U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 86-05

Docket No. 50-271 License No. DPR-28

Licensee: Vermont Yankee Nuclear Power Corporation
RD 5, Box 169, Ferry Road
Brattleboro, Vermont 05301

Facility: Vermont Yankee Nuclear Power Station

Location: Vernon, Vermont

Dates: February 9-27, 1986

Inspectors: William J. Raymond, Senior Resident Inspector
Glenn W. Meyer, Project Engineer

Approved by: J. E. Tripp 3/3/86
W. E. Tripp, Chief, Reactor Projects Section 3A Date

Inspection Summary: Inspection on February 9-27, 1986 (Report No. 50-271/86-05)

Areas Inspected: Special, unannounced inspection on day time and backshifts of the events associated with the discovery during surveillance testing on February 8, 1986, that the Standby Liquid Control System was inoperable. The inspection involved 61 total hours by the Senior Resident Inspector and a Project Inspector.

Results: One apparent LCO violation was identified for the SLC system being inoperable from July 14, 1984 to October 3, 1985 when required to be operable. Concerns were also identified with the SLC system continuity monitoring circuitry, the apparent loss of configuration control in the SLC firing circuit wiring, and the apparent inability to detect a manufacturing error during preservice tests.

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1. Summary

During a February 8, 1986 surveillance test, Vermont Yankee found that the SLC system was inoperable due to the inability to actuate the explosive squib valves. The prior successful actuation of the squib valves had occurred during a July 11, 1984 surveillance test. The licensee found that the replacement squib valve explosive primers, installed following the July test and presumed to be electrically the same as the primers successfully fired, were electrically different due to a changed connector pin to bridgewire configuration. The primer wiring change was a manufacturing error unknown to the vendor, Conax Corp., and had not been detected by the licensee during receipt inspection or preservice testing. The continuity monitoring circuit for the firing circuit was incapable of detecting the problem.

Although the inspection found that the principal reason the squib valves failed to fire was due to the primer manufacturing error, irregularities were also found in the firing circuit. The inspection found that the firing circuit (external to the primer) had been modified in 1977 as a result of GE SIL 186. The licensee determined that the as-found firing circuit wiring differed from the wiring design drawing. Apparently, this difference occurred when difficulties encountered during installation resulted in a needed field modification to the firing circuit. This field modification did not go through the normal required review process and therefore was not reflected in a change to the as-built drawing of the firing circuit.

Ironically, it was found that if the firing circuit field modification had not been made, the improperly manufactured primers would have fired the squib valves and allowed the SLC to function as designed. However, since the field modification would have been approved in 1977 if properly submitted, the primary cause of the SLC system failure remains the primer manufacturing error and the failure of the manufacturer and the licensee to detect this error.

The licensee was reviewing corrective actions including firing circuit design changes, revised surveillance testing, and additional pre-installation checks at the end of this inspection.

2. Purpose

The purpose of the special inspection was to review the failure of the Standby Liquid Control (SLC) system during the February 8, 1986, refueling surveillance test and to identify the factors that caused the SLC system to be inoperable. The reactor was in a cold shutdown, defueled condition to support the replacement of the reactor recirculation system piping. The SLC system was not required to be operable when the discrepant condition was discovered.

3. Event, Initial Evaluation, and Notification

During the SLC surveillance testing per OP 4114 and 4203 on February 8, 1986, both primer charges for the 14A squib valve failed to fire at 9:45 A.M. when SLC System 1 was actuated. The parallel 14B squib valve was not tested as part of the System 1 testing, and its firing was deferred pending further investigation of the A circuit.

Licensee investigation of the System 1 firing circuit determined that the primer charges were miswired (when compared to Control Wiring Diagram (CWD) 191301, Sheet 1200) by having both 120 VAC high side leads wired to the A-B primer bridgewires, and both neutrals wired to the C-D primer bridgewires. The wiring was found rolled (i.e., interchanged) at a local terminal box (TB) mounted immediately above the squib valve. Instead of the white-black-green-red sequence (W-Bk-G-R) required by the CWD, entering and leaving the TB, the sequence into the TB was Bk-G-W-R, and the sequence leaving the TB was W-G-R-Bk. The firing circuit worked properly when tested at 4:19 P.M. after the TB was rewired per Maintenance Request (MR) 86-0278 to agree with the CWD. The TB wiring for the System 2 squib valve was inspected and also found miswired as follows: sequence into the TB was R-W-G-Bk, and the sequence out of the TB was Bk-R-G-W. Although different in appearance, the terminal boxes were electrically the same (e.g., black connected to white, white connected to red, etc.).

