28, 2002, the licensee revised relief request PR-1 and resubmitted it for approval for the remainder of the second 10-year IST interval.

### 3.1 Code Requirement for which Relief is Requested

The licensee requests relief for its containment spray pumps from the requirements of the ASME OM Code, Paragraph ISTB 4.3(e)(1) that requires reference values be established within ± 20% of the design flow rate for the comprehensive pump test.

### 3.2 Licensee’s Proposed Alternative to the ASME Code

The licensee proposed the following alternative to the Code requirements:

> Reference values for testing the Containment Spray Pumps will be established and comprehensive pump testing will be performed while operating on the installed recirculation loop. Additionally, in order to compensate for testing the subject pumps at reduced flow rate during the comprehensive pump test, as required by ISTB 4.3(e)(1), the CBS [containment building spray] pumps are included in the Predictive Maintenance Monitored Equipment Program. This program includes enhanced vibration monitoring

> and analysis of the pump and periodic sampling and analysis of the lube oil. If additional measured parameters are found to [be] outside of the normal operating range or were determined to be trending toward an unacceptably degraded condition, corrective actions are required. These corrective actions include monitoring additional pump parameters, review of relevant data to determine the cause of the deviation, and potential removal from service. This program contains testing and analysis requirements beyond those required by the 1995 Edition, (including the 1996 Addenda) of the ASME OM Code.

3.3 Licensee's Bases for Alternative

The licensee provided the following basis for the proposed alternative:

> The Containment Building Spray (CBS) system is designed to remove the energy discharged to the containment following a loss-of-coolant accident (LOCA) or main steam line break (MSLB) to prevent the containment pressure from exceeding design pressure and to reduce and maintain containment temperature and pressure within acceptable limits. The CBS pumps are motor-driven, horizontal, centrifugal pumps. The subject pumps are designed to take suction from either the Refueling Water Storage Tank (RWST) in the Emergency Core Cooling System (ECCS) injection mode or the containment recirculation sump in the ECCS recirculation mode. The CBS pump discharges the flow back into the containment through the containment spray nozzles. Each train of the CBS system includes one 100% capacity pump.
>
> As such, the CBS pumps are required to be inservice tested in accordance with Subsection ISTB of the 1995 Edition, (including the 1996 Addenda) of American Society of Mechanical Engineers (ASME) Code for the Operation and Maintenance of Nuclear Power Plants (OM Code). Subsection ISTB 4.3(e)(1) of the OM Code requires that comprehensive tests of pumps be performed on a biennial (2-year) frequency at reference conditions within ± 20% of pump design flow.
>
> The flow path used [recirculation flow path] to perform both the biennial comprehensive pump test and the quarterly Group B test are the same. Both CBS pumps take suction from the Refueling Water Storage Tank (RWST) through a series of manual valves and a suction check valve and discharge water back to the RWST. The pump discharge flow path contains a piping run to a heat exchanger (CBS-E-16A or CBS-E- 16B) and then continues to the containment spray ring header penetration(s) (X-14 and X-15). Upstream of this penetration is the return line to the RWST. In the return line, there is an air-operated valve (AOV) (open/close type) specific to each train (CBS-V31 and CBS-V32) with no remote throttling capacity. The return lines for each train tie together into a common line that utilizes a similar type AOV (CBS-V33). This common line then connects to the RWST, which is located downstream. The Safety Injection pumps also utilize this common return line to the RWST. CBS pump flow is measured utilizing a flow indicator (FI-2340) located in the common return line to the RWST. Due to the design of the valve, there is no practical method to vary the resistance of test path to adjust flow. IST testing is performed at this fixed reference condition.
>
> During the pre-operational test period, a test (PT-12.1) was performed to verify CBS system performance. PT 12.1 was performed utilizing a temporary manual throttle valve

installed in a spool piece (for a temporary strainer) in the common RWST return line. This spool piece still exists as a bolted joint but the manual valves and strainer have been removed. Installation of a similar temporary throttle valve with the plant on-line to achieve additional flow points for the subject pumps is impractical due to use of this line by other pumps such as the Safety Injection pumps. Installation of a temporary manual throttle valve during shutdown periods would be a substantial burden.

