U. S. NUCLEAR REGULATORY COMMISSION
REGION I

DOCKET/REPORT NO: 50-336/95-27

LICENSEE: Northeast Nuclear Energy Company
Hartford, Connecticut 06141-0270

FACILITY: Millstone Nuclear Power Station, Unit 2
Waterford, Connecticut

DATES: July 10-14, 1995

INSPECTOR: Brenda Whitacre, Reactor Engineer, Systems Section

LEAD INSPECTOR: _____ 9/5/95
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Summary: Core reload safety analyses were evaluated along with licensee management involvement, interfaces with fuel vendors, and staff training/qualification. The reduction in boric acid storage tank (BAST) concentration for Unit 2 operation in Cycle 10 (and beyond) was also evaluated.

The inspectors found good corporate engineering support for Millstone 2 core reload activities. Both site and corporate nuclear reactor engineering staff were knowledgeable on reload activities. Reload safety analyses and safety evaluations were adequate. Good interface between the fuel vendor and licensee was observed, although independent reviews of past reload calculations in accordance with established design procedures were apparently not documented or assured. This item was left unresolved (95-27-01) pending short and long-term actions to ensure appropriate reviews, to clarify existing procedures and to review the applicability of NU's June 27, 1995 letter's corrective actions to core reload analyses.

The inspectors reviewed licensee calculations for boric acid storage tank concentrations, compared the results with Combustion Engineering recommendations, and found them to be appropriate.

DETAILS

1.0 RELOAD ACTIVITIES (60710)

The scope of this inspection was to review the Millstone Unit 2 core reload performance analysis. The analysis provided information to support operation of the plant through forthcoming Cycle 13 recently begun on August 4, 1995. The information in the reload analysis was used by the licensee as a basis for the 10 CFR 50.59 safety evaluation and to determine whether an unreviewed safety question exists. The reload analysis is important to safety because it assures that the new core provides adequate shutdown margin to limit core damage during postulated accidents.

1.1 Reload Safety Evaluation Report

The inspector reviewed the current Millstone Unit 2 Cycle 13 safety analysis report. The report evaluated operating conditions for Cycle 13 power distribution, control rod reactivity requirements, temperature coefficient, thermal-hydraulic design analysis, Final Safety Analysis Report (FSAR) Chapter 15 events, and trip setpoint verification. The Cycle 13 core consists of 84 new fuel assemblies. The safety analysis was provided by Siemens Power Corporation (SPC). The cycle length is estimated to be 559 full power days assuming a Cycle 12 burnup of 15,615 megawatt-days per metric ton of fuel (MWD/MTU). A core map showing the location of fuel assemblies and different types of fuel pins in the fuel assemblies are shown in SPC EMF-94-017, "Millstone 2 Cycle 13 safety analysis report."

The neutronic characteristics of the Cycle 13 core were reviewed by the inspector and found to be similar to those for Cycle 12. The nuclear design bases for Cycle 13 core are as follows:

1. The Cycle 13 design shall permit operation within plant technical specifications and core operating limit report (COLR) for Millstone Unit 2.

2. The Cycle 13 loading pattern shall be designed to achieve power distribution and control rod reactivity worths according to the following constraints:

   a). The peak linear heat rate (LHR) shall not exceed 15.1 kilowatts per foot (kW/ft), and the radial peaking factor (Fr), shall not exceed 1.69 in any single fuel rod under full power operating conditions.

   b). The scram worth of all control rods, minus the most reactive control rod, shall exceed the shutdown requirement of 3600 pcm (per cent millirho of reactivity).

The inspectors reviewed representative power distribution maps for Cycle 13 for beginning-of-life (BOC) and end-of-life (EOC). The power distributions were obtained from a three-dimensional quarter-core computer model with moderator density and doppler feedback incorporated. The calculated nominal BOC Fr is 1.60 and the LHR is 12.8 kW/ft. At EOC conditions, the corresponding values for Fr and LHR are 1.52 and 11.6 kw/ft, respectively. The technical specification limits on Fr and LHR are 1.69 and 1.51 kW/ft., respectively.

The inspectors reviewed the neutronic characteristics depicted in the Cycle 13 safety analysis report, EMF-94-017. This includes critical boron concentration, moderator temperature coefficient, doppler coefficient, delayed neutron fraction, and shutdown margin. This data reveals the neutronic similarities between both cycles 12 and 13. The methods used to generate the data are documented in "Exxon Nuclear Neutronics Design Methods for Pressurized Water Reactors", XN-74-27(a), April 1977. The inspectors compared the Cycle 12 and Cycle 13 neutronic data contained in the Millstone Unit 2 final safety analysis report (FSAR) with the above Exxon report and found that the data was bounded by the FSAR. Based on this comparison, the inspectors concluded that neutronic characteristics for Cycle 13 were technically adequate.

