U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-213/90-16

Docket No. 50-213

Licens. No. DPR-61

Licensee: Connecticut Yankee Atomic Power
P.O. Box 270
Hartford, Connecticut 06141

lity Name: Haddam Neck Plant

Inspection At: Haddam, Connecticut

Inspection Conducted: October 1 to October 5, 1990

Inspectors: Leonard S. Cheung — 1/8/91
L. S. Cheung, Senior Reactor Engineer — date

G. Rangarao — 1/8/91
G. Rangarao, Reactor Engineer — date

Leonard S. Cheung for — 1/9/91
G. Garten, Reactor Engineer — date

Approved by: C J Anderson — 1/5/91
C. J. Anderson, Chief, PSS, DRS — date

Inspection Summary: Inspection on October 1 to October 5, 1990 (Inspection Report No. 50-213/90-16).

Areas Inspected: Special, announced inspection to review the licensee's implementation of Regulatory Guide 1.97, Revision 2 which relates to post accident monitoring instrumentation.

Results: Based on this inspection, the inspectors determined that the licensee had implemented a program to meet the recommendations of RG 1.97 except for certain deficiencies listed below:

2 VIOLATIONS	DISCUSSED IN PARAGRAPH	ITEM NUMBER
1. Qualification of auxiliary feedwater flow transmitters.	4.3	50-213/90-16-01
2. Qualification of containment pressure transmitters.	4.5	50-213/90-16-05
1 DEVIATION		
All auxiliary feedwater flow instrument cables routed in a common conduit.	4.3	50-213/90-16-02
2 UNRESOLVED ITEMS		
1. Oscillation of auxiliary feedwater flow indicators.	5.0	50-213/90-16-03
2. RG 1.97 instruments in the control room not specifically marked.	5.0	50-213/90-16-04

DETAILS

1.0 Persons Contacted

See Attachment 1

2.0 Background

The purpose of this inspection was to review instrumentation systems for assessing plant conditions during and following the course of an accident based on the criteria specified in Regulatory Guide (RG) 1.97, Revision 2. These systems were inspected to determine if they were installed in accordance with Generic Letter number 82-33 "Requirements for Emergency Response Capability" (Supplement 1 to NUREG-0737). This letter specifies those requirements regarding emergency response capabilities that have been approved by the NRC for implementation. This supplement also discusses, in part, the application of RG 1.97 to the emergency response facilities, including the control room, the technical support center (TSC) and the emergency response facility. Regulatory Guide 1.97 identifies the plant variables to be measured and the instrumentation criteria for assuring acceptable emergency response capability during and following the course of an accident.

Regulatory Guide 1.97 divides Post Accident Instrumentation into three categories and five types. The three design categories are noted as 1, 2 and 3. Category 1 has the most stringent design requirements and category 3 has the least stringent. The five types of instrumentation identified in the Regulatory Guide are types A, B, C, D, and E. Type A variables are plant specific and classified by the licensee. Type B variables provide information to indicate that plant safety functions are being accomplished. Type C variables provide information regarding the breach of barriers for fission product release. Type D variables indicate the operation of individual safety systems. Type E variables are those that indicate and determine the magnitude of the release of radioactive materials. Each variable type can be any design category. However, Type A variables must meet Category 1 design requirements.

3.0 Scope

The NRC inspection scope included: equipment qualification (Seismic and Environmental), redundancy of power supplies, display and recording methods used for measured variables, independence and separation of electrical circuits, range and overlapping features of multiple instrument indicators, equipment identification for RG 1.97 instruments, service, test and surveillance frequency, and direct and indirect measurement of parameters of interest.

The safety related (Q) and environmental qualification (EQ) master equipment lists were reviewed for the instruments selected to ascertain whether they had been evaluated and tested to the appropriate environmental, quality assurance (QA) and seismic qualification requirements.

4.0 Inspection Details

The inspectors held discussions with various members of the licensee's staff, reviewed drawings and procedures, and selected variables for a system walkdown. Walkdowns were performed for the sensing instruments at various locations of the auxiliary building and the display instruments in the control room to assess the implementation of RG 1.97, Rev. 2.

Instrument variables reviewed included, reactor coolant pressure, pressurizer level, reactor coolant cold leg temperature, steam generator pressure, steam generator level, auxiliary feedwater flow, containment pressure, containment hydrogen concentration and neutron flux monitors.