Alternative means to vary system resistance in order to provide additional test data were evaluated. The local manual throttling of either CBS-V31, CBS-V32 or CBS-V33 was eliminated as an option due to the potential for valve damage since these valves incorporate a soft seat type design. Additionally, local manipulation of these valves at power would over ride the automatic signals that these valves receive to close to protect the containment spray flow path to containment.

The potential to vary system resistance utilizing a manual valve located in the pump suction lines was also evaluated. This option was eliminated due to the potential to cavitate the pumps and reduce net positive suction head (NPSH) margin for the pumps. As a result, the Containment Spray Pumps (CBS-P9A, CBS-P9B) can only be tested on a recirculation flow path which is sized for approximately 63% (1900 GPM) of the Best Efficiency Point (BEP) Flow of 3000 GPM and approximately 68% of the required design flow of 2808 GPM.

Full flow testing would require system alignment to the containment spray headers and subsequent discharge to the containment. In order to perform full flow testing without alignment to the spray headers, temporary piping would be required to recirculate water to/from the ECCS Containment Sumps. This was performed one time previously, to verify CBS pump curve data (pre-operational test 1-PT-11, Containment Recirculation Sump Operability Demonstration). 1-PT-11 required modification of the sump by means of building a 2 to 3 feet high steel dike around the top of the sump (at -26’ elev. floor level) in order to hold the volume of water required to achieve the necessary pump NPSH without flooding the containment. The spray header piping would also require modification by means of removing the spool pieces downstream of valves CBS-V13 and CBS-V19 and connecting temporary pipe (minimum 8" diameter) from 25’ elevation in containment to the ECCS Sumps at -26’ elevation. Performing these temporary modifications to the CBS system or enlarging the recirculation piping and components to achieve 80% design flow is not warranted since there will be no benefit in pump testing.

Testing of the subject pumps utilizing the recirculation flow path provides for substantial flow testing in a stable, region of the pump curve, well above the minimum continuous flowrate specified by the pump manufacturer. Testing the CBS pumps at reference values established in this region of the pump curve will not cause damage to the pumps and will provide meaningful data to assess pump operational readiness.

In order to compensate for testing the subject pumps at reduced flow rate during the comprehensive pump test, as required by ISTB 4.3(e)(1), the CBS pumps are included in the Predictive Maintenance Monitored Equipment Program. This program includes enhanced vibration monitoring and analysis of the pump and periodic sampling and analysis of the lube oil. If additional measured parameters are found to [be] outside of the normal operating range or were determined to be trending toward an unacceptably degraded condition, corrective actions are required. These corrective actions include monitoring additional pump parameters, review of relevant data to determine the cause of the deviation, and potential removal from service.

3.4 Evaluation of Licensee's Proposed Alternative

There are two horizontal CBS pumps at Seabrook Station. These pumps are designed to take suction from either the RWST in the ECCS injection mode or the containment recirculation sump in the ECCS recirculation mode. The CBS pumps discharge the flow back into the containment through the containment spray nozzles. Each train of the CBS system includes one 100% capacity pump. Figure 1 shows a simple flow diagram of one of the CBS trains for information only. The containment building spray system is designed to remove the energy discharged to the containment following a LOCA or MSLB to prevent the containment pressure from exceeding design pressure and to reduce and maintain containment temperature and pressure within acceptable limits.

The OM Code, in Subsection ISTB 4.2, requires that a comprehensive pump test be conducted in accordance with ISTB 5.2.3. The IST parameters that must be measured during the comprehensive test for the containment spray pumps, as specified in Table ISTB 4.1-1, are differential pressure, flow rate, and overall vibration. The OM Code, Paragraph ISTB 4.3(e)(1), requires that the reference values for the comprehensive test shall be established within ± 20% of the pump design flow rate. Table 5.1-1 requires that the comprehensive test be conducted biennially for each pump in the IST program.

The licensee states that the required (system) design flow is 2808 gpm and pump BEP flow is 3000 gpm. The licensee considers the containment building spray system a fixed system because, as they state, the flow cannot be varied by use of any of the installed valves. This option was eliminated due to the potential to cavitate the pumps and reduce the NPSH margin for the pumps. As a result, the CBS pumps, CBS-P9A and CBS-P9B, can only be tested on a recirculation flow path which is sized for approximately 63% (1900 gpm) of the BEP flow and approximately 68% of the required design flow. Although the Code does not define pump design flow, the intent of ISTB, as stated in ISTB 1.1, is to assess the operational readiness of safety-related pumps. Assessing pump performance by using overall system parameters would be inappropriate. Therefore, in order to meet Code requirements, the test would have to be conducted at 2400 gpm which is 80% of the flow at the BEP of the CBS pumps.