1.2 Reload Plant Design Change Records

The inspectors reviewed several plant design change records (PDCRs) to assess the quality of engineering activities performed by the licensee's staff:

- PDCR No. 2-34-88, "Cycle 10 Reload of Fuel," Rev. 0., Cycle 10 was the first cycle to use fuel designed and built by Advanced Nuclear Fuels (ANF). The core was loaded with 60 ANF Batch M fuel assemblies, three once burned and eight twice-burned Westinghouse Batch H assemblies, and one once burned and one twice-burned Westinghouse Batch G assembly. The inspectors reviewed the PDCR summary and safety evaluation (ISE/MP2-88-116) and found the analyses to be acceptable.

- PDCR No. 2-068-92, "Cycle 12 Reload of Fuel," Rev. 0, Cycle 12, consisted of 72 new SPC fuel assemblies and one twice-burned Westinghouse assembly. The cycle length was calculated to be 482 fuel power days, assuming a Cycle 11 burnup of 11500 MWD/MTU. The inspectors reviewed the safety evaluations for Cycle 12 (ISE/MP2-92-045) and found them to be technically sound and reasonable.

- PDCR No. 2-021-94, "Cycle 13 Reload of Fuel," consisted of 84 new SPC batch fuel assemblies of the advanced rod design. The cycle length was estimated to be 559 full power days. The inspectors reviewed both the PDCR overall design summary and the safety evaluation (ISE-MP2-94-043), and found them to be technically sound and of appropriate detail.

On July 12, 1995, the inspectors found that for Cycles 10, 11, 12, and current Cycle 13, the licensee apparently had no records which document that the reload safety analysis reports had been reviewed. In accordance with Nuclear Group Procedure (NGP) 5.05, "Design Input, Design Verification, and Design Interface Reviews," design reviews shall be conducted by an independent reviewer to provide assurance that design documents, such as calculations, analyses, or specifications, are correct and satisfactory. Per Paragraph 6.2.2 of NGP 5.05, "the results of the independent review shall be documented on the Design Review Form (Figure 7.4) by the independent reviewer." The inspectors concluded that this finding has limited safety impact because other reviews were performed, such as 50.59 safety evaluations and reviews required by the PDCR modification process. Also, some overlapping requirements exist in those procedures governing the control of purchase services, PDCR process, and in NGP 5.05, specifically, the requirement for independent reviews to be performed and documented. Further, NRC Inspection Report 50-336/95-08 and its associated enforcement action previously identified problems with reviews of vendor-provided analyses. NU provided corrective actions for that enforcement action in a June 27, 1995 letter to NRC. This item is unresolved until the licensee implements short and long-term actions to ensure appropriate reviews, to clarify existing procedures and to re-review the applicability of the June 27, 1995 corrective actions (URI 50-336/95-27-01).

2.0 RELOAD STAFF TRAINING AND QUALIFICATION

The inspectors reviewed the qualifications of personnel, both at the site and at the corporate office, who are involved in the review of the vendor's Cycle 13 core reload analysis. This review was conducted to verify that personnel involved in the review process were adequately qualified. The inspectors found that all personnel held college degrees in related technical fields, with several holding advanced degrees. Also, most personnel involved in the evaluation process had over 10 years experience in related activities.

The inspectors also reviewed the training records for those employees responsible for reviewing the reload analysis. Each employee was responsible for reviewing those procedures related to their job function and, if appropriate, were provided training on changes made to those applicable procedures. The staff also received comprehensive plant systems training.

Based on interviews with several Nuclear Fuels Engineering and Technical Support Group personnel, and reviews of training records, the inspectors conclude that those personnel involved in the review of the vendor reload analysis were adequately qualified and met the guidelines set forth in ANSI 18.7-1979, "Selection and Training of Nuclear Power Plant Personnel."

3.0 LICENSEE/FUEL VENDOR INTERFACE

The contract between the licensee and fuel vendor stipulates that both the licensee and the vendor will designate a project manager (engineer) who shall have full authority to act for his principal in all technical matters. The designated project engineer resides in the Nuclear Fuel Engineering, Reactor Performance Group at the licensees corporate office. Nuclear Fuel Engineering Procedure, NFE2, "Project Follow, Review and Documentation for Reload Fuel

Campaigns," establishes responsibilities of the project engineer from the initial cycle design decisions to the end of the cycles refueling outage. In addition, a designated reactor engineer in the site Technical Support Group is involved with day-to-day issues related to the core reload. During the course of the reload process, the corporate project engineer and designated Technical Support engineer regularly attend the quarterly project review meetings held between the licensee and the vendor to discuss reload progress, new issues, or vendor methodologies. The inspectors verified their attendance by reviewing the list of attendees. A report is published by the vendor to document those issues discussed at the quarterly meeting.

The inspectors interviewed several Technical Support personnel and corporate Nuclear Fuel Engineering personnel to better understand their roles in the core reload process and how information between the vendor and licensee is communicated. The inspectors found communications between site and corporate personnel to be good. Both groups appear to work well together in completing shared responsibilities in a timely manner. With regards to communications between the licensee and vendor staff, the inspectors found that both site and corporate personnel involved in the core reload process regularly exchange information with the vendor staff. The corporate project engineer maintains a log of communications (via letter or telephone) between the licensee and vendor. Technical Support personnel also route all correspondence with the vendor to the project engineer, to maintain control over the exchange of information between the licensee and the vendor. The inspectors concluded that good communication between the vendor and licensee staff has contributed to the success of past and present core reload evolutions.