Even though the SLC system was not required to be operable for the existing plant mode, licensee personnel deemed it probable that the SLC system would not have been functional during the last operating cycle (XI) which ended in September 20, 1985. The licensee notified the NRC Duty Officer per 50.72(b)(2)(iii) at 4:40 P.M. on February 8, 1986, of the potential loss of function for the SLC system.

Following the appointment of a lead engineer to systematically investigate and evaluate the as-found SLC conditions, the licensee attempted to perform OP 4114 on System 2 at 3:15 P.M. on February 11, 1986. The B pump started and injected into the reactor vessel during the test (through the already open A valve), but squib valve 11-14B failed to fire. A second notification was made to the NRC Duty Officer per 10 CFR 50.72(b)(2)(iii).

Reviews completed during this inspection (discussed further below) identified no modification, maintenance, or testing activities that would have made the SLC system inoperable following the July 11, 1984 test. As noted below, the squib valves most likely became inoperable following the installation of new primer charges during the 1984 test. The inspector concluded that the SLC system was inoperable from July 11, 1984 until February 8, 1986. The SLC system was required by Technical Specification 3.4.A to be operable whenever the reactor had fuel and the mode switch was not in the shutdown position, i.e., from July 14, 1984 to October 3, 1985. The failure to meet these conditions is a violation of Technical Specification 3.4.A (VIO 86-05-01).

4. SLC System Description

The SLC system consists of two redundant pumps that take suction from a tank containing sodium pentaborate solution and inject into the reactor vessel through two normally sealed, closed squib valves mounted in parallel on the pump discharge line. To initiate SLC injection, the reactor operator turns a key locked switch on control room panel (CRP) 9-5 to either the System 1 or System 2 position. Turning the switch to the System 1 position causes the A pump to start and the A squib valve to open. Should either component in

System 1 fail, the B pump and B squib valve would then be activated by turning to the System 2 position. When the system is in a standby mode, a relay circuit monitors the electrical continuity of the valve firing circuit and lights a light bulb on CRP 9-5 for each valve when the circuit has continuity.

The wiring configuration for the System 2 firing and monitoring circuits, which is typical for System 1, is shown in Figure 1. The mechanical details of the squib valve and explosive chamber are shown in Figure 2. The squib valve is opened by shearing the cap on the inlet fitting mounted in the valve flow path. The cap is sheared off by the trigger assembly that is actuated by two explosive charges in the primer subassembly. Either primer charge is sufficient to shear the inlet fitting plug. The primer charges are ignited by concurrently applying 120 VAC to bridgewires embedded in the charges. Turning the CRP 9-5 control switch to the System 2 position closes contacts 2, 4, 6, and 8, which starts the B pump, applies voltage to the bridgewires in the B valve primer change, and shunts around control relay 11-67B of the continuity monitoring circuit. Once actuated, the primer, the trigger assembly, and the inlet fitting cannot be reused and must be replaced.

The as-found wiring of System 2 is shown in Figure 3.

5. Primer Wiring Change

The licensee's investigation of the February 8, 1986 event identified a primer wiring change as the primary cause of the incident. The vendor supplied two types of primer assemblies with the same part number and drawing number, but with different wiring between the connector pins and the firing circuit.

The squib valves are supplied by the Conax Corp. of Buffalo, New York, and are described in GE Specification 21A5468 and Conax Instruction DS 1832-2, Rev C dated June 18, 1970. The trigger assembly part number is 1617-139-01. Revision E of this Conax drawing dated August, 1970 shows a connector pin to bridgewire grouping of A&B and C&D. The primer subassembly part number is 1621-186-01. Revision E of this drawing dated August, 1970, also shows pin wiring with the same bridgewire/configuration. However, Revision K of drawing 1621-186-01 dated November 2, 1982, showed a pin to bridgewire grouping of 1&4 and 2&3 with a labeling convention in the counterclockwise (CCW) direction. The initial information from the vendor on Feburary 13, 1986 indicated that the two connectors are electrically equivalent, and further, that only one type of connector had been produced since 1980.

