U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-336/85-19

Docket No. 50-336

License No. DPR-65 Priority -- Category C

Licensee: Northeast Nuclear Energy Company

P.O. Box 270

Hartford, Connecticut 06141-0270

Facility Name: Millstone Nuclear Power Station, Unit 2

Inspection At: Waterford, Connecticut

Inspection Conducted: May 13-17, 1985

Inspectors: c/o for F Paulitz 7/19/85
F. P. Paulitz, Reactor Engineer date

Approved by: C J Anderson 7/19/85
C. J. Anderson, Chief date
Plant System Section, EPB

Inspection Summary:
Inspection conducted on May 13-17, 1985 (Inspection Report No. 50-336/85-19)

Areas Inspected: Routine, announced inspection by a region-based inspector of the Degraded Grid voltage procedure and licensee action on previous inspection findings. The inspection involved 7 hours at the NUSCO Berlin Office and 31 hours on site by one region based inspector.

Results: No violations were identified.

DETAILS

1.0 Persons Contacted

1.1 Northeast Utilities

R. Hallack, Generation Electric Engineer
J. Regan, Generation Electric Engineer
N. Thomas, Generation Electric Engineer
G. Sullivan, Generation Facilities Licensing
*J. Kelley, Millstone Unit 2 (MS2) Superintendent
*R. Bates, MS2 Assistant Engineering Supervisor
J. Summa, MS2 Assistant Engineering Supervisor
M. Wilson, MS2 Assistant Training Supervisor
K. Desalandes, MS2 Engineer
D. Kross, MS2 Instrument and Control Supervisor
*J. Heg, MS2 Assistant Operations Supervisor

1.2 United States Nuclear Regulatory Commission

*J. Shedlosky, Senior Resident Inspector

*Denotes those present at exit interview.

2.0 Licensee Action on Previous Inspection Findings

2.1 (Closed) Inspector Follow-up Item (79-30-01) Failure of all Control Room Annunciators

Background

The control room annunciators were designed with all annunciators sharing a common output of twenty eight (28) power supplies. This network concept provides reliability even with a number of individual power supply failures. However, the failures must be detected and corrected. The number of individual power supplies that can fail and the system remain operable must also be known.

Event

On December 29, 1979 all control room annunciator windows began to flash and eventually all windows went dark. The digital signals, that originated from the annunciators going to the process computer were also lost. One year after the above event, the 125 dc input to the twenty eight (28) power supplies was lost, during a loss of dc event. This again caused a total failure of the annunciator system.

Analysis

The annunciator system failure, associated with tne first event, was attributed to the licensee not knowing the number of power supply failures the system could tolerate. Also, no method had been established to monitor these power supplies to detect failures. The second failure was attributed to the vulnerability of a single input power supply.

Corrective Action

The licensee has modified the annunciator power supply as follows:

-- The first event immediate corrective action was to replace the fourteen (14) failed power supplies. The power supplies were to be monitored for operability.

-- The second event immediate corrective action was to restore the dc input power to the twenty eight (28) power supplies. The long term corrective action was the replacement of the twenty eight power supplies with two 100% capacity power supplies. The input to the new power supplies is from redundant 120 volt instrument busses, VR-11 and VR-28, which are associated with the class 1E electric system. The outputs from the power supplies required for the annunciators are 12 volts, 28 volts and 125 volts direct current. These outputs are connected to their respective auctioneer circuits. The power supply with the highest voltage would supply power to the annunciators.

   The annunciator power supplies are tested during each refueling outage using annunciation power supply voltage test procedure 1C 2433.

Finding

The above modification and the surveillance test being conducted has increased the reliability of the annunciator power supply system. No similar failures have occurred within the last four (4) years. This inspector follow-up item is closed.

2.2 (Closed) Inspector Follow-up Item (82-24-01) Reactor Trip and Normal Power Loss to a Safeguard Bus

Background

The Engineered Safety Features Actuation System (ESFAS) was designed with logic modules and output relays. Both the logic modules and the output relays have a lock-in and reset feature. After a partial or complete loss of supply power the logic modules must be reset, prior to resetting the output relays, to prevent inadvertent actuation of safety system components from ESFAS. Power must also be restored to

the output relay reset feature, and the output relay reset, before power is restored to the operation function of the output relay, otherwise inadvertent actuation of the safety system components would occur.