The licensee stated in its relief request that in order to test the containment spray pumps to obtain the pump flow required by the Code, a dike of approximately 3 feet in height would have to be temporarily erected around the top of the sump in order to maintain sufficient NPSH to the pump. In addition, a spool piece would have to be removed, and temporary piping installed and routed back to the sump. This was previously performed as a part of the Seabrook Station pre-operational test when the plant was initially constructed, and the pump was tested insitu. The licensee has investigated using the existing flow loop to obtain additional data to validate some of the pre-operational test data, but concluded that using the installed flow control butterfly valves may damage the soft seats which were installed to address leakage issues.

The licensee has proposed to perform the comprehensive pump test at the reduced flow conditions. The licensee has not proposed an alternative test for the quarterly Group B testing.

This is because the quarterly test allows the reference point flow rate to be established at the highest practical value (i.e., 68% design flow). As such, the containment spray pumps will be tested in accordance with the current Group B requirements contained in ISTB 5.2.2. At Seabrook Station, Group B testing is also performed at the same point as the comprehensive test because it is a fixed resistance system. As specified in Table ISTB 4.1.1, quarterly vibration testing is not required. The required hydraulic acceptance criteria, as specified in Table ISTB 5.2.2-1, for the containment spray pumps, includes either flow or pressure measurement. This testing is less stringent than current Code requirements. Therefore, the licensee has proposed additional compensatory actions to offset the limited testing of the containment spray pumps during the comprehensive test. These additional compensatory actions are also discussed in a paper included in NUREG/CP-0152, Volume 4, Proceedings of the Seventh NRC/ASME Symposium on Valve and Pump Testing, entitled “Comprehensive Pump Testing Based on ASME OM Code Requirements and its Alternative and Related Relief Requests.”

In general, the comprehensive pump test was developed by the ASME Code to ensure a more accurate evaluation of the pump performance characteristics at reduced frequency. This test is intended to be conducted at, or near, the pump’s design flow rate because this area of the pump curve is considered to be the most representative of the pump’s design performance characteristics. The quarterly Group B test for standby pumps is intended as a largely qualitative test to allow for detection of gross mechanical or hydraulic failures, and not for determination of hydraulic performance capabilities, or to detect minor imbalances through vibration measurements.

Figure 2a is reproduced from curves provided by the licensee in its submittal dated August 18, 2000, and compares performance data for pump CBS-P9A taken both at the factory and during pre-operational testing with a recent IST hydraulic data point. Figure 2b is plotted from data provided in the licensee’s submittal dated September 8, 2000, and consists of performance data taken from all ISTs performed on CBS-P9A. Different reference flow rates are plotted on the same graph according to the date the test was performed. At higher flow rates, a lower pump head is expected. Figures 3a and 3b provide similar data for containment spray pump CBS-P9B.

In order for the licensee’s proposed alternative to provide an acceptable level of quality and safety, the pump test must be able to demonstrate that degradation will be readily detected, if performed at 63% of pump BEP. The optimum performance point to detect pump degradation is near the pump’s design flow rate because, as previously stated, this area of the pump curve is considered to be most representative of the pump’s design performance characteristics. Changes in hydraulic performance near the design point would not be as readily masked as they would be at conditions near the shutoff head of a centrifugal pump.