The licensee completed bench continuity measurements on February 13, 1986 of two primer subassemblies taken from the 17 items currently available in stores. The tested subassemblies are labeled type A and B for this narrative. The type A primer (S/N 254) was manufactured in May, 1982 and was obtained under purchase order 18163. Two primers from this group were installed in the SLC system squib valves in 1983 under material issue slip 4V0277. When tested on February 13, 1986, the primer had a pin to bridgewire grouping of 1&4 and 2&3, measured with a CCW rotation, which agreed with Rev K of drawing 1621-186-01. The type B primer (S/N 557) was manufactured in October, 1983, and

was obtained under purchase order 21182. Two primers from this group were installed in the SLC squib valves following the July 11, 1984 testing, under material issue slip 7V543. When tested on February 13, 1986, the type B primer had a pin to bridgewire grouping of 1&2 and 3&4 when measured in a CCW rotation, which disagreed with the vendor drawing.

It is notable that primers of either type would have fired in the VY SLC squib valves if the external circuits were wired in the neutral-hot-neutral-hot sequence on the CWDs. However, in the as-found hot-neutral-neutral-hot wiring sequence, only the type A (manufactured in 5/82) primers will fire. To demonstrate this latter assertion, the licensee performed an in-situ test of a 5/82 primer in the B valve on February 14, 1986 with the wiring in the configuration as-found on February 8, 1986, and demonstrated that the squib valve fired.

The licensee notified the Conax Corp of the above findings on February 14, 1986. Based on these results and their own review, the vendor indicated an error had occurred internally that would have affected the production of primer assemblies (i.e., a reversal in pin labeling from a CCW to a CW rotation during a change in manufacturing facilities in 1983). The Conax Corp. made an oral report to NRC Region I per 10 CFR Part 21 on February 14, 1986. The vendor's written report will be reviewed by the NRC at a later date. This item is open pending further NRC review of the vendor report and the licensee's actions to determine whether the licensee properly reviewed and used information supplied by the vendor, or if the vendor did not properly control and/or document changes to his product (UNR 86-05-02).

6. SLC Continuity Monitoring Circuit

The continuity monitoring circuit, mentioned above, continuously confirms that the fuses, resistors, wires and bridgewires in each firing circuit are intact and lights a panel 9-5 light for each valve to confirm this. It does this by closing a contact in series with the panel light when control relay 11-67B is energized (picked up). The relay is normally energized when 120 VAC is supplied to one side of the coil, and a path to ground exists through the following circuit: 15K resistor R1B, fuse F2B, primer bridgewire AB, resistors R3B1-R4B1-R4B2-R3B2, primer bridgewire CD, fuse F3B, 15K resistor R2B, and neutral (see Figure 1).

The inspector noted that in the as-found condition on February 8, 1986, neither squib valve was capable of performing its intended function, yet all indications available to the reactor operator indicated that continuity of the ignition circuit existed.

The monitoring circuit indicated continuity existed, even though it would not fire because the following closed circuit existed (shown for "B" side - typical for both; see Figure 1): 120 VAC was provided through fuse F1B to one side of the coil for relay 11-67B; a path to ground existed through resistor R1B, F2A, terminal point FF 54, primer coil BA, terminal point FF 55, fuse F3B, resistor R2B, terminal point FF 53, and to neutral. Only one primer bridgewire was included in the monitoring circuit, instead of two for each squib valve, as is normally the case.

This item is significant because the configuration at Vermont Yankee is believed to be typical of the standard circuit design recommended by the vendor. This item will be reviewed further by the NRC to determine for generic applicability and appropriate followup actions (IFI 86-05-03).

7. SLC Surveillance Testing

Refueling surveillance testing of the SLC system is performed under OP 4114, SLC System Surveillance, and OP 4203 Maintenance and Testing of SLC Squib Valves. SLC pump capacity testing is also conducted per OP 4114 on a monthly basis. For the refueling surveillances, OP 4114 governs the overall sequence for the conduct of the test and establishes the required plant and system valve lineup conditions. OP 4203 is performed in conjunction with OP 4114 and provides for bench and simulated in-system electrical testing of the explosive charges.

The major objective of the tests is to meet the refueling surveillance requirements of the technical specifications, including manual initiation of the system except the explosion valves, injection of demineralized water into the reactor vessel, and explosion of one of three charges in a batch to verify proper function. Accordingly, the tests verify an operable flow path to the reactor vessel by manually actuating the system using the normal controls from the control room. Additionally, the tests verify that the explosive charges installed in the system and to be removed following the test were capable of being fired using the actual system wiring configuration. Finally, the tests demonstrate that the batch of charges from which the two replacement primers will be taken is acceptable by exploding one charge from the batch on a bench test set-up.