Event

Plant personnel were conducting an inventory of unused or untagged cables in the control board. During this activity a control wire was dislodged from its terminal lug and made contact with the control board metal frame. This caused a momentary electric fault to a 120 volt instrument bus and the following conditions occurred:

-- The 120 volt vital instrument bus supply was transferred from its primary source to its alternate source, prior to the fault being cleared by the faulted circuit protective device.

-- The ESFAS logic module 15 volt power supply was degraded, due to the above fault.

-- The ESFAS logic module 15 volt power supply monitor (PSM) sensed the above degraded voltage condition.

-- The PSM shorted the 24 volt output relay power supply which caused its fuses to open circuit. This feature prevents an output actuation from a faulty logic, due to a degraded 15 volt power supply.

-- During power restoration of the ESFAS and the system reset an output relay actuated and caused the following to occur:

    1. The safeguard bus normal power supply breaker was tripped open.

    2. The load shedding circuit tripped running loads from the safeguard bus.

    3. The Emergency Diesel Generator was started and its output breaker closed to energize the safeguard bus.

    4. Certain loads were sequenced back onto the safeguard bus.

-- When the safeguard bus normal supply breaker tripped open the 120 volt instrument bus VR-11 was deenergized.

-- The steam generator feed water level transmitter failed in the high level trip condition. This was due to either the degraded voltage condition caused by the initial fault or deenergizing the safeguard bus when restoring the ESFAS.

-- The steam generator high feed water level trip caused the turbine to trip.

-- The turbine trip caused the reactor to trip.

Analysis

The ESFAS as designed, used a 24 volt power to reset the 15 volt logic module system. During the resetting a reset race occurred between the logic reset and the output relay reset.

A second problem was identified with the resetting of the output relay. The power must first be restored to the output relay reset function and the relay reset prior to restoring the 24 volt power to the relay operation function.

Either of the two problems would result in inadvertent action of safety system components.

A third problem was a short circuit in the 15 volt logic power supply from failures of the incandescent indicating lamp sockets. This condition would then be detected by the power supply monitor (PSM). The PSM would cause the 24 volt power supply fuses to open circuit.

Corrective Action

The licensee provided the following design or procedure changes:

-- The logic module reset was redesigned to use 15 Volts instead of 24 volts. This permits the reset of the logic module before resetting the output relay and eliminates the reset race.

-- A procedure was developed to assure the proper sequence of output relay fuse replacements

-- The output relay fuses were properly identified.

-- Additional plant personnel training, for power restoration and resetting the ESFAS, was provided.

-- The logic modual incandescent indicating lamps were replaced with light emitting diodes.

Findings

The above corrective action should increase the availability of the ESFAS to perform its safety function upon demand. It should also preclude misoperation and undesirable system interactions. This inspector follow-up item is closed.

2.3 (Closed) Inspector Follow-up Item (84-01-01) Engineered Safety Features Actuation System (ESFAS) Partial Inadvertent Actuation During Manual Test Inition (MTI)

Background

The ESFAS is continually monitored for operability by the Automatic Test Insertion (ATI) system. This ATI system utilizes a electric signal that checks the six logic combinations of each process variable that inputs the ESFAS. The signal magnitude and time duration was designed to preclude output actuation. The operability of the ATI system is required by the Technical Specification. The MTI system is used as a backup to the ATI system and after ESFAS modifications.

Event

Licensee event report, 84-001-00, describes a random partial actuation of the ESFAS during a routine surveillance of the ESFAS using the MTI equipment. Three days later a similar event occurred.

A similar occurrence was previously reported to the NRC a month before this LER. The cause of the activation was unknown. A possible cause was Electromagnetic Interference (noise) from the MTI test equipment.