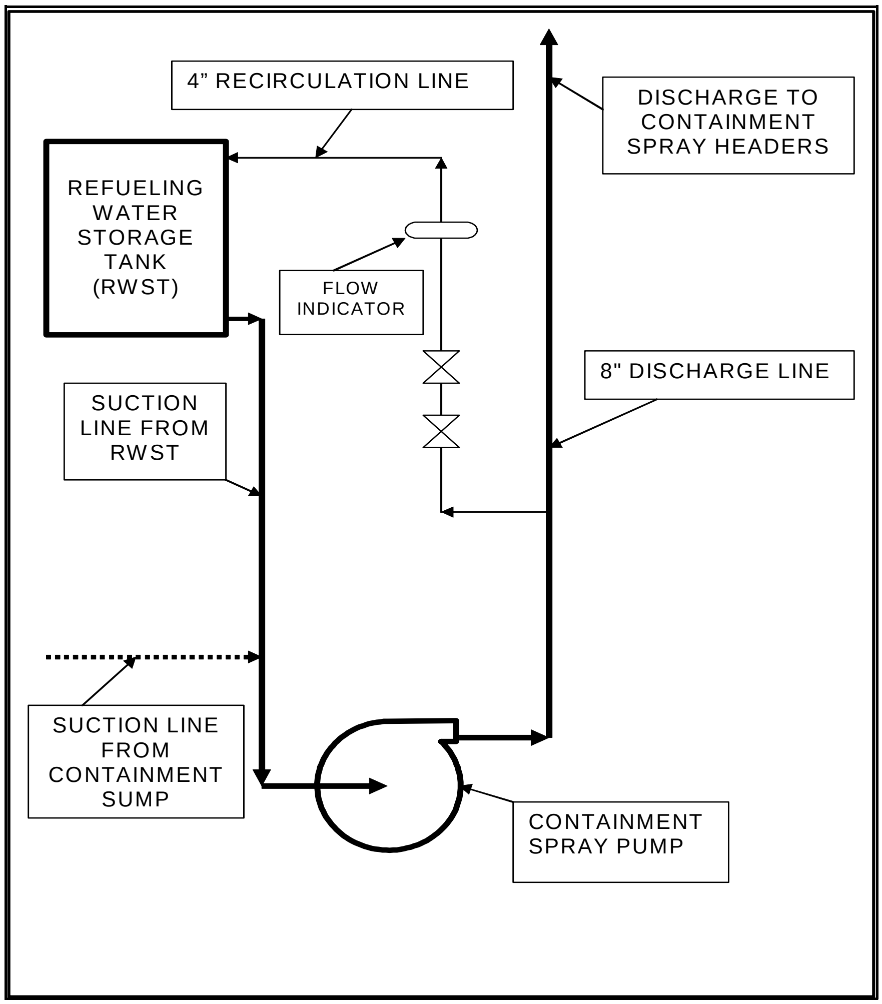
Based on the factory curves, the shutoff head of both containment spray pumps is 700 gpm. The staff also noted that the pre-operational performance curves are offset from the factory curve, possibly due to higher system resistance and methods of collecting and reducing the performance data. The representative IST points plotted on these two curves either coincide or are above the pre-operational performance curves. The staff also observed that the slopes of the pump/head curve measured at the factory and the pre-operational test curves show very small changes in the pump total developed head up to 2000 gpm. For example, for CBS-P9B, the total developed head at approximately 1900 gpm is 680 feet. At this value, the total developed head is within 3% of the shutoff head of the pump. At 2400 gpm, the curve plotted using data from pre-operational test PT-11 shows that the total developed head is approximately 620 feet, or 12% below the shutoff head of the pump. At 3000 gpm, the total developed head drops to approximately 560 feet, or 20% below the shutoff head.

Because the licensee considers the system to be a fixed resistance system, there is no fixed reference value. To evaluate the performance of each containment spray pump against the Code acceptance criteria, each pump is started, the system flow is allowed to stabilize, and pressure and flow measurements are recorded and compared with their respective acceptance criteria. Using the IST data provided by the licensee, the staff noted that the measured flow rate for both pumps have total variation of approximately 1.3%, while the total developed head variation is approximately 4.6% for pump CBS-P9A, and 2.4% for CBS-P9B. These values appear to be well within the acceptable Code required action limits. In addition, the repeatability of the test flow rate appears to be consistent with the guidance in NUREG-1482, Section 5.3, which refers to pump testing in earlier editions of the ASME OM Code.