The combined OP 4114 and OP 4203 testing sequence is generally as follows:

- -- remove the inlet fitting from the A valve and reassemble the valve body to establish an open flow path to the vessel.
- -- install the existing primer in a test block mounted adjacent to the squib.
- -- fire the A valve primer in place with the system wiring when System 1 is actuated.
- -- install the existing B primer in a test block mounted adjacent to the squib.
- -- fire the B valve when System 2 is actuated.
- -- install new primers in the A and B squibs valves.
- -- bench test a new primer with the inlet fitting removed from the A valve to verify the explosive primer batch is acceptable, and the charge is capable of shearing the cap.
- -- install a new inlet fitting in the A squib.

The bench test of the new primer is completed using a type C or D battery connected across two of the primer electrical pins. It should be noted that no rewiring of electrical circuits is required to complete the OP 4203 steps. The firing circuit is disconnected from the in-situ primers by disconnecting the connector at the primer.

The last time prior to the 1985-86 outage that the SLC system was tested using the above procedures was on July 11, 1984. Both squib valves fired as required during that test.

8. Previous Circuit Design Changes

The last documented design change on the SLC firing circuitry was PDCR 77-2 on September 17, 1977, to enhance the circuit reliability by adding a second neutral line (a common neutral existed previously) and to improve the monitoring capability so that the circuit resistors were included in the monitoring circuit. The changes were made based on General Electric (GE) Services Information Letter (SIL) No. 186, dated July 30, 1976. The inspector reviewed the nature and scope of the design changes and determined the changes were appropriate to accomplish the intended objectives.

Further, the changes recorded in the PDCR documentation package would have prevented the February 8, 1986 event, as it would have resulted in the hot leads alternating on the primer connector even though the CWD showed an incorrect connector wire to primer pin configuration. However, it is possible that the unrecorded deviation from the CWD configuration occurred in 1977 during the PDCR and remained in place as noted in 1983, on January 6, 1986, and following the 1986 test. During implementation of PDCR 77-2, a circuit problem was noted that apparently prevented the successful firing of the B squib valve the first time it was attempted on September 11, 1977. The circuit problem was corrected by rolling (i.e. interchanging) two wires some place in the circuit. The evidence for this is a hand written note on the PDCR Installation and Test Procedure (reference Page 7, Step 45). Based on an interview with the electrical worker who completed the PDCR wiring, there are no further details as to what the problem was, what wires were moved, or whether the circuit wiring drawings were updated. The worker involved with the job in 1977 did not recall having to roll the wires in the local TBs to the as-found configuration. The worker further felt that such a change would have been documented had it been necessary at the time. He supposed that the wires rolled would have more likely been some of the non-color coded 9-5 panel wires.

It should also be noted that the licensee identified another deviation between the as-built conditions and the wiring configuration called for in CWD 191301, Sheet 1201. The four conductors of cable C11201 were found to terminate at points DD-89, 90, 94, and 95 in CRP 9-5. The circuit is then carried through to the intended termination points of FF 54, 55, 56, and 57 using gray benchboard (SIS) wire. It was these SIS wires the electrician supposed may have been rolled during PDCR 77-2. Continuity checks completed by the licensee on February 11, 1986 confirmed that this wiring configuration did not contribute to the test failure on February 8, 1986. The as-built wiring is recorded on CRP 9-5 panel drawings 5920-3738, Rev. 22 and 5920-3703, Rev. 27. However, the wiring configuration was recorded on those drawings during an as-built update of the prints in 1984. There apparently was no attempt made in 1984 to compare the updated panel diagrams with the CWDs. The deviation between the as-found wiring, the CWDs and the panel diagrams most likely existed prior to 1984.

The discrepancy between the as-found circuit wiring and the approved design drawings represents a potential loss of configuration control that is of significant concern to the NRC. This matter warrants further review by the licensee and the NRC to determine whether the wiring configuration noted on February 8, 1986 resulted from an approved design change. This item is unresolved and will be reviewed further on a subsequent NRC inspection (UNR 86-05-04).

9. Previous Maintenance Activities

Maintenance requests (MRs) for the SLC system were reviewed by the licensee and the inspector to determine which involved the electrical circuits and to possibly identify a repair activity that may have altered the wiring at the local terminal boxes. The inspector's review included the following MRs: 83-1303, 83-0450, 83-0500, 83-1064, 83-1180, 83-1136, 84-1185, and 85-2635. The following items warranted further followup.

