U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-423/85-32

Docket No. 50-423

License No. CPPR-113 Priority -- Category A

Licensee: Northeast Nuclear Energy Company

P. O. Box 270

Hartford, Connecticut 06101

Facility Name: Millstone Nuclear Power Station, Unit #3

Inspection At: Waterford, Connecticut

Inspection Conducted: July 8 - 12, 1985

Inspectors: QAV for — 8-8-85
K. Manoly, Lead Reactor Engineer — date

A G Varela — 8-8-85
A. Varela, Lead Reactor Engineer — date

Approved by: Jon R. Johnson — 8/14/85
J. Johnson, Chief, Operational Programs Section, OB, DRS — date

Inspection Summary: Routine Inspection on July 8 - 12, 1985 (Report No. 50-423/85-32)

Areas Inspected: Routine, unannounced inspection by two region-based inspectors to follow-up on licensee actions related to the following: violations, unresolved items and construction deficiency reports the majority of which were identified during the Construction Team Inspection (CTI) No. 423/84-06. In addition, the inspection included a follow-up on a request by the Office of Inspection and Enforcement (IE) regarding verification of FSAR commitment to Regulatory Guide 1.94 for exemptions of concrete testing. The inspection involved 51 hours on site and 7 hours in the regional office.

Results: No violations were identified.

DETAILS

1. Persons Contacted

Northeast Utilities Service Company (NUSCO)

*K. Gray,	Staff Assistant
*P. Quinlan,	Staff Engineer
*L. Nadeau,	Assistant Project Engineer
*D. Hoisington,	Senior Engineer
J. LaWare,	QA Engineer Technologist
K. Lakshmi,	Structural Engineer
S. Orifice,	QA Engineer

Stone and Webster Engineering Corporation (SWEC)

G. Milley,	Lead Engineering Mechanics
R. Bain,	Millstone #3 Project Engineer Mechanics Staff
*G. Basilesco,	Millstone #3 Project Engineer Mechanics Staff
C. Kuhns,	Assistant QA Program Administrator
*W. Vos,	Senior FQC Engineer
*M. Matthews,	Assistant Superintendent, FQC
*P. Nelson,	Lead Engineering Assurance
M. Sinha,	Principal Structural Engineer
J. Capozzoli,Jr.,	Supervisor of Construction
R. Currier,	Structural Engineer
R. Zawacki,	Lead QC Engineer
P. Reilly,	Structural Designer
L. Peterson,	QC Engineer

U. S. Nuclear Regulatory Commission (NRC)

*T. Rebelowski, Senior Resident Inspector

* Indicates persons present at the exit meeting.

2. Licensee Response on Previous Identified Items

2.1 (Closed) Unresolved Item (423/83-21-04):

This item is related to the evaluation of feedwater piping at the steam generator (S.G.)inlet nozzle. Concerns were identified regarding the qualification of the piping reducing elbow fitting at the S.G. nozzle on the basis of actual geometry and wall thickness. Four specific items of concern were identified in inspection report No. 50-423/84-12.

The piping stress re-analysis of the feedwater piping was performed by SWEC to reconcile the actual as-built configuration and geometry of the reducing elbow and nozzle junction at the steam generator.

Revision #3 of the re-analysis (which is documented in stress calculation No. 12179-NPCF-X1701) was reviewed during this inspection. The re-analysis addressed the previously identified concerns as follows:

- Consideration for effects of stress intensification (SIF) of nozzle stresses on both sides of the junction has been addressed. The guidance regarding stress indices for abutting products in ASME section III sub-section NB 3683.2(a) was found to be applicable to SIF's for two piping products (reducers) at the nozzle junction.

- The actual as-built configuration and wall thickness of the nozzle reducing elbow were obtained by taking the outside diameter and UT thickness measurements at 0° and 180° along four locations on the elbow centerline. These measurements were used for the computation of the flexibility and stress intensification factors as required in the pipe stress re-analysis for steam generator C & D.

- Consideration of load transients resulting from the isolation condenser valve closure inside containment was addressed in the analysis. The transient analysis was performed using time dependent forcing function at various locations along the piping (at change of direction points).

The maximum computed stresses at the nozzle junction to the steam generator were determined as follows:

-- Sustained loads (EQ.8): 7,768 psi
-- Occasional loads (Normal + upset) (EQ.9): 13,733 psi
-- Occasional loads (Faulted) (EQ.9) : 15,383 psi
-- Thermal Expansion (EQ.11) : 33,240 psi

All of the above stresses were below the corresponding ASME code allowable limits in section NC 3650. It was also determined that the licensee has included the inlet nozzle of the steam generator in the ISI program. This item is closed.