As stated above, the IST data for both pumps was graphed such that for a particular flow rate, the corresponding total developed head was plotted on the date of the test. The intent of the plot is to provide trend data of total developed head at each measured flow rate for both containment spray pumps. The expected result was that at higher flow rates, there would be a lower pump total developed head. This would provide an indication that the pumps were being tested in an area of the curve such that the intent of the comprehensive test would be satisfied. However, in examining the IST data graphs for both CBS-P9A and CBS-P9B, the only trend that can be inferred is that the variability of the pump total developed head decreases significantly in tests after 1995. The plot of CBS-P9A yielded no similarity in pump head at constant flow rates. Additionally, despite the variability in the measured flow rate of 15 gpm (CBS-P9B testing, 1997), the total developed head is a constant 680 feet. These results may be due to instrument accuracy. Another possible explanation is that the region in which the pump is being tested is insensitive to small variations in pump flow because the pump is operating near its shutoff head.

Based on its analysis of the IST data, the staff finds that containment spray pump testing using the bypass line does not provide any additional information when compared to pump testing at much lower flow rates. Notwithstanding this analysis, the staff finds that the evaluation of the containment spray pump testing shows repeatable results using the current Code test strategy of using a flow test recirculation loop, which allows the pump testing at significant flow rates (albeit at a performance point that is approximately within 3% of the pump shutoff head). In addition, the licensee has proposed compensatory actions to supplement the testing strategy for the containment spray pumps. The compensatory actions include monitoring the CBS pumps in the Predictive Maintenance Monitoring Equipment Program. Under this program, the licensee will perform enhanced vibration monitoring and analysis of the pump and periodic sampling and analysis of the lube oil. If the additional measured parameters are found to be outside of the normal operating range, or are determined to be trending towards an unacceptably degraded condition, corrective actions will be taken. These corrective actions include monitoring additional pump parameters, reviewing relevant data to determine the cause of the deviation, and possibly removing the pump from service. Additionally, the flow testing of the containment spray pumps will be performed quarterly at significant flow rates. The staff further noted that the licensee has not identified any recent maintenance or testing issues with these pumps.

On the basis discussed above, the NRC staff finds that testing the containment spray pumps at 63% of the pump best efficiency point using the recirculation flow lines, together with the proposed compensatory actions, provides reasonable assurance of the operational readiness of the containment spray pumps and, therefore, concludes that the licensee's proposed alternative provides an acceptable level of quality and safety.