Work completed under MRs 83-0450 and 0500 in March-April, 1983 resulted in the change-out of the pigtails (connectors and short length of cable) from the local terminal boxes to the squib valves. Based on interviews with the I&C technician who performed the work, the replacement was one-for-one, wire-for-wire. The technician noted at the time that the wiring sequence did not match the CWD. No further actions were taken since it was noted that the existing wiring sequence worked based on previous satisfactory performance of system testing, and the only repair activity was a one-for-one replacement. The observations by the technician while performing the work under MRs 83-450/500 indicate that the wiring configuration observed to fail on February 8, 1986 was in place prior to the satisfactory test performed per OP 4114 in July, 1984.

Maintenance was performed per MR 84-1185 on the A squib valve continuity circuitry on July 13, 1984, two days after performance of the OP 4114 testing. The problem, loss of squib valve A continuity, was corrected by replacing fuse F2A. The operability testing completed following the repair consisted of verification that normal indication and continuity meter readings returned. While it appears that more rigouous testing following MR 83-1185 may have detected a change in the monitoring circuits, the scope of the actual testing completed, in the inspector's opinion, was not inappropriate for the nature of the work completed.

MR 85-2634 was submitted by a reactor operator on December 29, 1985, to investigate the intermittent occurrence of the squib valve loss of continuity alarm. The alarm apparently occurred, even though the circuit trickle current of 0.25 mamp was above the alarm setpoint of 0.1 mamp. The problem appeared to occur concurrent with a lower voltage condition on the 345 KV grid. However, no direct association between the two events has been established. Troubleshooting activities under MR 85-2634, consisted of visual inspections and continuity measurements and were completed on January 6, 1986, even though the problem had cleared and no further symptoms were present. During this effort, the I&C technician (who also happened to complete the work under MRs

83-0450/0500) again noted that the local terminal box wiring did not match that required by the CWD. The technician further noted that the continuity readings across the primer bridgewires indicated that the squib valves could not possibly fire as wired. No wires were moved. After consulting maintenance personnel to confirm the satisfactory system testing on July 11, 1984, I&C supervision decided to take no further actions to investigate the anomaly until after the 1986 SLC testing per (OP 4114), as the system was not required to be operable, either then or prior to the test.

Based on the above, the inspector concluded that SLC system maintenance activities within the scope of the above review did not appear to have contributed to the wiring configuration noted on February 8, 1986. It also appears that a minor intermittent problem in the monitoring circuit remains to be investigated and resolved. The licensee should review the monitoring circuit to assure curent loops are appropriately balanced. This item is open pending completion of a review by the licensee of the monitoring circuit design and function and subsequent review by the NRC (IFI 86-05-05).

10. Licensee's Conclusions

The licensee issued Plant Information Report (PIR) 86-03 on February 24, 1986 covering the SLC failure. Under the PIR system, the PIR will be reviewed by plant management, concurred on by the PORC, and approved by the Plant Manager. Accordingly, the PIR reviewed by the inspector represented the licensee's preliminary conclusions and recommendations.

The licensee concluded that the SLC system was inoperable from July 11, 1984 until February 8, 1986, and that the primary cause of the event was the inadvertent, undetected manufacturing error by the vendor, Conax, which changed the wiring between primer pins and explosive charge bridgewires. The licensee concluded that the as-found wiring of the firing circuit was a contributing factor to the event in that its configuration permitted a primer failure with the inadvertently revised primers. However, the licensee concluded that the as-found wiring was an acceptable design when utilized with the as-designed primer and had properly fired the primers many times when correct primers had been installed. The as-found wiring met the design specified in SIL 186. The licensee concluded that the difference between the as-found wiring and the CWD occurred during the installation of the 1977 wiring design change, and the CWD was never revised to reflect the as-built wiring. The licensee concluded that such a design change/drawing revision process would have been unlikely to realize the potential problem and unlikely to result in a different wiring.

The licensee concluded that the as-found wiring had existed since the 1977 wiring design change based on the lack of any records of design change or maintenance activities which would have changed the wiring subsequent to 1977. Further, PDCR 77-2 and the resultant CWD were not correct, in that the pigtail cable between the primer connector and the local terminal box was misrepresented (e.g., the black lead connected to pin A, whereas the white lead actually connects to pin A). The licensee hypothesized that the electricians

realized this misrepresentation during the installation and revised the wiring in the terminal box to provide a workable wiring. This field change was then never implemented on the drawing or approved in the drawing change process.