2.2 (Closed) Violation (423/84-04-05) and CDR (423/84-00-05)

The violation (423/84-04-05) was related to the deficiency identified in ITT Grinnell hanger strut No. 3-CCP-2-PSR039 in which the rod end was found to be jammed against the weld on the inside of the rear bracket and thus did not allow the required angular movement of ± 5 degrees of the rod. The licensee issued a potential significant deficiency (CDR 423/84-00-05) indicating that the five degree cone of action required between the strut and the rear bracket was not available due to an interference which only allowed a swing angle of two degrees from normal.

The CDR also indicated that the interference was due to a bent rear bracket in conjunction with a bent end of the sway strut. This determination differed from an earlier finding in the Report of a Problem (ROAP) which identified the weld on the rear bracket as the cause for interference with the rod end of the strut.

The inspector reviewed the licensee's response which concluded that construction damage had caused movement of the pipe clamp 2 1/2 inches from its installed location. The following documents were also reviewed in conjunction with the identified deficiency and corrective action:

- Nonconforamnce and Disposition Report (N&D) No. 4741 which authorizes and documents the rework by replacing the existing defective rear bracket and moving the hanger to its original condition. The completed rework was signed off on April 16, 1984.

- The QA inspection report (IR No. P4A91977) documenting the sampling inspection of two hundred and two supports randomly selected from tnirteen systems for similar end bracket deficiency as identified on hanger No. 3-CCP-2-PSR-039. All of the inspected hangers were found to have acceptable paddle to the end bracket assembly.

- Memoranda from superintendent of construction to construction personnel on January 19 and July 20, 1984 emphasizing the necessity for adherence to Quality Standard (QS) 14.1, "Post Acceptance Work Control" which controls unplanned work performed on an item component, equipment or structure which had previously been accepted by FQC.

The identified hanger deficiency was found acceptable to close the violation and the construction deficiency report.

2.3 (Closed) Violation (423/84-04-09)

This violation was concerned with the identification of two beams (No. 34 B1 & 33 B3) in the Main Steam Valve Building (MSVB) which were not properly seated such that full bearing on the stiffened beam seat was not achieved as required in detail "AJ" of drawing ES-31J-3.

The inspector reviewed the licensee's response to the violation which addressed the original corrective action in addition to that undertaken as a result of the agreement between SWEC, NUSCO and the NRC on August 3, 1984. The licensee 's original corrective action included the inspection of all structural beams in the MSVB with end connection details similar to those with the identified deficiency.

The reinspection by SWEC field QC resulted in the identification of a third improper bearing of beam No. 33 B1. The inspector reviewed the QA reinspection record (IR No. S4A03661) and Non-Conformance & Disposition Report (N&D) No. 4788 which provided the disposition for the repair by using shims to provide full bearing for three nonconforming beam seats. The shimming was completed and inspected in July 13, 1984.

Additionally, the inspector reviewed the QA records (IR No. S4A04575 and S4A04576) which document the reinspection of fifty more similar beam seats for proper installation (41 in the Reactor Bldg. and 9 in the Control Bldg.). These connections were selected, from a sample of 119 beam seats of a similar design function, and were provided by the structural group for FQC inspection on a sample basis. The inspection was performed in accordance with the structural steel installation specification (C970). This effort was conducted to meet the new commitment for additional sampling reinspection dated August 3, 1984. No other findings of unsatisfactory beam seat installations were identified in the field QC reinspection effort. The licensee's action was considered adequate to close this violation.

2.4 (Closed) Construction Deficiency Report (423/82-00-13)

This item involved the reduced capacity of pipe straps with "reduced ears" and the licensee's action regarding the modification of four-pipe anchors which utilized these straps. The supports were originally designed as six way restraints and were modified as three way restraints. The concern was related to the capability of the straps to restrain the piping along its axis.

The inspector reviewed the licensee's written response which was provided by SWEC. The response was incorrect as it stated that the pipe straps were designed to restrain the piping in two lateral directions only and that the third or axial restrained direction (for the strap and other support structures associated with it) was designed to accommodate the frictional forces resulting from the normal loads in the two lateral directions.

