UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 6, 1995

Mr. Robert E. Busch
President - Energy Resources Group
Northeast Utilities Service Company
c/o Mr. Richard M. Kacich
P.O. Box 128
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SUBJECT: AUGUST 24, 1995, MEETING WITH NORTHEAST NUCLEAR ENERGY COMPANY REGARDING SERVICE WATER SYSTEMS/STRAINERS (TAC NO. M93344)

Dear Mr. Busch:

By letter dated February 10, 1995, Northeast Nuclear Energy Company (NNECO) stated that they had concluded an internally initiated design review of the strainers associated with the Millstone Unit 1 service water (SW) and emergency service water (ESW) systems. The review was initiated to clarify apparent inconsistencies in the design and qualification, including the quality assurance status, of the SW and ESW components.

On August 24, 1995, a meeting was held between NNECO and the NRC staff to discuss the review. During the meeting, NNECO presented the results of the review, as well as the schedule and scope of proposed modifications which were recommended by the review team. In addition, NNECO raised several questions regarding the safety classification of the strainers and other equipment associated with the SW and ESW systems.

The NRC staff has reviewed the issues and concluded that NNECO's present safety classification used for various portions of the SW and ESW systems are within the licensing basis for Millstone Unit 1. Enclosed is the staff's review of the questions raised during the meeting. If you have any questions regarding this matter, please contact me at (301) 415-1437.

Sincerely,

James W. Andersen, Project Manager
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Office of Nuclear Reactor Regulation

Docket No. 50-245

Enclosure: As Stated

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REVIEW BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO

SERVICE WATER SYSTEMS/STRAINERS

NORTHEAST NUCLEAR ENERGY COMPANY

MILLSTONE NUCLEAR POWER STATION, UNIT 1

DOCKET NO. 50-245

1.0 BACKGROUND

By letter dated February 10, 1995, Northeast Nuclear Energy Company (NNECO) stated that they had concluded an internally initiated design review of the strainers associated with the Millstone Unit 1 service water (SW) and emergency service water (ESW) systems. The review was initiated to clarify apparent inconsistencies in the design and qualification, including the quality assurance status, of the SW and ESW components. On August 24, 1995, a meeting was held between NNECO and the NRC staff to discuss the review. During the meeting, NNECO raised 11 questions or concerns regarding the safety classification of the strainers and other components associated with the SW and ESW systems. These 11 questions or concerns are interrelated and revolve around the basic issue of whether the strainers (and hence the strainer backwash and other related equipment) should be considered as safety-related support systems for the safety-related SW and ESW systems. Rather than give specific responses to each of the 11 questions, the staff will give a general response and description of the overall issue that will address all of the questions. This will avoid a lot of repetition in the response and provide a better overall understanding of the bases for any conclusions reached. However, for purposes of clarifying the issues involved, the 11 specific questions or concerns are identified below. Some of the questions or concerns have been further paraphrased for clarity.

1. Whether or not the SW and ESW systems fall, or should fall under the provisions of Item (g) of Appendix A of the Quality Assurance Topical Report. That is, should these systems be considered safety related and fall under the provisions of Appendix B to Part 50 of Title 10 of the Code of Federal Regulations (10 CFR)?

2. Whether or not the strainer backwashing components of the SW and ESW systems fall, or should fall, under the provisions of Item (r) of Appendix A of the Quality Assurance Report. This question is similar to Question 1 and asks if the strainer backwashing components should fall under the provisions of Appendix B to 10 CFR Part 50.

3. If the SW and ESW backwashing components should fall under the provisions of the Quality Assurance Topical Report, and are by definition Category I, is not the attempt to create "exceptions" in Appendix A for these components contrary to the provisions of 10 CFR Part 50.54; at least without prior NRC approval? Note that Category I

Enclosure

is defined by NNECO in Appendix A to the subject quality assurance topical report and is basically meant to include all safety-related equipment.

4. Inasmuch as the self-cleaning strainers are described as a "support system" for the SW and ESW systems in the Updated Final Safety Analysis Report (UFSAR), are they not included in the technical specification's definition of operability; which explicitly includes support systems by definition?