4.0 UPDATE OF PLANT PROCEDURES WITH NEW CYCLE DEPENDENT PARAMETERS

The inspector reviewed those plant procedures requiring updating to include new cycle dependent parameters. From each new core reload analysis, new cycle dependent parameters are defined. Engineering Procedure EN 21022, "Conduct of Reactor Engineering," provides instruction for activities performed by the reactor engineer in support of the refueling outage. This procedure defines those procedures and forms which require updating to incorporate the new fuel cycle parameters. The Technical Support group is responsible for marking-up the affected procedure pages, assembling the change packages, and forwarding them to the responsible departments to obtain PORC/SORC approval. This document revision process is governed by Administrative Procedure DC1, Rev. 3, "Administration of Millstone Procedures and Forms."

The inspectors reviewed a sample of those procedures and forms that required revision for the new fuel cycle. All procedures were found to be updated with the new cycle parameters. The inspectors also reviewed the PORC meeting minutes to verify that all procedure revisions were approved by the PORC. The Plant Design Change Review (PDCR) package was reviewed to verify that all procedure changes were completed and documented. The inspectors concluded that procedure and form changes were made in accordance with station procedures.

5.0 BORIC ACID STORAGE TANK HEAT TRACING

The inspector reviewed a Combustion Engineering (CE) Technical Report, CEN-342(n), "Boric Acid Concentration Reduction Effort," dated November 1986. This report described the technical bases for allowing a reduction in the boric acid storage tank (BAST) concentration, to the point where heat tracing for the boric acid makeup system was no longer required in order to prevent boric acid precipitation.

To ensure that the current analysis remains valid for future cycles, the report contains bounding physics assumptions that were used to produce the required boron concentration values. These parameters include: inverse boron worths, EOC Xenon poisoning transient after shutdown, and moderator cooldown curves as shown in Appendix 8 of the CEN-342(n) report. As long as these inputs are more conservative than the reload cycle physics parameters, the values produced in the CEN-342(n) analysis report will bound the boron concentration values for future reload cycles. Hence, a sufficient concentration of dissolved boric acid will be maintained in the boric acid storage tank to provide the required shutdown margin.

On April 29, 1988, Northeast Utilities submitted a proposed revision to the technical specification on boric acid concentration reduction. Approval was granted in time for Cycle 10 operation. The technical basis and operational analysis to support this technical specification revision were contained in CE Report CEN-342(n). This technical specification (Section 3.1.2.7 and Figure 3.1-1) revision allowed a reduction in the BAST concentration to the point where heat tracing of the boric acid makeup system is no longer required.

With boron concentration in the range of 2.5-3.5 parts per million (ppm) in the refueling water storage tank (RWST), a plant cooldown table (from 557°F to 210°F) was generated by the nuclear engineering staff. The inspectors compared this cooldown table with the table generated by CEN-342(n) report and found it to be bounded. The boron concentration in the BAST tanks, which is required to bound all reload cycles, was calculated to be 663.9 ppm. This concentration involves a plant cooldown from 557 to 200°F, with BAST concentration at 3.0% weight boric acid and the RWST at 2,300 ppm of boron. The inspectors reviewed maximum boron concentrations under the above conditions. These concentrations were 471 ppm, 515 ppm, 447 ppm and 546 ppm for Cycles 10, 11, 12 and 13, respectively, and below the 663.9 ppm, calculated in the CE report.

Based on the above comparison, the inspectors concluded that the boron inventory in the Millstone Unit 2 BAST was sufficient for safe shutdown during previous Cycles 10, 11, 12, and current Cycle 13 operation.

6.0 MANAGEMENT MEETINGS

Licensee representatives were informed of the scope and purpose of the inspection at an entrance meeting conducted on July 10, 1995. During the course of the inspection, the inspectors' findings were discussed daily with the licensee representatives. An exit meeting was conducted on July 14, 1995, at which time the preliminary findings of the inspection were presented. During the inspection, the licensee indicated that fuel vendor proprietary information was reviewed as part of this inspection; however, none of this proprietary information was included as part of the final inspection report.

Persons attending the exit meeting are as follows:

Northeast Utilities

W. Baranowski	Manager, Plant Quality Services, NUSCO
R. Borchert	Sr. Reactor Engineer, NNECO
J. Guerci	Manager, Nuclear Fuel Engineering
M. Hills	Supervisor, Reactor Engineering
T. Honan	Supervisor, Reactor Performance
P. Lutzi	Engineer, Nuclear Licensing
G. Mendenhall	Sr. Engineer (Auditor), Assessment Services
J. Riley	Manager, Unit 2, Technical Support
M. Robles	Sr. Engineer, Nuclear Licensing
G. Van Noordennen	Supervisor, Nuclear Licensing
C. Wu	Sr. Engineer, Reactor Performance, NUSCO

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