As was identified during the inspection and from the review of the drawing, the supports are three way restraints for which the axial load components exceeded those in the plane of the strap. Despite the inaccuracies in SWEC's response, generic calculations were performed for the qualification of the straps in three directions using "STRUDL" computer program. The qualification was performed for a two directional in-plane load of 100 lbs and an out-of-plane load of 1000 lbs.

The straps stiffness were determined to be equal to 5 x 10^4 lb/in in the out-of-plane direction. The inspector also reviewed the four calculation packages involving the modified anchor supports. The packages reviewed are:

- Calculation No. Z88A - 031 for pipe support No. 3BRS-2-PSR 031
- Calculation No. Z88A - 066 for pipe support No. 3BRS-2-PSR 066
- Calculation No. Z88A - 019 for pipe support No. 3BRS-2-PSR 019
- Calculation No. Z88A - 065 for pipe support No. 3BRS-2-PSR 065

No further concerns were identifed during this review. This item is closed.

2.5 (Closed) Unresolved Item (423/84-04-06)

This item is related to the approach used by SWEC for the combination of piping seismic support loads of intermediate anchor points located between piping runs. Anchor seismic loads are determined using the square root of the sum of the squares (SRSS) of the respective pipe support loads obtained from the pipe stress analyses of piping in both sides of the anchor.

A review was performed of SWEC's response to the unresolved item, which included specific analyses of three representative piping systems to demonstrate the adequacy of the loading combination technique being used. In addition, the response included other supporting studies which demonstrate the inherent conservatism in the present approach for piping analysis. The following studies were presented in SWEC's response:

- A study by SWEC based on three piping models, each containing one or more intermediate anchors. The models were separated at their intermediate anchor points and each sub-model was analyzed using the response spectrum modal analysis technique. The three models were also analyzed using the more accurate seismic time history method. The time history analysis utilized the floor time history from which the response spectrum is based.

  A comparison of the results from both analyses indicated that the approach utilizing the SRSS summation of the sub-model results had overpredicted the intermediate anchor loads by a factor of 1.24 to more than three over that which utilizes the time history approach. The analyses covered pipe sizes from 4" to 14" inclusive.

- A study by G. Hubert (ASME Piping and Pressure Vessel Conference, Denver, June 15-16, 1981) to compare the dynamic response of LMFBR coolant loop piping using the response spectra and time modal superpostition techniques. Both analyses were based on the assumption of linear conditions. The modal responses in the response

spectrum method were combined in accordance with NRC Reg. Guide 1.92. In the time history method, the maximum responses were determined utilizing four possible algebraic combinations of three directional earthquakes. The results at the reactor nozzle from the piping analysis using the time history method were between 11 percent to 42 percent lower then those determined using the response spectrum method.

The conservatism resulting from removal of valleys in the response spectra method was evaluated in the study done by Hubert. Examination of the analytical results at a particular mode (12.31 HZ), indicated that the contribution to nozzle loads using the response spectrum method were approximately 24.5 percent higher than those obtained using the time history method.

- A study of the effects of pipe supports non-linearities by L. Severud et al (ASME Piping and Pressure Vessel Conference, June 1982, Vol. 67, "Special Applications in Piping Dynamic Analysis"). A comparison of small bore piping responses was done using: dynamic test simulating seismic accelerations, linear response spectrum analysis, and non-linear time-domain analysis. The results indicated that when a more exact piping model (including support non-linearities) is introduced, the piping responses were significantly lower than those obtained using the linear response spectra approach. The study also showed that the time domain non-linear analysis overpredicted the piping response when compared to the results from the pipe testing.

- Studies by Barte et al (ASME Piping and Pressure Vessel Conference, August 1980, vol. 40, "Seismic Analysis of Piping with Non-linear Supports") were performed to evaluated the effects of supports non-linear characteristics such as free play and local damping at snubber locations. The study was performed using three piping models and utilized the linear response spectrum and non-linear (direct integration) time history methods.

  Results from the analyses of the 4", 16" and 28" piping models indicated that the linear response spectra method predicted more conservative piping response and support loads than the more exact non-linear time history method when various support non-linearities were included.

The above data were found to provide a reasonable confidence that the SRSS technique for combination of loads at intermediate anchor points in piping runs is an appropriate analytical approach. This item is closed.