5. Inasmuch as the UFSAR describes the strainers as self-cleaning, isn't this design basis information in accordance with the definition of 10 CFR Part 50.2? Also, if the SW and ESW systems are Category I, and the strainers are an in-series flow component within these systems, is it acceptable that they are self-cleaning under normal plant operation, but not under loss-of-coolant accident (LOCA) conditions?

6. Is the argument that periods of high intake structure fouling, due to seaweed ingestion, need not be considered coincident with a LOCA a valid argument? Do not the provisions of Criterion 2 of Appendix A to 10 CFR Part 50 require that the plant must consider a moderate frequency event, such as coastal storms with high seaweed concentrations at the intake structure, coincident with a LOCA? It is recognized that Millstone Unit 1 was built before the general design criteria (GDCs) were issued, but the UFSAR indicates it meets the intent of the GDCs.

7. Operability of the SW system would appear to be in question since the strainer will not backwash upon the loss of normal electric power (Generic Letter 91-18 indicates a loss of power results in a component being inoperable) and there is no platform from which to (safely) operate the SW strainer bypass valve which is approximately 10 feet above the floor.

8. It is not clear that under those conditions which have existed, where the SW self-cleaning strainer was clogging, while self-cleaning (no loss of power), adequate diesel generator cooling can be assured. It too would appear questionable, if valid credit can be taken for the SW bypass valve since this would imply that unstrained and debris laden sea water would then tend to clog the diesel generator's duplex strainer.

9. If the current revision of the Quality Assurance Topical Report implies the backwash components should be Category I (Item 2.above) and the current revision of Nuclear Group Procedure 6.01, Material, Equipment, and Parts List for In-Service Nuclear Generation Facilities, also implies the backwash components should be Category I, is this then not the current licensing basis?

10. In the context of asserting that a system is single-failure proof, is it complete and accurate information, if facility manual actions, under adverse conditions (disassembling components, climbing a vertical ladder and/or turning a hand wheel while standing on perhaps wet pipe; without any emergency lighting), in an ill defined time frame, have been assumed? In other words, do all these possibly complex or difficult actions that could be required after strainer clogging make the statement "the system is single failure proof" inaccurate or false?

11. Inasmuch as there was a priori knowledge that the strainer pit could flood, that it has flooded and in the context of Item 3 of Section 2.4, Nonconforming Conditions, Enclosure 1, of Generic Letter 91-18, shouldn't there be redundant safety related sump pumps in the strainer pit?

The overall general issue expressed by the above questions is rather complicated as confirmed by a 1991 NRC review of the October 4, 1990, intake structure event at Millstone Unit 1. In that review, similar questions were raised concerning potential design vulnerabilities in the SW intake structure, which serves both the SW system and the ESW system. The staff concluded that the strainers' designs were acceptable because they met the relevant criteria of the staff's regulations. However, it also noted that changing environmental conditions over the years might warrant changes in strainer design such as different size pore diameters or even redundant (SW) strainers with the capability to shift strainers while on line. The staff also noted that NNECO should be investigating potential improvements as part of individual plant examination (IPE) and the IPE for external events (IPEEE).

In the following sections, the staff briefly describes the SW and ESW systems, identifies what it considers to be the safety-related functions of both systems, and attempts to address all of the questions or concerns raised by NNECO.

2.0 SYSTEM DESCRIPTIONS

Both the SW and ESW systems perform safety-related functions. The SW system is required to function during normal plant operations and after plant accidents and transients. It performs both safety-related and non-safety-related functions. The safety-related function of the SW system is to provide cooling water to the diesel generator and the turbine building secondary closed cooling water system in the event of an accident or transient. The ESW system is a standby system that is manually initiated after certain design-basis accidents (large-break LOCAs) that result in operation of the low pressure coolant injection system in the containment cooling mode. Therefore, it is a safety-related system. The ESW system may occasionally operate during shutdown to supply some SW loads if the SW system is out for maintenance. However, it is not required to respond to a LOCA during this mode of operation.