The PIR contained recommended corrective actions, as follows:

-- Revise testing procedure OP 4203 to include pin to pin continuity tests and a test of new primers using the firing circuit.

-- Revise terminal box wiring such that hot leads alternate around the connector and either primer type will fire.

-- Revise CWD to as-built configuration.

-- Revise procurement program to specify latest drawings are sent with parts.

-- Review other surveillance procedures which test performance of components following use to determine whether additional testing and design changes are appropriate.

-- Retest SLC system following completion of other recommendations.

The PIR recommended that no additional changes be made to the design change and configuration control program, as revisions to these programs since 1977 have instituted administrative controls to ensure that field changes are properly reviewed and approved and that as-built drawings are completed.

NRC review of the approved PIR 86-03, including the recommended corrective actions including changes to OP 4203, is an open item (86-05-06).

11. Inspection Findings and Conclusions

A. As documented throughout the report, the inspector identified the following:

-- 86-05-01; Violation for inoperable SLC system.

-- 86-05-02; Unresolved item for evaluation of the Conax manufacturing error and the licensee's failure to find it prior to use.

-- 86-05-03; Open item for design of continuity monitoring circuit.

-- 86-05-04; Unresolved item for loss of configuration control.

-- 86-05-05; Open item for repetitive maintenance of continuity monitoring circuit.

-- 86-05-06; Open item for review of PIR recommended changes.

B. The inspector agreed with the conclusion of the PIR that the primary cause of the inoperable SLC system was the manufacturing error in the primer charges.

Concerning the as-found firing circuit wiring, which permitted the revised primers to fail, the inspector agreed the that this probably resulted during the installation of the 1977 design change and that the as-found wiring represented an acceptable design implementation of SIL 186.

C. The inspector noted that the Traversing In-core Probe (TIP) shear valves also incorporate an explosive primer which actuates the valve. The inspector's preliminary evaluation of the firing circuit and the primer component found that the firing circuit was similar to SLC and the primer also used a four pin connector. Accordingly, the licensee's evaluation of the applicability of the SLC corrective actions to the TIP shear valves is an open item (86-05-07).

D. The inspector noted that the licensee had 17 primers in stock following the incident. As the design life of the primer is five years and only three primers are used per operating cycle (if the batches are good), the 17 primers in stock appeared to be excessive. The licensee's shelf life program, which should prevent usage of outdated primers, is under development. Also, there appeared to be no provision in the primer installation procedure to ensure the primer's useful life would not expire during its use. Therefore, the licensee's action to ensure that primers are installed which will be within their useful life during their use is an open item (86-05-08).

E. The inspector noted that the February 8, 1986 incident constituted the first example wherein an apparent vendor supplied product deficiency was not detected by the licensee's receipt inspection program or post-installation preservice testing, and which rendered a plant safety system inoperable.