Corrective Action

The immediate corrective action was securing the affected equipment and returning the ESFAS to its normal condition.

The licensee returned the MTI equipment to the vendor (Consolidated Controls) for analysis, repair and post repair test. The vendor performed the following work on the MTI equipment:

-- Replaced defective power supply.
-- Isolated the new power supply from the equipment housing.
-- Replaced three integrated circuits and one socket.
-- Removed the power cable ground from the equipment housing.
-- Verified the correct resistance between components.
-- Corrected the parts list.
-- Tested the repaired MTI equipment in accordance with Acceptance Test Procedure KB7315.

Finding

The vendor concluded that part of the MTI problem was a ground loop between the MTI housing and the ESFAS. This ground loop was

eliminated by completely isolating the MTI test equipment from all grounds. The licensee has not used the MTI test equipment since it has been repaired. The equipment will be used following this refueling outage prior to restarts. The above repairs and test should preclude the MTI test from causing ESFAS inadvertent actuation. This inspector follow-up item is closed.

2.4 (Closed) Inspector Follow-up Item (84-25-01) NRC Information Notice No. 84-86 Isolation Between Signals of the Protection System and Non-Safety Related Equipment

The NRC information Notice 84-86 and Combustion Engineering Information Bulletin 84-14 both address interface problems with the plant computer and the plant protection system. Failures of the mercury wetted relays in the multiplexer of the plant monitoring computer caused inaccurate analog current signals in protective process instrumentation. Millstone 2 has a different design which uses current to current isolation devices between the process loop and the computer inputs. This Inspector Follow-up Item is closed.

2.5 (Closed) Inspector Follow-up Item (83-31-01) Preventive Maintenance (PM) Procedure for 480 volt breakers

The PM form 2701J-1 Revision 7 which was applicable to all 480 volt breakers did not give guidance for the Reactor Trip Breakers (RTB) in accordance with General Electric Company SAL 175-9.3 with respect to the following:

-- Lubrication
-- Latch Engagement
-- Positive Trip Adjustment

The licensee has revised PM 2701J-1 which is revision 9, dated November 8, 1984, that now includes the following items of inspection and their acceptable values, for RTB and any breaker tripped by an undervoltage device on an AK breaker:

-- Trip shaft torque requirement
-- Trip latch engagement
-- Lubrication
-- Trip Shaft Travel

Production Test (PT) procedure PT 21429 revision 2, dated December 27, 1983 "Reactor Trip Switchgear Shunt Trip and Undervoltage Device Test" provides guidance for response time tripping and independent trip verification of the shunt trip and the undervoltage trip device.

The Maintenance Procedure (MP) 2720C1, Revision 2, dated August 19, 1980, "AK-24 480 volt AC Power Circuit Breaker Repair" had been revised September 17, 1983 to require post maintenance testing on RTBS.

The above revised procedures provide adequate surveillance, preventative maintenance and post maintenance testing guidance to the licensee personnel to assure the RTBS will perform their function upon demand. This Inspector Follow-up Item is closed.

3.0 Facility Tour

The alarms, indicators and controls that the operator would utilize during a degraded grid voltage condition were observed in the control room. Also, a discussion was held with the assistant operations supervisor, who was on duty, about the degraded grid voltage procedure.

In addition to the systems and components associated with the Inspector Follow-up Item discussed in Section 4 of this inspection report the following were observed:

-- Batteries
-- Chargers
-- Invertors
-- Reactor Trip Switchgear
-- Annunciators
-- 4.16 KV Safeguard busses
-- Engineered Safety Features Actuation System

A discussion was held with test personnel about the new switches on the reactor trip breakers to permit independent testing of the shunt and undervoltage trip devices. The personnel were knowledgeable and understood the need for proper surveillance. No violations were observed.

4.0 Degraded Grid Voltage

A degraded grid voltage condition occurred at the Millstone Nuclear Power Station on July 5, 1976. This condition caused component failures in the class IE electric system of Unit 2. The licensee has elected to manually protect the class 1E system, for a non-accident degraded grid voltage condition. The NRC in a letter, dated April 27, 1984, requested the licensee to submit an operating procedure for this manual protection. The licensee transmitted this procedure to the NRC with a letter dated December 4, 1984.