The SW system contains a single strainer in the discharge path of all four SW pumps. The strainer can be bypassed by operator action to open a manual bypass valve. Hence, if the strainer were to become totally blocked all SW system flow would be lost until the strainer could be cleaned or bypassed. The ESW system contains two parallel strainers, one for each 100-percent capacity train. Therefore, both strainers would have to become blocked in order to lose the ESW system safety function. These strainers have no manual bypass capability and would have to be cleaned if they became blocked.

To minimize the potential for clogging, all of the strainers are self-cleaning and the intake structure is provided with traveling screens with a screenwash system to prevent debris from entering the forebay where the debris could be picked up by the SW and/or ESW pump suctions. The main potential cause of strainer clogging is probably seaweed (based on actual Millstone events). The self-cleaning aspect of the strainers consists of automatic backwash systems that are in continuous service (automatically cycle on and off) any time the system is operating. The strainers can also be manually backwashed locally, and the SW strainer can be bypassed by local manual operations. Since the valves and strainer motors associated with the automatic backwash function are not powered by a diesel generator bus (valves also require a non-safety-related air supply), local manual operations would be required in the event the strainers became blocked or partially clogged during a loss of offsite power (LOOP).

3.0 DISCUSSION/RESPONSE

Both the SW and ESW systems fall under the provisions of Appendix B to 10 CFR Part 50 because they are systems that prevent or mitigate the consequences of accidents that could cause undue risk to the health and safety of the public. Therefore, they should also fall under the provisions of NNECO's Quality Assurance Program Topical Report. The structural integrity of the strainers also fall under Appendix B because in the event of a seismic event the strainers must not fail in a manner that would affect the operation of their associated seismic Category I systems.

However, during its licensing review the staff did not assume a concurrent (concurrent with an accident) external event condition that could lead to blockage or clogging of the strainer(s) in the short term following any accidents. Therefore, the original licensing basis did not require a safety-related automatic backwash system. This licensing basis determination for the SW system is clear as neither the FSAR nor the UFSAR describe or discuss any automatic self-cleaning capabilities for the SW system strainer. Hence, a staff reviewer would not be aware that such capability existed for the SW system, and therefore, acceptance of the SW system could not be based on any self-cleaning strainer features. Although the FSAR does identify the self-cleaning features for the ESW strainers, it is not implied that those features are or need to be safety related. In the brief FSAR safety evaluation subsection, a loss of normal ac power is discussed and it is noted that the ESW pumps are supplied power from emergency power sources. The FSAR is mute

on the self-cleaning strainer feature in the event of a loss of normal ac power or LOOP. Hence, a staff reviewer would assume that the feature is not available for a LOOP.

Because the ESW system is only required to perform a safety function after design-basis LOCAs, strainer clogging or blockage is not a concern under any other conditions. The postulation that such unrelated conditions (instant blockage plus LOCA) would exist simultaneously is beyond the staff's licensing requirements. The staff believes that the probability of such occurrences is small enough that it does not pose an undue risk to the health and safety of the public. As for the post-LOCA long term potential for clogging, the staff assumes that operator actions to restore the ESW system (for containment cooling) to operation could be taken before any containment design limits were exceeded. In order for strainer blockage to occur, the seaweed or other debris must first pass through or over the traveling screens. The circulating water pumps, which provide most of the flow through the screens during normal plant operation, provide the main driving force to cause debris to enter the forebays and affect the SW and ESW pump bays. Without operation of the circulating water pumps, the rate of strainer fouling that could occur is expected to be rather slow with a gradual buildup in the strainers if they are not in a self-cleaning mode. The circulating water pumps provide a high differential pressure (d/p) across the traveling screens and have been instrumental in actual events associated with intrusion of seaweed or debris into the SW and ESW pump bays. Also note that if the circulating water pumps are running, offsite power must be available and the self-cleaning features should still be operable.

