NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

General Offices • Selden Street, Berlin, Connecticut

P.O. BOX 270
HARTFORD, CONNECTICUT 06141-0270
(203) 665-5000

July 15, 1985

Docket No. 50-423
B11612

Director of Nuclear Reactor Regulation
Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

References: (1) W. G. Counsil letter to B. J. Youngblood, Response to Requests for Additional Information, dated September 19, 1984.

(2) B. J. Youngblood letter to W. G. Counsil, Issuance of Safety Evaluation Report - NUREG 1031 - Millstone Nuclear Power Station, Unit No. 3, dated August 2, 1984.

Dear Mr. Youngblood:

Millstone Nuclear Power Station, Unit No. 3
Revised Response to Question 492.7

In Reference (1), Northeast Nuclear Energy Company (NNECO) submitted a response to Core Performance Branch Question #492.7 concerning reactor coolant system (RCS) flow measurement capability at Millstone Unit No. 3. In that response, we indicated that an evaluation of the uncertainties associated with the instrumentation used in the RCS flow measurements was being performed and that the results of the evaluation would be submitted when complete. The Reference (1) response has been revised to include the results of our evaluation and is attached.

Please also note that this information also addresses SER Open Item #8 which was contained in Reference (2).

B001
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If you have any questions concerning this submittal, please feel free to contact our licensing representative directly.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY
et. al.

BY NORTHEAST NUCLEAR ENERGY COMPANY
Their Agent

J. F. Opeka
J. F. Opeka
Senior Vice President

W. F. Fee
By: W. F. Fee
Executive Vice President

STATE OF CONNECTICUT)
) ss. Berlin
COUNTY OF HARTFORD)

Then personally appeared before me W. F. Fee, who being duly sworn, did state that he is Executive Vice President of Northeast Nuclear Energy Company, an Applicant herein, that he is authorized to execute and file the foregoing information in the name and on behalf of the Applicants herein and that the statements contained in said information are true and correct to the best of his knowledge and belief.

Judith Alusa
Notary Public

My Commission Expires March 31, 1988

NRC Letter May 25, 1984

Question 492.7

Q.492.4 mentioned Seabrook rather than Millstone 3 (page 4 of response to Q.492.4). We therefore do not have confidence that you performed the required review of the Westinghouse standard response on flow measurement to assure that it applies to your plant. In order to provide this assurance, please answer the following questions.

(1) The instrumentation uncertainties cited are the generic bounding values for Westinghouse instrumentation. Plant-specific instrumentation uncertainties exceeding the bounding values cited in the Westinghouse response should be identified and used for the plant-specific analysis. Identify any instrumentation which deviates from the Westinghouse instrumentation and provide the uncertainty value pertinent to this instrumentation and measurement arrangement with comparison to the Westinghouse generic value. The bases or sources for the uncertainty value should also be provided. The sources can be from purchase specifications, manufacturing specifications, calibration data provided by instrumentation vendor or obtained on site, published industry standard or other justifiable bases.

(2) For the RCS flow measurement, the Westinghouse generic response states: "It is assumed for this error analysis, that this flow measurement is performed within seven days of calibrating the measurement instrumentation, therefore, drift effects are not included (except where necessary due to sensor location)." Does you plant operating procedure have provisions that require the RCS flow measurement be performed within seven days of calibrating the measurement instrumentation? If not, what are the drift uncertainty values associated with each component such a P Cell, local meter, RTD, thermocouple, process rack and sensors? What is the effect on the overall flow measurement uncertainty?

(3) The Westinghouse report states: "It is also assumed that the calorimetric flow measurement is performed at the beginning of a cycle, so no allowance has been made for feedwater venturi crud buildup;" and "If venturi fouling is detected by the plant, the venturi should be cleaned, prior to performance of the measurement. If the venturi is not cleaned, the effect of the fouling on the determination of the feedwater flow, and thus, the steam generator power and RCS flow, should be measured and treated as a bias, i.e., the error due to venturi fouling should be added to the statistical summation of the rest of the measurement errors."

(a) How do you assure that the venturi is clean at the beginning of a cycle? Is the venturi cleaned at the beginning of every cycle?

(b) How do you detect the venturi fouling and to what extent of uncertainty can you detect fouling?

(c) Describe the design provisions and procedures to clean the venturi if fouling is detected.

(d) How do you determine the error on feedwater flow measurement due to the fouling effect if the venturi is not cleaned or if the venturi fouling is not detected?

(e) If the venturi is not cleaned prior to the calorimetric flow measurement because no fouling is detected, an error component should be added. The magnitude of the error component should depend of the minimum detectable value of fouling.