Characteristics examined for each variable include instrument identity, location, function, separation (physical/electrical), isolation, seismic qualification, power source, environmental qualification status and instrument range.

The instrumentation for the variables selected are discussed as follows:

4.1 Neutron Flux Monitor

The neutron flux instruments are classified as type B variable, Category 1 instruments in RG 1.97. The recommended instrument range is 10^{-6}% to 100% full power. The licensee's submittal to the NRC indicated that four wide range neutron monitors (WR-1, through WR-4, each with a range of 10^{-8}% to 200%) meet the recommended instrument range. However, WR-4 is not environmentally qualified due to certain components within the containment structure. The licensee excluded WR-4 from the RG 1.97 application, therefore, there are no EQ requirements for this instrument. The other three are environmentally and seismically qualified and capable of providing redundant information for this variable. These instruments are powered from Class 1E power supplies. One indicator is provided for each instrument channel and a multi-pen recorder is provided for this parameter. All three instrument channels were found to be in calibration. The inspector reviewed the associated drawings and procedures and did not identify any deficiencies. Instrument marking in the control room and isolation devices are discussed in paragraphs 5.0 and 4.10, respectively.

4.2 Containment Hydrogen Concentration

In their original submittal to the NRC, the licensee classified the containment hydrogen concentration to be a type A variable. Two hydrogen analyzers are provided for this variable. However, these two hydrogen analyzers are not environmentally qualified. The licensee excluded these analyzers from their RG 1.97 application. The licensee relies on the post-accident sampling system (PASS) to provide information for this variable. This deviation was documented in the licensee's Integrated Safety Assessment Program (ISAP) as part of a submittal to the NRC. This deviation was accepted by the NRC due to the fact that Haddam Neck has a large containment and the

hydrogen level takes about 8 months to build up to a dangerous level following an accident. The deviation and the acceptance were addressed in the Safety Evaluation Report (SER) dated January 18, 1990. During a December 14, 1990 telephone conversation, the licensee stated that the PASS is located in a mild environment (temperature and post accident radiation from the sample tubing). Therefore, environmental qualification is not required for the PASS.

4.3 Auxiliary Feedwater Flow

The licensee classified the auxiliary feedwater flow to be a type A variable. Four auxiliary feedwater flow instruments (FT-1303-1C, 2C, 3C, 4C) were provided for this variable, one for each steam generator. No deviation was addressed in the SER. The licensee's submittal indicated that these instruments were not environmentally qualified. The transmitters and the associated instrumentation cable are located in the Terry Turbine Room. The licensee stated that for post LOCA condition, the Terry Turbine Room is a mild environment. Therefore, environmental qualification is not required for those transmitters.

For a high energy line break (HELB) accident, the licensee originally relied on a feed-and-bleed process to maintain the steam generator water level, auxiliary feedwater flow indications are not required. However, this feed-and-bleed approach was not accepted by the NRC. Since July 1990, the licensee must rely on the auxiliary feedwater flow indication to provide safety information to the control room operators to perform safety manual functions. Therefore, the auxiliary feedwater flow transmitters and the associated cable must be qualified for the post-HELB environment. The licensee stated that these transmitters were never qualified for the post-HELB environment and were not on their EQ master list.

At the conclusion of this inspection, the licensee was still performing an operability evaluation for these instruments. Following the inspection, on October 9, 1990, the licensee informed the inspector that they determined these transmitters were operable. However, the associated State Terminal Blocks located inside the local electric box were not operable. These terminal blocks were replaced with qualified Raychem cable splices on October 6, 1990. The licensee is still in the process of qualifying these transmitters. The instrument cables used for these transmitters are Kerite FR cable and Rockbestos Firewall III cable. These cables are on the Haddam Neck EQ Master list.

Since auxiliary feedwater flow was classified by the licensee as a type A variable (RG 1.97 Category 1 instruments), the auxiliary feedwater flow transmitters and the associated terminal blocks are considered to be electric equipment important to safety as specified in paragraph b.2 of 10 CFR 50.49. The lack of environmental qualification for these instruments, since July 1990, is a violation of 10 CFR 50.49 paragraph f which requires that electric equipment important to safety be qualified by type testing, analysis or a combination of

both (50-213/90-16-01). In response to this deficiency, the licensee stated that following a postulated HELB accident, even if the auxiliary feedwater flow indicators become inoperable, the wide range steam generator indicators can be used to provide safety information to the control room operators to perform safety manual functions.