**Containment Building Spray Pump Flow Diagram**

Figure 1

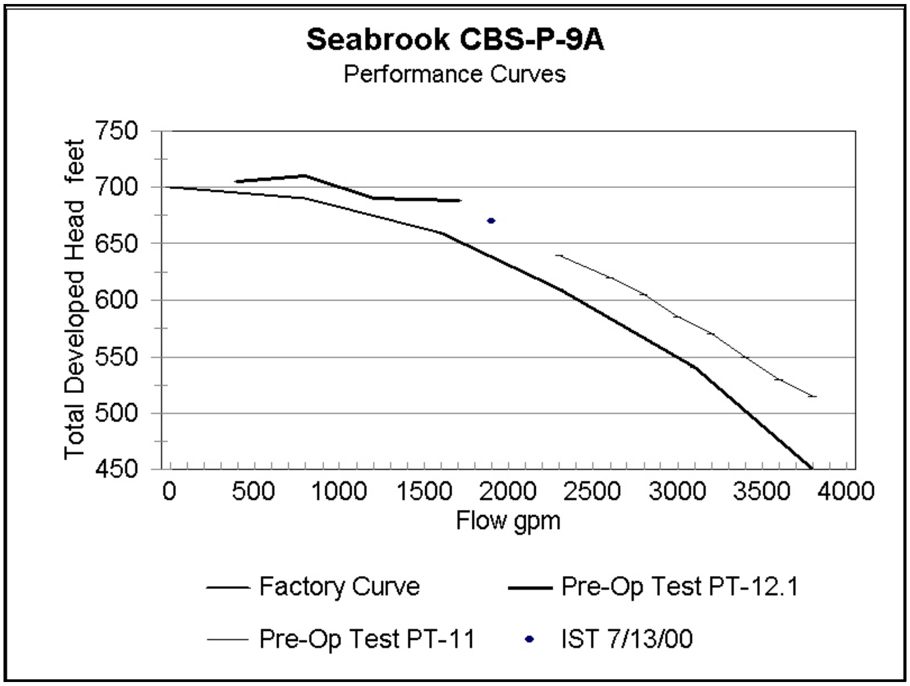



**Figure 2a**

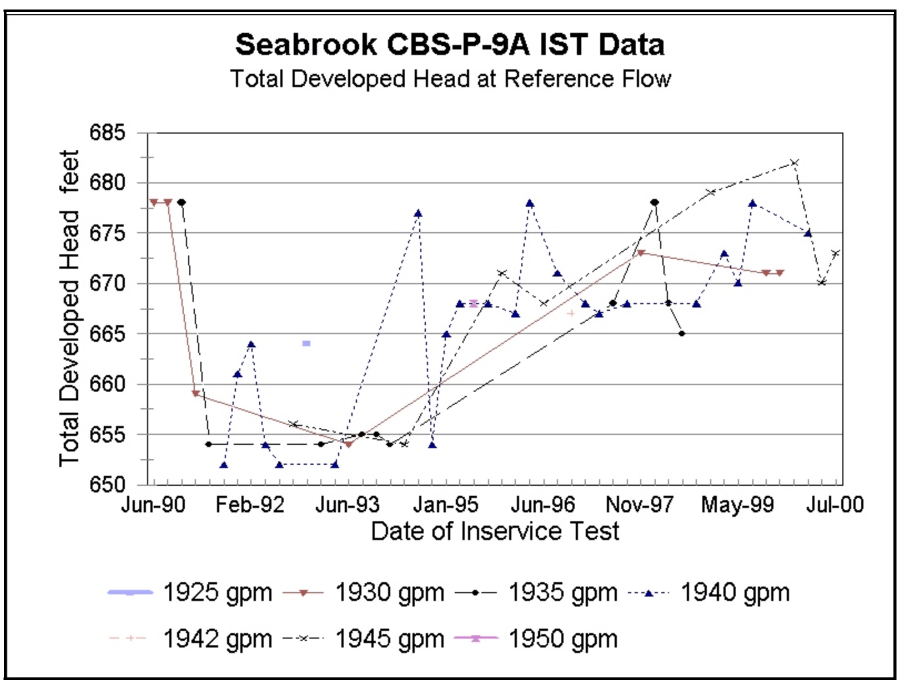



**Figure 2b**

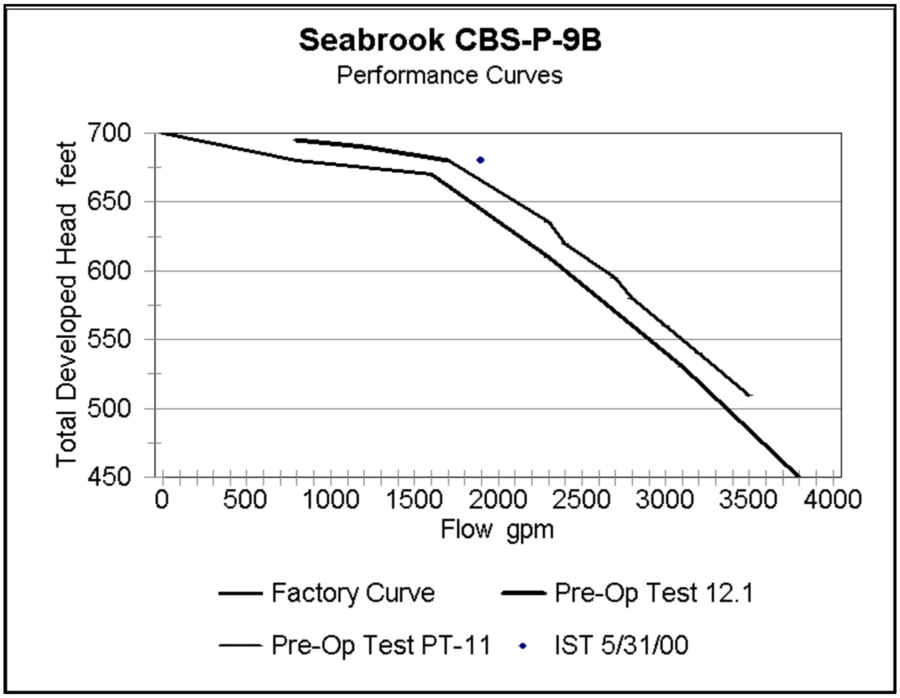



**Figure 3a**

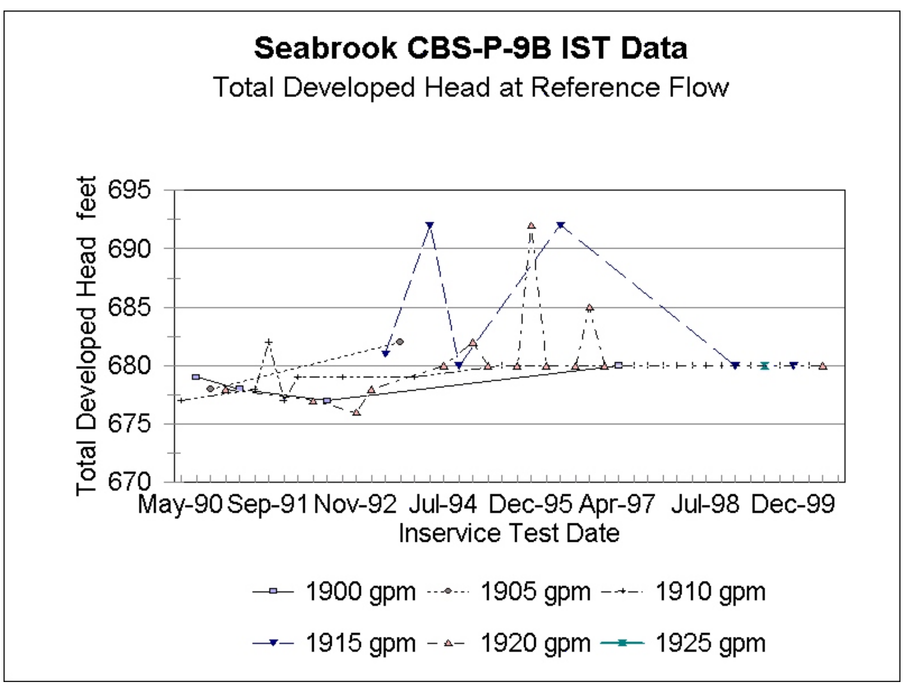



**Figure 3b**

## 4.0 CONCLUSION

Based on a review of the information provided by the licensee, the staff concludes that performance of the comprehensive inservice test at 63% BEP flow, coupled with the proposed compensatory actions, will provide an acceptable level of quality and safety by assuring the operational readiness of the containment spray pumps (CBS-P9A and CBS-P9B). Therefore, the proposed alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the remainder of the second 10-year IST program.

## 5.0 REFERENCES

*U.S. Code of Federal Regulations*, "Domestic Licensing of Production and Utilization Facilities," Part 50, Chapter I, Title 10, "Energy," Section 50.55a, Codes and standards.

U.S. Nuclear Regulatory Commission, "Guidance on Developing Acceptable Inservice Testing Program," Generic Letter 89-04, through Supplement 1, April 4, 1995.

