

U.S. NUCLEAR REGULATORY COMMISSION  
REGION I

Report No. 50-271/91-21

Docket No. 50-271

License No. DRP-28

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

Facility Name: Vermont Yankee Nuclear Power Station

Inspection at: Vernon, Vermont

Inspection Conducted: August 6-22, 1991

Inspector: *A. DellaGreca*  
A. DellaGreca, Sr. Reactor Engineer,  
Electrical Section, EB, DPS

10/18/91  
date

Approved by: *C. J. Anderson*  
C. J. Anderson, Chief, Electrical  
Section, Engineering Branch, DRS

11/13/91  
date

Areas Inspected: Routine, announced inspection to review the status of several unresolved issues identified by the NRC and the corrective actions proposed by the licensee following the loss of offsite power event on April 23, 1991.

Results: The inspection concluded that the corrective actions that emerged from the licensee's review of the event were appropriately addressed, with short term corrective actions completed and long term corrective actions well underway.

Of the unresolved issues identified by the NRC, three items were found to be in conformance with the current licensee's criteria for surveillance and maintenance and were closed. However, two other activities, pertaining to the replacement of switchyard battery 4A and to the service water discharge valve lineup, were determined to be apparent violations of the 10CFR 50.59 requirements. Two additional deficiencies pertaining to reportability discrepancies and the surveillance of diesel generator instruments were found to be of minor safety significance and with corrective actions already underway. Therefore, they were considered to be "non-cited violations."

## DETAILS

### 1.0 INTRODUCTION

On April 23, 1991, while operating at 100% power, Vermont Yankee Nuclear Power Station (VYNPS) experienced a complete loss of offsite power (LOOP). The event occurred while maintenance activities were being conducted on the switchyard batteries. An NRC Region I Augmented Inspection Team (AIT) was dispatched to the site to determine the circumstances surrounding this event. The results of this inspection are described in the AIT Report No. 50-271/91-13.

The licensee's analysis of the causes that led to the LOOP identified a variety of long and short term corrective actions to prevent a recurrence of the event. In addition to the licensee's identified corrective actions, several other issues relating to the plant's surveillance and maintenance activities were identified by the NRC. These issues were unresolved at the end of the AIT inspection.

The purpose and scope of this inspection were to review the status of the licensee's proposed corrective actions and to address the unresolved issues identified by the NRC.

### 2.0 FOLLOW UP OF PREVIOUS INSPECTION FINDINGS

- 2.1 (Open) Unresolved Item No. 50-271/91-13-01 pertaining to the adequacy of the dc control system battery maintenance procedure.

Power for the control and protection of the Vermont Yankee switchyard equipment is provided by two 125 Vdc buses, DC-4A and DC-5A, which are designed to operate independently from each other. Reliability of the source is ensured by equipping each bus with its own battery and battery charger. An additional battery charger, 4A-5A, is provided to support either bus, whenever necessary.

Operability of the two switchyard battery systems, prior to reactor criticality, is required by the Technical Specification, Section 3.10.A.2.c. However, in accordance with Section 3.10.B.2.f, continued reactor operation is allowed, if one of the battery systems is inoperable, provided that the remaining battery system is operable. The surveillance requirements (weekly and quarterly) for the 125 Vdc switchyard batteries are specified in Technical Specification Section 4.10.A.2.a and .b and detailed in the approved operating procedure No. OP-4210, titled Maintenance and Surveillance of Lead Acid Storage Batteries.

Surveillance tests conducted on battery 5A in late 1989 indicated that the specific gravity of the electrolyte in several cells had dropped to or below the specified limit. At approximately the same time, the licensee discovered that battery 4A appeared to be approaching the end of its service life. The observations resulted in a decision to replace this battery. In order to reconstitute the electrolyte of battery 5A and replace battery 4A, the Maintenance Department developed a Guideline and issued a Temporary Modification request, TM No. 89-55, to perform the work. The purpose of this modification was to remove a mechanical interlock which prevented the dc output breakers of battery charger 4A-5A from being closed at the same time. The removal of the interlock and the closure of both breakers would have allowed both dc buses to be supplied by one battery, while the other was undergoing maintenance. Because the cross connection of the buses constituted a deviation from the system description detailed in the PSAR, the temporary modification was reviewed and a safety evaluation was issued. This evaluation apparently recognized the need for maintaining a battery on the buses and stated: "To provide a smoother dc voltage which will prevent any indication problems in the relay house and at REMVEC, the two buses will be tied together by closing the four dc breakers associated with the battery charger 4A-5A. This will allow both busses to have a smooth power supply from the battery that will remain in service." The temporary modification was presented to the Plant Operations Review Committee (PORC) and approved on November 1, 1989.

Evaluation of the events that led to the LOOP indicates that the Temporary Modification was properly applied and that the Guideline was properly executed in conjunction with the maintenance of battery 5A. However, subsequent to the servicing of battery 5A, the Guideline instructions were revised to separate bus DC-4A from battery 5A before restoration of battery 4A to the same bus (step 5.1.2.1). The instructions were revised even though the licensee had previously recognized that the possibility existed that the dc bus, without the surge suppression capability of the battery, could be affected by voltage transients. The revision of the guideline instructions changed the conditions for performing the modification, therefore, it voided the original safety evaluation according to 10CFR 50.59. A safety evaluation of the modification using revised instructions was not performed. The LOOP experienced by Vermont Yankee was the direct result of the revisions made to the Guideline.

The implementation of a plant modification without an adequate safety evaluation is an apparent violation of 10CFR 50.59, which states in part that records of changes to the facility "must include a written safety evaluation which provides the bases for the determination that the change does not involve an unreviewed safety question" (50-271/91-13-01).