The electrical drawings reviewed by the inspector indicated that the power supplies to the four auxiliary feedwater flow transmitters are from two class 1E buses, FT-1301-1C and 2C from one bus while FT-1301-3C and 4C from the other bus. The inspector observed that the instrument cables of all four transmitters are routed in one common conduit for a relatively long distance. A single failure along the cable routing could cause all four instruments to be inoperable. This deviates from the RG 1.97, Revision 2, design criteria for Category 1 instrument as described in section 1.3.1, item b, which states "No single failure within either the accident-monitoring instrumentation, its auxiliary supporting features, or its power sources concurrent with the failures that are a condition or result of a specific accident should prevent the operators from being presented the information necessary for them to determine the safety status of the plant and to bring the plant to and maintain it in a safe condition following that accident."

In response to this concern, the licensee stated that this design had been accepted by the NRC for NUREG 0737, item II.E.1.2, for Auxiliary Feedwater System Automatic Initiation and Flow Indication. Acceptance of this design was addressed in the SER for this item dated October 8, 1982. Careful review of this SER indicated that the instrument requirements for NUREG 0737, item II.E.1.2, are not for type A variable application. The licensee later classified the auxiliary feedwater flow as a RG 1.97, type A, Category 1 variable in their September 30, 1986 submittal to the NRC for RG 1.97 implementation because Haddam Neck relies on these instruments to provide important information to the control room operators to perform safety manual functions. Therefore, these instruments must meet the RG 1.97, Category 1 design criteria. This constitutes a deviation from RG 1.97, Revision 2 (50-213/90-16-02).

4.4 Steam Generator Pressure

The licensee classified steam generator pressure as a type A, category 1 variable. Eight instrument loops are provided for this variable. Four transmitters (PT-1201A-1202A,-1203A,-1204A) are located outside the reactor containment, one for each steam generator. These instruments are also used to satisfy 10 CFR 50, Appendix R, requirements. Four transmitters (PT-1201B,-1202B,-1203B,-1204B) are located inside the reactor containment, one for each steam generator. None of the eight pressure transmitters are on the EQ master list. The licensee stated that all of these transmitters are considered to be located in a mild environment in that; during an accident inside the reactor containment, the outside containment transmitters will be used to monitor the variable; during an accident outside the reactor containment, the inside containment transmitters will be used.

The SER identified instrument range and the instrument power supply as two unacceptable areas requiring licensee resolution. These issues were addressed in the licensee's Integrated Safety Assessment Program (ISAP) which is followed by NRR. The licensee stated that the steam generator pressure transmitters will be upgraded later. The upgrade will resolve all of the NRC's concerns regarding the steam generator pressure instrument loops.

All eight instrument loops were determined to be in calibration as indicated in the instrument calibration records.

4.5 Containment Pressure

The licensee classified containment pressure as a type A, Category 1 variable. Two redundant pressure instrument loops (P-1810A and B) were provided for this variable. The instrument range meets the RG 1.97 recommended range. The containment pressure transmitters were not on the EQ master list and were not environmentally qualified. This issue was also addressed in the licensee's ISAP.

During the December 13, 1990 conversation, the licensee stated that they are in the process of removing these instruments from list of instruments designated type A, category 1. As of December 13, 1990, no submittal had been sent to the NRC regarding this action.

Category 1 instruments are classified as equipment important to safety as indicated in paragraph b.2 of 10 CFR 50.49. Lack of environmental qualification of the containment pressure transmitters constitutes a violation of 10 CFR 50.49 paragraph f, which requires that electric equipment important to safety be environmentally qualified by type testing, analysis, or a combination of both (50-213/90-16-05). The licensee did address in their submittal to the NRC that these transmitters are located outside the containment in a radiation-harsh-only environment. During the December 14, 1990 telephone conversation, the licensee claimed that these transmitters are qualifiable.

The instruments are in calibration as indicated in the instrument calibration record. The inspector reviewed the associated drawings and procedures. No other deficiencies were identified.

4.6 RCS Cold Leg Water Temperature

The licensee classified RCS cold leg water temperature as a type A, category 1 variable. One temperature sensing instrument loop is provided for each of the four RCS cold legs. Redundancy is provided by supplying two of the temperature sensing instrument loops from train A and two from train B. Physical independence was maintained in accordance with the plant's design basis which predates RG 1.75.