U.S. Nuclear Regulatory Commission, "Guidance for Inservice Testing at Nuclear Power Plants," NUREG-1482, April 1995.

U.S. Nuclear Regulatory Commission, "Proceedings of the Seventh NRC/ASME Symposium on Valve and Pump Testing," NUREG/CP-0152, Volume 4, July, 2002.

ASME/ANSI, *Code for Operation and Maintenance of Nuclear Power Plants*, 1995 Edition and 1996 Addenda; Subsection: ISTB, "Inservice Testing of Pumps in Light-Water Reactor Power Plants."

Letter from J. M. Vargas, North Atlantic Energy Service Corporation, to Nuclear Regulatory Commission, "Seabrook Station, Inservice Testing Program for Pumps and Valves for Second 10-year Interval," dated March 21, 2000 and RAIs response letters dated August 18 and September 8, 2000.

Letter from J. M. Vargas, North Atlantic Energy Service Corporation, to Nuclear Regulatory Commission, "Seabrook Station, Inservice Testing Program for Pumps and Valves for Second Ten year Interval - Revision to Relief Request PR-1," dated October 28, 2002.

Safety Evaluation of relief requests for second 10-year interval inservice test program plan, Seabrook Station, Unit No. 1 (TAC No. MA8532), dated November 1, 2000.

Principal Contributors: G. Bedi
V. Nerses

Date: May 30, 2003