The Operating Procedure (OP) 2347B, revision 4, "Normal Station Service Transformer 15G-25" was revised by the licensee to include the Degraded Grid Voltage procedure. This was approved and implemented on January 20, 1983.

The Degraded Grid Voltage Procedure submitted as change 1 and 2 to OP 2374B, Revision 4, items 8.2(a) and 8.2(b) was discussed with the engineering and operation personnel and the following was noted:

-- The procedure only addressed the initiating device which is computer point (EE032). This is a voltage measured on the common supply to the normal 4.16 KV busses 24 A and B. The set point is less than 3620 volts. This set point is 90% of the motor designed voltage of 4000 volts plus a 20 volt lead drop. The inspector stated the procedure should also address the Engineered Safety Actuation System (ESAS) alarms from the voltage sensor on the 4.16 KV safeguard Busses 24C and 24D. The setpoints of these voltage sensors are 88% of the nominal bus voltage of 4,160 volts or 3660 volts. These alarms include an 8 second time delay. The inspector questioned the licensee about the need for steps to assure that operators are aware that these additional alarms may follow the computer alarm and are additional verification of a degraded grid voltage condition.

-- The procedure included a note that the short degradation voltage for safety related motors is 85% of rated voltage. The time limit at this voltage before permanent damage is approximately 4 hours.

The inspector questioned the adequacy of the guidance to the operator, as written, to protect the class 1E system from a degraded grid voltage condition. The licensee proposed further changes to the degraded grid voltage procedure. These changes will be reviewed by the plant operating review committee (PORC).

The changes proposed by the licensee to the procedures are as follows:

-- The additional eight (8) alarms, associated with the safeguard busses, which would alarm during a degraded grid voltage condition have been identified and discussed.

-- After receiving the 3620 volt computer alarm the operator would close breaker 24-C-2T-2 from train A bus 34C(Z1) to energize the swing bus 24E(Z5). The following pumps would then be started:

1. Service water pump P5B
2. Reactor Building Closed Cooling Water Pump P11B
3. Charging pump P18B

-- The following pumps on train B bus 24D (Z2) would be stopped:

1. Service water pump 5C
2. Reactor Building Closed Cooling Water Pump P11C
3. Charging pump P18C

The control switches for the above pumps would be placed in the lockout position to prevent any auto restart.

Should the degraded grid voltage condition continue (bus voltage less than 3620 volts) at two (2) hours the operator would take the following actions:

-- The reserve supply breaker 22S3-24D-2 (52-A411) to train B 4.16KV bus 24D (Z2) control switch would be placed in the lockout position.

-- The normal supply breaker 52-A410 to Train B bus 24D (Z2) would be manually tripped open. The bus deenergization would be detected by the, 70% voltage setpoint, Loss of Normal Power System which would start the Emergency Diesel Generator H7B (130) and close breaker 52-A401 to reenergize bus 24D.

-- The following pumps on bus 24D would be started one at a time:

1. Service water pump 5C
2. Reactor Building Closed Cooling Water Pump P11C
3. Charging Pump P18C

Should the degraded grid voltage condition continue for three (3) hours the operator would trip the reactor/turbine and go to hot standby mode using those systems powered from 4.16 KV bus 24D (Z2) and 480 volt bus 22F.

A discussion with the training personnel was held. Abnormal operating procedures are a part of the training required for operator requalification. Although a degraded grid voltage condition is abnormal, the procedure for handling this condition is incorporated into operating procedure OP 2347B. The Licensee plans to provide operator training on the Degraded Grid Voltage procedure.

The proposed revised procedure and the licensees commitment to training should assure a safe shutdown of the reactor during or following a degraded grid voltage condition.

5. Exit Interview

The inspector met with the licensee representatives (denoted in paragraph 1) on May 17, 1985, and summarized the purpose, scope and findings of the inspection.

At no time during this inspection was written material provided to the licensee by the inspector.