Regulatory Guide 1.97 recommended an instrument range of 50-750° F. The licensee's original submittal to the NRC stated that the range of the installed temperature indicators was 0-700° F. This range was found acceptable by the NRC and documented in the SER dated January 1990. However, since the original submittal, the licensee has replaced the old indicators with new indicators that provide a range of 50-750° F. The new range is consistent with RG 1.97 recommendation and is acceptable to the NRC.

The power supplies for both instrument channels are from Class 1E buses. The instrument loops were in calibration as evidenced by the calibration records. The inspector reviewed the associated drawings and procedures and observed no deficiencies.

4.7 Reactor Coolant System Pressure

The licensee classified reactor coolant system pressure to be a Type A variable. Two instrument channels (PT-403 and PT-404) are provided to monitor this variable following a postulated accident condition. An indicator and a recorder are provided for each channel. The transmitters are on the EQ master list. The seismic listing snows only the transmitters, whereas the indicators and the recorders, located in the main control room, are separately analyzed for the mountings and qualified for seismic requirements with other instrumentations mounted on the same section of the main control board. The power supply for trains A and B are provided respectively from the control racks AF/AR and DF/DR through Foxboro Spec-200 nest which are connected to Class 1E buses. The instrument loops were found to be in calibration as evidenced by the calibration records. The inspector reviewed the associated drawings and procedures and observed no deficiencies.

4.8 Pressurizer Water Level

The licensee classified pressurizer water level to be a type A variable. The licensee provided three instrument channels (LT-401-1, -2 and -3) for this variable. An indicator and a recorder are provided for each instrument channel.

Regulatory Guide 1.97 recommends pressurizer level instrumentation with a range from the bottom to the top of the pressurizer. The licensee has instrumentation with a range from 145 to 343 inches. This covers 86 percent of the pressurizer volume. The other 14 percent is in the hemispherical ends. The licensee indicated in their 1984 and 1986 submittals that this range can be complemented by the reactor vessel level instrumentation. This deviation was accepted by the NRC and addressed in the NRC SER dated January 18, 1990.

The transmitters are on the EQ master lists. The seismic listing shows only the transmitter, whereas the indicators and recorder located in the main control room, are separately analyzed for the mountings and qualified for seismic requirements with other

instrumentation in the main control board section. The power supply trains A and B are provided from instrument racks AF/AR, BF/BR and CF/CR through Foxboro Spec-200 nest which are connected to Class 1E buses. The instrumentation loops were found to be in calibration as evidenced by the calibration records. The inspector reviewed the associated drawings and procedures and observed no deficiencies.

4.9 Steam Generator Water Level

The licensee classified the steam generator water level to be a type A variable. The licensee has provided two level instruments for each of the four steam generators (LT-1302-1A&B, -2A&B, -3A&B, -4A&B).

For this level instrumentation, the licensee has not provided any recorders for the recording function. However, the level inputs are provided to the plant process computer with necessary signal isolation. The level transmitters are on EQ master lists. The seismic listing shows only the transmitters, whereas the indicators mounting and locations are assessed for the seismic requirements with main control board instrumentation. The power supply trains A and B are provided from Class 1E buses. The instrument loops were found to be in calibration as evidenced by the calibration records. For level indication, the licensee has provided a dual type indicator at the main control board for each steam generator. Each of these indicators derives signals from respective transmitter channels A and B through a signal isolation device. The cable termination on each indicator is greater than one inch apart. The wire leads that are taken from the cables are tie wrapped together behind the Unistrut support. Since isolation is provided in each instrument channel and the computer inputs are from different isolators and the computer display is still available, the propagation of an indicator failure is not a major concern for a four loop plant.

The inspector reviewed the associated drawings and procedures and observed no deficiencies.

4.10 Isolated Devices

When a Category 1 signal is used as input to a non-category 1 system, Regulatory Guide (RG 1.97) specifies the use of isolation devices which are fully qualified for use in category 1 circuits. The isolators (Module 2AD-VAI) used at Haddam Neck are part of the Foxboro Spec 200 system. This module was qualified by the manufacturer. The inspector reviewed reports from Foxboro entitled "The Foxboro Company Corporate Quality Assurance Laboratory Type Test Report," Nos. QOAAB17 Rev. B, QOAAB21 and QOAAB44 Rev. A. These reports provided analysis and test data that support the equipment qualification requirements for preventing fault propogation. Within the scope of this review, no deficiencies were identified.