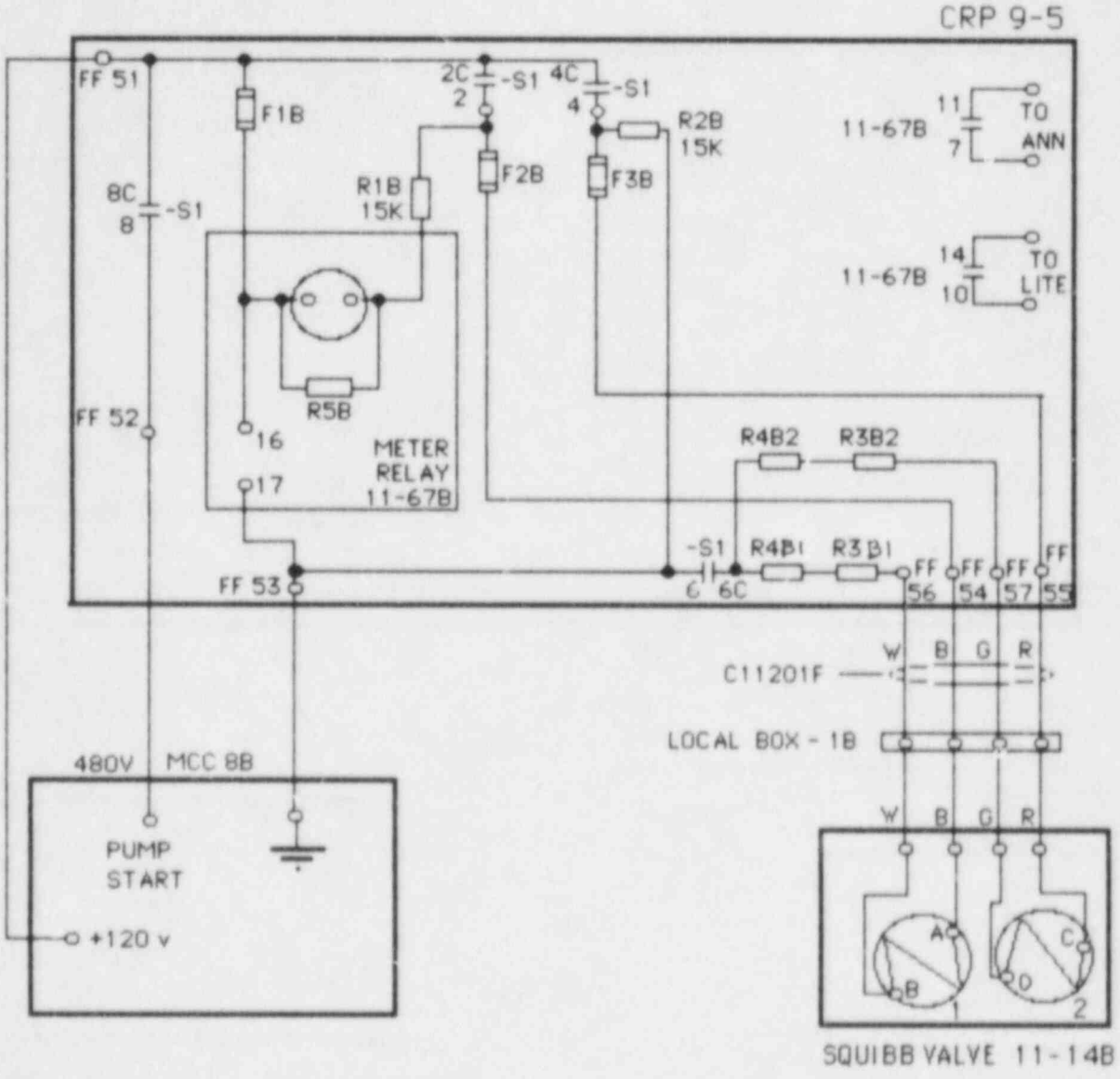
12. Persons Contacted and Management Meetings

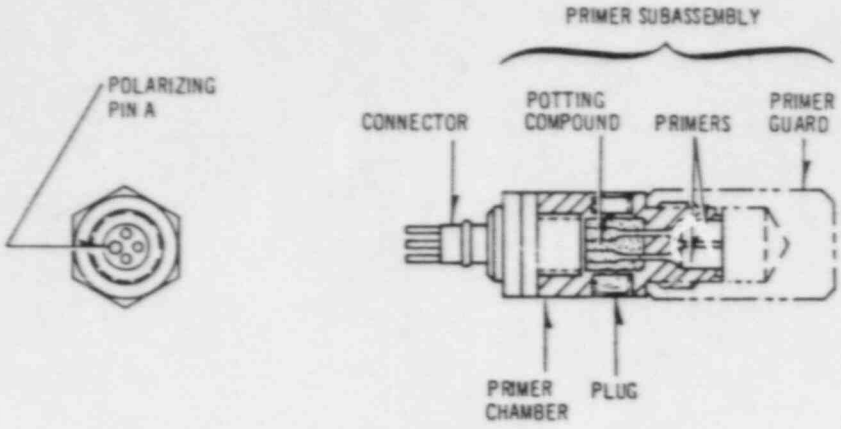
Interviews and discussions were conducted with members of the licensee staff and management during the inspection to obtain information pertinent to the areas inspected. Preliminary inspection findings were discussed with the Acting Plant Manager on February 14, 1986, and final inspection findings were discussed with the Plant Manager on February 27, 1986. The contacted personnel included the following people.