Operation of the SW system, on the other hand, is required for normal plant operation as well as response to design-basis accidents or transients. Therefore, the timing of postulated strainer clogging coincident with other events is not as clear cut. The accepted design of one strainer with a manual bypass presumes that operator action is an adequate means of dealing with a clogged strainer. The most probable transient that might occur with or due to conditions (offshore or onshore storms) that might lead to debris intrusion and strainer blockage is a LOOP followed by a reactor scram. Although this is not a design-basis event, it leads to a complete loss of ac power (because of loss of diesel generator cooling), which is a design-basis event under the station blackout (SBO) rule. Under these conditions the isolation condenser system (ICS) maintains the plant in a safe shutdown condition until SW is restored, which is assumed to occur much before the end of the SBO (duration of 8 hours for Millstone Unit 1 is required by the SBO rule). NNECO should determine the risk associated with this scenario (and possibly other scenarios associated with debris intrusion in the intake structure) during its performance of the IPEEE for Millstone Unit 1.

In light of the above, the staff considered NNECO's question of whether the strainer backwash components should fall under the provisions of Appendix B to 10 CFR Part 50. If the random failure of the backwash system would definitely (or directly) result in the loss of ESW flow, the staff would conclude that it is a <u>required</u> support system (like the lube oil system) and should fall under

the provisions of Appendix B, as its operation would be necessary for continued functioning of the SW system. However, the backwash system is only "necessary" in the event of excessive buildup of debris in the strainer. Thus, backwash system failure alone (or its unavailability during a LOOP) will not fail the SW system but would make it susceptible to another failure mode strainer blockage. Therefore, reliance on manual bypass or manual cleaning is necessary if such clogging occurs when the automatic backwash fails or is otherwise unavailable. Because such blockage is most likely to occur during normal plant operations or in the long term (rather than short term) after any accident or transient, the manual bypass function should be considered safety related (allows for manual strainer cleaning without interrupting flow) and the operability of the bypass valve should be demonstrated periodically. Hence, the strainer bypass path and its components, including the manual bypass valve, should fall under the provisions of Appendix B. Hence, the strainers' self-cleaning function does not fall under the technical specification definition of operability (as proposed in Question 4), which explicitly includes support systems, because they are not support systems required for the system to operate, such as lube oil or cooling water system.

General Design Criterion 2 (GDC 2) of Appendix A to 10 CFR Part 50 requires consideration of "appropriate" combinations of the effects of normal and accident conditions with the effects of the assumed natural phenomenon. Note that the term "appropriate combinations" is used and implies that it is a matter of judgment as to what combinations of accidents or transients and natural phenomena are to be considered to occur simultaneously. Historically, the staff has only assumed accidents or transients that may be caused by the natural phenomena under consideration. A particular plant's IPEEE should show if this assumption is adequate from a risk standpoint. The structures, systems, and components (SSCs) necessary to respond to the normal and accident conditions should be designed to withstand the effects of those natural phenomena that are postulated. If the natural phenomenon considered is a coastal storm (as postulated in one of the questions) that produces high seaweed conditions, there are a number of ways for an SSC to withstand these effects and perform its safety function. One of the ways for a system to be able to withstand these effects is through "appropriate" operator actions. The term "appropriate" is used because it is a matter of judgment as to what an operator can accomplish in a given period. It is also a matter of judgement in some cases as to what the given (assumed) period is before operator action is considered necessary. At Millstone Unit 1, the ICS should provide the operator with sufficient time to assess and correct the situation. With regard to the SW system strainer bypass valve (10 feet above the floor), NNECO should provide adequate lighting and accessibility to ensure that an operator could manipulate the valve with relative ease. It should also be noted that strainer blockage is not an automatically assumed result of a coastal storm. The trash racks and traveling screens function to reduce the potential for seaweed intrusion into the pump bays. Tripping of the circulating water pumps (high d/p across screens or LOOP) also reduces this potential. Most of the debris of concern floats and when only the SW pumps are operating the likelihood of drawing in floating debris is greatly reduced

because of the reduced flows through the screens. As long as the levels in the bays remain high, the floating debris will not enter the suction bell of the pumps.

In response to question 6, the staff believes that it is a valid argument that periods of high intake fouling due to seaweed (to the point of strainer blockage) will not occur coincident with a LOCA. Plant-specific risk assessments (IPEEEs) should be used to validate this assumption. As pointed out in the preceding paragraph GDC 2 does not require that a moderate frequency event, such as a coastal storm (specifically with high concentrations of seaweed), that would definitely block the SW or ESW strainers be considered coincident with a LOCA. The appropriate considerations are left to the judgment of the reviewer. In this particular case it was probably assumed that even if some strainer blockage did occur (regardless of cause), it would be a progressive long-term blockage and operator action could be taken to make the systems operable. However, such blockage was not expected to occur with any other design-basis event and, therefore, specific actions to recover from such blockage was not reviewed in detail.