2.6 (Open) Unresolved Item (423/84-04-08)

This item is related to the assumption of decoupled piping response when performing seismic analysis of piping systems supported from structural steel beams. Four cases of piping hangers supported from structural steel in the reactor building were provided to the licensee as examples of this concern. The response provided by SWEC addressed the bases for performing de-coupled seismic analysis when piping systems are compared to the structural steel (as a primary system) with regard to mass and stiffness characteristics. The response, however, did not address the coupling effect between the floor system, such as the annulus steel rack framing with attached piping and equipment, and the building structure (as the primary system) at the specific locations for which the response spectra are specified. Effects of floor amplifications of piping system response as a result of floor mass and flexibility characteristics (as subsystem) was not addressed either for the four cited examples or generically. This item will remain open pending the licensee evaluation and NRC review.

2.7 (Open) Unresolved Item (423/84-04-10)

This item is related to the lack of specific evaluation for local stresses at web attachments of structural steel, introduced by piping or conduit hanger supports. Review of design calculation for the structural steel floor framing in the reactor building annulus area, at elevation 14'-10" between column lines 2 & 3, indicated that no specific evaluation was performed for piping hanger No. 3CCP-1-PSST-092 support attachments to the web of supporting wide flange floor beams. SWEC's response to the unresolved item was that "envelop" loads were considered in the design of structural steel framing to account for anticipated piping and other support attachments. It was also stated in the response, that the effects of local stresses would have been evaluated as hanger loads and attachment configurations were determined. However, no specific procedure was available for this evaluation of local attachments to webs of structural steel shapes. As was indicated in the unresolved item and confirmed by SWEC's response, Guideline NETM-27 was being utilized for the evaluation of eccentric attachments to the flanges of structural steel W shapes. Discussion of the above concern with the licensee and SWEC's representatives identified that SWEC has recently developed a procedure for the evaluation of attachments to webs of structural shapes. This procedure along with NETM-27, will be used for the evaluation of final attachment loads to building steel during the stress reconciliation effort of piping systems. It was also identified that a procedure No. NETM-57 was developed to provide technical direction for the verification of Category I structural steel. The procedure outlined a sampling program for the verification and documentation of original steel design for final loading conditions.

The inspector requested to review the generic web attachment procedure. A partial submittal was provided after the exit meeting. This item will remain open pending the evaluation of the entire procedure and its implementation in the load verification effort of Category I structural steel.

2.8 (Closed) Unresolved Item (423/84-04-07)

This item is related to the identification of inaccuracies in the design calculation of pipe support No. 3-CCP1-PSA-152. Improper application of loads was noted during the review of the above design document. A review of the revised calculations was performed during inspection (423/84-12) and it was verified that the proper design interface loads were used for the evaluation of the embedded plate at which the piping support was anchored.

The licensee had also committed to performing additional sampling review of piping support calculations to adequately address the extent of the identified design inaccuracy. The inspector examined the results of the licensee's sampling review of 109 design packages prepared between October 1 and December 12, 1984. All Engineering Mechanics Division (EMD) designers were required to fill out a special load verification form prior to the revision of any EMD calculation of duct supports, instrumentation supports and large and small bore piping supports. In addition, the inspector performed a sample review of the following pipe support design load verification identified above.

Support Mark No.	Calculation Package No.
CP-374092-H001	12179-NP(F)-Z2074-S092-H001-1
CP-374039-H011	12179-NP(F)-Z2074-S039-H011
CP-374524-H018	12179-NP(F)-Z074-S524-H018-0
CP-372053-H002	12179-NP(F)-072-R053-H002-1
CP-374524-H004	12179-NP(F)-Z74-S524-H004-1

The licensee's corrective action was adequate, and no discrepancies were identified during the review of the above design documents. This item is closed.

2.9 (Open) Unresolved Item (423/83-17-01)

This item is concerned with the generic approach to the analysis of piping systems which is based on nominal values of piping and fitting thicknesses. The concern was identified at another facility, when the failure to consider heavier walled and higher schedule pipe fittings in pipe stress analysis had resulted in increased piping and support loads. The licensee presented the report prepared by SWEC which addresses the review of piping analysis including effects of heavy elbows.

The licensee was informed that the office of Nuclear Reactor Regulation of the NRC will issue a safety evaluation for this generic concern. In addition, the licensee was also informed that, based on preliminary discussions with NRR, a specific evaluation for effects of actual over-thickness of piping fittings (in particular, rigid piping systems which operate at high temperature) will be required to resolve this concern. The licensee agreed to provide the results for the evaluation of the diesel generator exhaust piping system for NRC review, to assess the potential overstress in a typically susceptible piping system. This item will remain open pending the issuance of the Safety Evaluation by NRR, the licensee's evaluation of the diesel generator exhaust piping considering actual piping/fitting thicknesses and the NRC review of the licensee's evaluation.