Response:

1. The measurement of Reactor Coolant System (RCS) flow is based upon performing a precision heat balance flow measurement at the beginning of each fuel cycle and using the result to calibrate the RCS elbow tap flow indicators. The determination of error associated with RCS flow measurement is done by statistically combining the uncertainty associated with the instruments used in the RCS flow measurement. The instruments used in determining RCS flow are permanent plant instrumentation and are assumed to be read on the plant process computer with the exception of RCS Narrow Range T_{HOT} and T_{COLD} which are read on a precision three wire bridge.

   Major instrumentation used in the flow measurement include:

   1. Main Feedwater Flow (ΔP)
   2. Main Feedwater Pressure
   3. Main Feedwater Temperature
   4. Steam Generator (Line) Pressure
   5. Pressurizer Pressure
   6. Narrow Range T_{HOT} and T_{COLD}

   To reduce the amount of error in the determination of RCS flow it is assumed that the above instrumentation with the exception of Pressurizer Pressure has had a calibration check performed within seven days of the RCS flow measurement as required by Technical Specifications.

   The method used in determining error of an instrument loop is the statistical combination of the groups of components in an instrument loop which are statistically independent. Errors which are not statistically independent are combined arithmetically. Sources for instrument uncertainty are vendor technical manuals and drawings.

   Uncertainties in measuring core calorimetric power include:

Feedwater Temperature Error	± 0.57%
Feedwater Pressure Error	± 0.0017%
Steam Pressure Error	± 0.04%
Feedwater Flow Error	± 0.66%
System Heat Loss, RCP Heat Input and Steam Generator Blowdown	± 0.0025%

   The total uncertainty in determining core power is ± 0.44% for four loop operation and 0.50% for three loop operation.

Errors associated with determining RCS Volumetric Flow rate include:

Hot leg Temperature Effects (including a 1.2°F streaming effect)	± 3.14%
Cold leg Temperature Effects	± 3.23%
Hot leg Pressure Effects	± 0.193%
Cold leg Pressure Effects	± 0.321%

Total RCS flow uncertainty based on a precision heat balance is ± 2.31% for four loop operation and ±2.32% for three loop operation.

The accuracy of the RCS elbow tap flow indicators in determining total flow is ± 0.54%. Combining the uncertainty of the precision flow measurement and the RCS flow indicators produces a total RCS flow measurement uncertainty of ± 2.37% for four loop operation and ± 2.37% for three loop operation.

The above number assumes that feed flow venturies are clean. If the venturis are not verified to be clean, an additional 0.1% error will be included to increase the total flow error to ± 2.47% for four loop operation and ±2.47% for three loop operation.

NNECO will ensure that the minimum RCS flow is met by incorporating appropriate surveillance requirements in the Millstone Unit No. 3 Technical Specifications.

2. As noted in the response to Item 1, above, all instrumentation used to determine RCS flow with the exception of pressurizer pressure which has been determined to have a negligible effect on the total instrument uncertainty will have a calibration check performed within seven days prior to the RCS flow measurement.

3. a. Prior to initial plant startup, main feedflow venturis were installed clean. In addition, the section of feedwater piping with the venturis will be flushed prior to initial plant startup. At the beginning of subsequent fuel cycles venturis will be inspected. If venturi fouling is discovered during inspection, the venturis will be cleaned.

   b. Venturi fouling is detected using the performance monitoring program. Plant performance data is collected automatically on a daily basis and trended on a monthly basis. The plant parameters specifically reviewed for determination of venturi fouling are electrical output, feedwater flow, main steam flow, and first stage turbine pressure. The base relationship of these parameters will be established during startup testing and the first month of operation by review of the collected performance monitoring data. During this period, the venturi will be presumed to be clean. During the monthly performance review, the trended daily data for the mean electrical output mean steam flow and mean turbine first stage pressure will be compared to the mean feedwater flow. If the trend of the monthly review indicates that the relationship has deviated, corrective action will be taken before performing the next precision heat balance RCS flow measurement. The corrective action will involve inspecting and cleaning the venturi when venturi fouling is indicated.

c. During the first refueling outage, inspection ports will be added upstream and downstream of the venturis. Cleaning will be done by hydrolasing when required.

d. The venturi fouling term is a bias that will result in a higher measured feedwater flow and, in turn, a higher determined RCS flow than actual value. Therefore, if the feedwater venturi is not cleaned, the effect of the fouling on the determination of the feedwater flow and thus the steam generator power and RCS flow is such that all values will be treated in a conservative manner. However, prior to performing the calorimetric flow measurement, the venturis will be verified to be clean by performing a visual inspection (borascope, photography, etc.) and cleaned, when necessary.

e. Prior to the start of each cycle, the venturis will normally be inspected and cleaned if necessary. If the venturis are not inspected, an additional 0.1% will be added to the total RCS flow measurement uncertainty.

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Notary Public

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