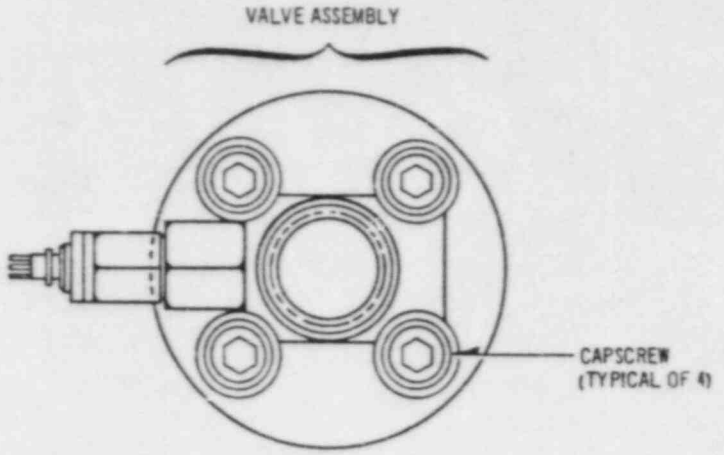
Mr. P. Donnelly, Maintenance Superintendent
Mr. J. Halvey, I&C Assistant
Mr. D. McElwee, Senior Engineer - Operations
Mr. M. Stone, Electrician

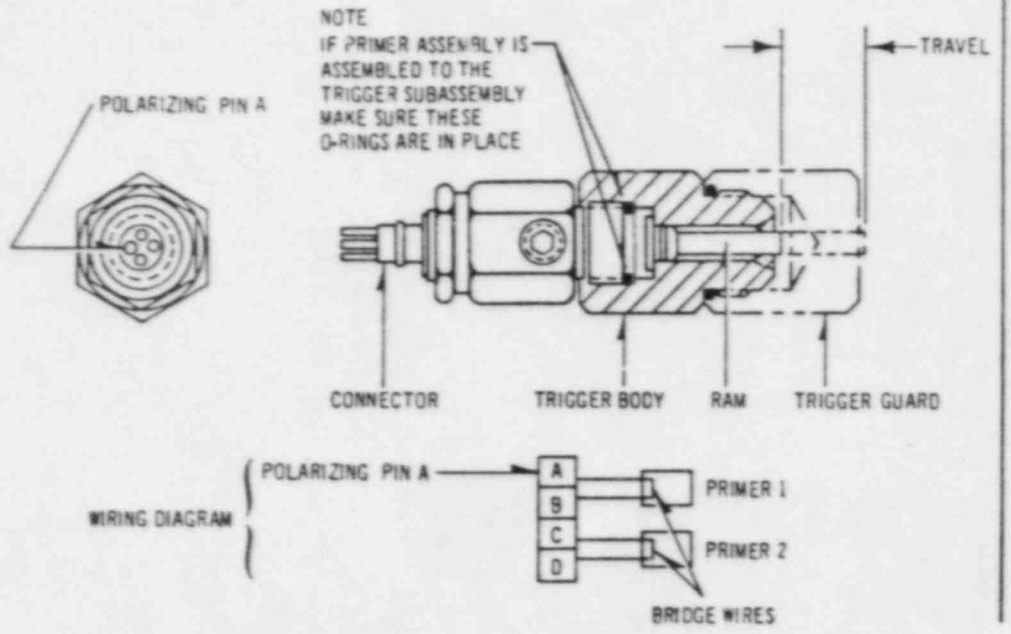
Figure 1

SQUIBB IGNITION & CONTINUITY









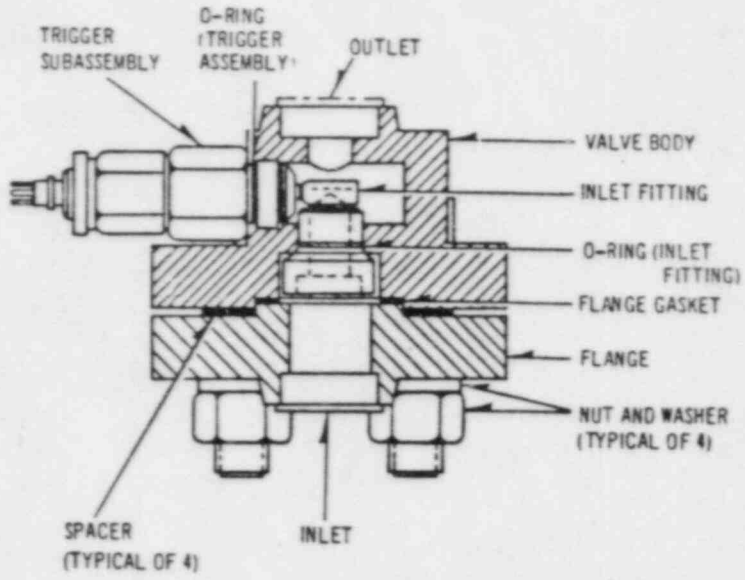


FIGURE 2 - SQUIBB VALVE DETAILS

Figure 3

AS - BUILT WIRING V11-14B