NNECO has added (since licensing) duplex strainers at the SW system supply to each of the diesel generators. It is possible that these strainers could also become blocked, especially while the main SW strainer was being bypassed. The staff assumes that this also is a gradual buildup and corrective action can be taken by shifting and cleaning strainers without loss of flow. NNECO should have procedures and should ensure sufficient personnel are available and trained to perform these functions.

A related question was also raised with respect to the adequacy of the single non-safety-related sump pump NNECO added to the strainer pit because of a water intrusion event that occurred, the staff believes, as a result of a strainer seal failure (or other similar cause). The staff agrees that the sump pump need not be redundant or safety related because a pipe break or leak that could result in flooding of the pit would not be postulated coincident with any other event.

Question 10 could be considered a generic question that asks if complex operator actions might invalidate a claim that a system meets the single (active) failure criterion. Generically speaking the answer could be yes depending on the circumstances and the assumptions made. To take credit for operator action and still meet the single failure criterion, the time it takes to detect and overcome or negate the effects of the single active failure must not result in unacceptable consequences. That is, the accident or transient analysis under consideration must bound the resulting conditions. A necessary amount of judgment must be used when determining whether an action can be taken in a certain amount of time. The question specifies single failure proof rather than single active failure proof. Note that the SW or ESW system does not have to be single failure proof from a passive standpoint. Therefore, the staff considers that the term 'single failure proof' only applies to active failure modes. This is consistent with the staff's practice

in the past. For the case at hand, clogging of the strainer is not considered an active failure; therefore, it does not invalidate NNECO's claim that the system is single (active) failure proof.

4.0 SUMMARY

The staff believes that, generally, the designs of the SW and ESW systems are within the plant's licensing basis. However, that licensing basis also includes the capability to manually bypass the SW system strainers and/or manually clean the strainers (SW and ESW). NNECO should ensure adequate emergency procedures exist to respond to any strainer blockage and verify that the necessary manual actions can be satisfactorily performed with a reasonable amount of effort. The bypass valve should be treated as safety related and be periodically cycled to verify that it is indeed operable. The fact that the licensing basis does not assume strainer blockage during accidents or transients does not relieve NNECO of its obligation of operating the plant in a manner that does not propose an undue risk to the health and safety of the public. Over the years the potential for the intrusion of seaweed (or other debris) appears to have increased because of a changing environment. NNECO points out this changing environment (apparently due mostly to a buildup of Codium) in its evaluation of the October 4, 1990, event involving traveling screen failure and subsequent SW system strainer blockage (see Licensee Event Report 90-016). A cost and risk benefit analysis (IPEEE) based on the latest data may support a number of changes in the operation of the strainers and their support systems. These changes could include the capability to maintain the strainers' self-cleaning features in the event of a LOOP. An upgrade to a safety-related classification may not be warranted, but the capability to function after a LOOP (or loss of air if the air system is not powered by onsite power supplies) might provide a significant decrease risk for a relatively small cost. Additionally, just because an SSC is not safety related does not mean that no quality control or assurance programs should be associated with it.

Lastly, although the components of the self-cleaning systems are not safety related, they are considered important to safety because the functioning of both the SW and ESW systems relies on them to some degree. Therefore, although not subject to the requirements of Appendix B, they are subject to the requirements of GDC 1 "Quality Assurance and Records, of Appendix A to 10 CFR Part 50." According to GDC 1, non-safety-related SSCs should be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function they perform. The safety function in this case is maintaining SW/ESW flow in the event of the intrusion of seaweed or other debris. GDC 1 further requires that a quality assurance (QA) program be established for these SSCs in order to provide adequate assurance that they will perform their safety functions when called upon. The QA programs for these SSCs should be determined and controlled by NNECO and should be consistent with industry standards.

Principal Contributor: W. LeFave

Date: December 6, 1995