2.10 (Closed) Significant Deficiency (423/81-00-05), Fire Damage to the Containment Liner:

The licensee's final report, submitted to the NRC, dated August 30, 1982 presented SWEC engineering and construction specifications and techniques for corrective actions to repair the fire damage. The final completion of the prescribed repairs and the required verification and testing by QA/QC was accomplished in February, 1985. Documentation of the corrective actions, QA/QC records and the close out of NCRs were reviewed by the inspector and discussed with cognizant personnel and responsible QC engineers. The actions taken to correct the significant deficiency adequately fulfill the requirements of 10 CFR (50.55.e) and warrants the close out of CRD (423/81-00-05). This is supported by work observations identified in previous NRC inspection reports.

3. Verification of FSAR Commitment to Regulatory Guide 1.94

In the Millstone Unit 3 FSAR, amendment 10, two exceptions are taken in the degree of compliance to Regulatory Guide 1.94, Revision of 1976, regarding inprocess sampling of concrete in construction and qualification testing of a concrete admixture. The licensee states that the degree of compliance with RG 1.94 which endorses ANSI N. 45.2.5 (1978) is as follows:

Exception #1

The frequency of correlation testing of structural concrete is required by ANSI N45.2.5 to be performed in accordance with the applicable paragraphs of section 6.11 of this standard. The degree of compliance to Section 6.11 involves an exception to the frequency of inprocess testing for correlation tests between point of delivery and the placement point. This is explained as follows: Documentary evidence of inprocess tests on concrete were reviewed by the inspector. QC records for concrete sampling of pumped concrete at the

truck discharge identify that strength tests were taken at the truck discharge. Tests of air content, slump and temperature taken every 50 cy. at truck discharge were correlated with the same tests every 200 cy taken at the point of placement. SWEC specifications on Concrete Testing Services (C282) and Concrete Mixing Delivery and Placement (C299) further require that any changes in slump, air content and temperature from the truck discharge to the placement point are considered acceptable as long as the test results at the point of placement are within specification limits. If correlation tests results are unacceptable, the specifications require that correlation tests shall be made at the truck discharge and at the placement point until the problem is alleviated. The compressive strength test reports were observed to clearly identify the correlation tests for evaluation purposes. The inspector considers the above exception adequately satisfies ANSI N 45.2.5, 1978, Section 6.11 by the more stringent controls required to alleviate unacceptable inprocess correlation tests.

Exception #2

The admixture manufacturer shall submit certified test data confirming air-entraining admixture complies with ASTM C260 when tested in accordance with ASTM C233. For each production lot shipped, the manufacturer shall certify that the admixture is similar to the material represented by the test data. This is an exception to Reg. Guide 1.94/ANSI N45.2.5 which requires admixture be inprocess tested by a composite of each shipment for chemical composition, Ph and specific gravity per ASTM C-494. The exception is explained as follows: Documentary evidence of the supplier's certified initial report and subsequent quality assurance certification of individual lot shipments were reviewed by the inspector. The admix manufacturer, Master Builders tested their airentraining product MBVR to meet ASTM C260 requirements when tested in accordance with ASTM C233. Records of each lot shipped certified that the admixture, Vinsol Resin Standard, conforms with all the requirements of ASTM C260, AASHO M154 and Corps of Engineers CRD C13 specifications for airentraining admixture for concrete. The records identify that ASTM C233 section 3.1 blend of three different cements and aggregates qualified the admixture to the ASTM C260 requirements. Based on the above documentation and observations during construction by the inspector, he concludes that the suppliers control in his manufacture of the liquid admixture that was shipped to Millstone Unit 3 is adequate to support taking exception to RG 1.94/N 45.2.5 of testing the composite of each shipment without testing its' affect on other concrete ingredients.

The licensee exceptions taken to FSAR commitment to RG 1.94, Installation, Inspection and Testing of Structural Concrete, were found acceptable.

4. Unresolved Items

Unresolved items are matters about which information is required in order to ascertain whether they are acceptable items, violations or deviations. Items remaining unresolved in this inspection are discussed in Section 2 of this report.

5. Exit Meeting

An exit meeting was held on July 12, 1984 with members of the licensee staff and contractors as denoted in Section 1 of this report. The inspector discussed the scope and findings of the inspection. At no time during this inspection was written material provided to the licensee by the inspector.