5.0 Physical Inspection

The inspector performed a physical inspection on October 7, 1990, of display instruments located in the control room, and local instruments located in various areas of the Reactor Building. For the display instruments (indicators and recorders) specified, the inspector verified instrument function, instrument range and identification of RG 1.97 Instruments. For the local mounted instruments, the inspector verified instrument mounting and supports, separation of cable routing and instrument tubing for redundant instrument channels.

While in the control room, the inspector observed that the auxiliary feedwater flow indicators oscillated even though there was no flow in the auxiliary feedwater paths. Three of four flow indicators (FI-1301-1C, -2C and -3C) oscillated between 50 gpm and 100 gpm, while flow indicator GI-1301-4C oscillated around 50 gpm. The scale for these indicators is 0-300 gpm. These four indicators are all Technical Specification items as indicated on Table 3.7.3 of Haddam Neck Technical Specification.

The inspector contacted the I&C maintenance supervisor regarding this issue. The supervisor stated that all four auxiliary feedwater flow instrument loops behaved properly during the surveillance test that was conducted before the September 1990 restart. The licensee stated that this problem was not due to leakage of the upstream isolation valves because these valves were checked recently to be not leaking. At the conclusion of this inspection, the licensee was still trying to isolate this problem. The inspector asked the licensee to provide the NRC their position regarding the operability of the auxiliary flow indicators.

During a telephone conversation on October 9, 1990, the licensee stated that they had isolated the problem and determined the auxiliary flow instruments to be operable. They explained that the indicator oscillations were due to variation of the back pressure at the main feedwater header because the isolation valve downstream of each of the flow elements was open. When the downstream manual isolation valve is closed, the indicator showed 0 gpm. During operation, the downstream manual valve is required to remain open. The inspector expressed a concern that there might be other problems in the instrument's mechanical loops (e.g., the flow elements, the instrument impulse lines, etc.) that caused the inaccurate flow indications. This item is unresolved pending NRC review of the licensee's actions in isolating this problem (50-213/90-16-03).

While in the control room, the inspectors observed that the Category 1 instruments on the main control board had not been specifically identified as recommended by paragraph 1.4 of RG 1.97 regarding equipment identification. In response to this concern, the licensee stated verbally that identification of these instruments will be provided when the results of a control room design review are implemented in the future. This item is unresolved pending NRC review of the licensee's implementation of RG 1.97 instrumentation identification (50-213/90-16-04).

6.0 Unresolved Items

Unresolved items are matters about which more NRC review of the licensee supplied information is required in order to determine if they are acceptable items or violations. An unresolved item identified during this inspection is discussed in details, Paragraph 5.0 of this report.

7.0 Exit Meeting

The inspectors met with licensee representatives (denoted in Attachment 1) at the conclusion of the inspection on October 5, 1990. The inspectors summarized the scope of the inspection, the inspection findings and confirmed with the licensee that the documents reviewed by the team did not contain any proprietary information. The licensee agreed that the inspection report may be placed in the Public Document Room without prior licensee review for proprietary information.

ATTACHMENT 1

1.0 Persons Contacted

1.1 Northeast Utilities Service Company

*M. Bain, Sr. Engineer
P. Blasioli, Supervisor, Nuclear Licensing
M. Etre, Engineer, Engineering Mechanics
D. Gerber, Supervisor, Engineering Mechanics
G. Johnson, Director, Generation Engineering
R. Kacich, Licensing Manager
M. Kai, Supervisor, Safety Analysis
*M. Lombardi, EEQ Engineer
V. Mazzie, Supervisor, I&C Engineering
R. McCarthy, Generation Specialist
G. Noordenner, Supervisor, Licensing
S. Oates, Sr. Engineer Tech
E. Perkins, Sr. Licensing Engineer
A. Roby, System Manager, Generation Electrical Engineering
F. Sears, Vice President, Nuclear and Environmental Engineering
T. Shaffer, Manager, I&C Engineering
B. Tuthill, Supervisor, Nuclear Engineering

1.2 Connecticut Yankee Atomic Power Company

L. LeBaron, Electrical Engineer

*Indicates persons not attending the exit meeting.