Following the LOOP event, the licensee voided the guideline instructions for the maintenance of the switchyard battery system.

2.2 (Closed) Unresolved Item No. 50-271/91-13-02 regarding the adequacy of the dc control system battery charger maintenance.

As described in the AIT report, a contributing factor to the Vermont Yankee LOOP event was the sporadic and inadequate maintenance performed by the licensee on the switchyard battery chargers. A post-event inspection of the chargers revealed noisy output in at least three of the four chargers. This was attributed to blown fuses and failed capacitors in the battery charger filter circuits.

The current inspection reviewed the licensee's requirements for the maintenance of the battery chargers in question and determined that no requirements existed and that no procedures had been prepared prior to the event. The switchyard battery systems are considered to be non-nuclear-safety-related and, as such, their operability, including that of the chargers, is required by the facility's Technical Specification. However, no specific maintenance requirements are imposed. In addition, the vendor manual provides little or no guidance with respect to required preventive maintenance. On the contrary, it indicates that all components have a nominally indefinite life with no expected aging effects. The only recommendations provided by the vendor are that the chargers should be kept clean and dry and that they should be checked periodically to ensure that all connections are tight. Adequate instruction are provided for corrective maintenance.

Discussions with the licensee indicated that some maintenance had been performed on the chargers. However, this had been irregular, primarily corrective in nature, and performed using the guidelines of the vendor manual.

As a result of the LOOP event, the licensee reevaluated the maintenance needs for all battery chargers and developed an appropriate procedure. This procedure, No. OP-5247, is currently under review by licensee engineering and operations personnel. In view of the fact that only limited guidance was available from the manufacturer and that adequate corrective actions were taken by the licensee with respect to the maintenance of battery chargers, this issue is closed.

2.3 (Closed) Unresolved Item No. 50-271/91-13-03 relative to the adequacy of the dc control system battery charger surveillance testing.

As described in the AIT report, another factor that contributed to the Vermont Yankee LOOP event was the inadequate surveillance testing performed by the licensee on the switchyard battery chargers.

During the current inspection, the NRC reviewed the existing requirements and the licensee's practices regarding the surveillance testing of the switchyard battery chargers. As indicated in Section 2.2, above, the Vermont Yankee Technical Specification requires that the switchyard battery systems be operable prior to criticality of the reactor. However, the surveillance requirements that are imposed only address verification that the batteries are capable of delivering power. No specific surveillance requirements are imposed on the battery chargers. Accordingly, the procedure in use at the time of the LOOP for the maintenance and surveillance of the switchyard battery systems, OP-4210, only required verification that the battery charger's output voltage was adequate and that the battery was being charged. The instrument used for this process was a digital voltmeter which was acceptable for the intended purpose, but not adequate to identify a noisy battery charger output. In addition, as indicated above, the vendor manual provided no guidance except for those cases where a problem existed or was suspected.

In view of the above and in consideration of the fact that operability of the battery systems, as defined by the licensee, was not in question, the inspector concluded that the licensee's practices pertaining to the surveillance testing of the switchyard battery systems were commensurate with available information. Nonetheless, regular and more suitable surveillance tests would have maintained the performance of the battery chargers within the manufacturer's specifications and possibly prevented the LOOP.

Recognizing the need for improved surveillance of all battery chargers, the licensee developed an appropriate procedure. This procedure, No. OP-5247, was currently under review by licensee engineering and operations personnel. The corrective actions taken by the licensee with respect to surveillance testing of battery chargers was considered adequate, therefore, this issue is closed.



2.4 (Open) Unresolved Item No. 50-271/91-13-04 pertaining to the adequacy of the 1987 Service Water System lineup analysis.

As described in Sections 4.2.3 and 6.2 of the AIT Report, the licensee experienced some problems with the Service Water (SW) System, during the recovery from the LOOP event. These problems included overheating of two air compressors and a significant reduction of the SW flow through the emergency diesel generators. An analysis performed by the licensee indicated that the above problems were the result of a high back pressure developed in the system's discharge header. As determined through subsequent tests, the back pressure was caused by an increased overall system pressure and flow resulting from the operation of the residual heat removal service water (RHRS) pumps and by increased elevation head and flow resistance that were present in the service water discharge piping to the cooling towers.

At the time of the AIT inspection, the NRC investigation determined that: (1) the service water discharge to the cooling towers was not the normal discharge path; (2) the rerouting of the service water discharge flow to the circulating water discharge would decrease the discharge header pressure by 10-15 psig and increase the service water flow to emergency diesel generator A from the recorded 32% to approximately 80%; and (3) the service water discharge flow had been redirected to the cooling towers in 1987. In light of AIT observations and of the problems experienced by the licensee with the Service Water System, the current inspection reviewed the extent to which the valve lineup to the cooling tower had been evaluated by the licensee and the results of that evaluation.

A review of the FSAR system description, Sections 10.6 and 10.8, confirmed that the normal discharge path of the Service Water System was to the circulating water discharge (Section 10.6.5), except during the winter months when, for deicing purposes, warm water from the system was diverted to the cooling tower basin (Section 10.8.3.1). Furthermore, the size of the line to the cooling tower basin (14"), when compared to the size of the line provided for discharge to the circulating water (20"), implied that the cooling tower basin was not intended for normal and full discharge of the system. No analysis or test addressing the effects of partial or full service water discharge flow to the cooling tower basin was found.

Discussions with the licensee indicated that, in 1987, the decision to permanently discharge the service water flow to the cooling tower basin was made to rectify some problems that had been experienced with some radiation instruments. The valve lineup deviation had been considered acceptable since the existing system operating procedure, while requiring that the discharge to the cooling towers be accomplished to prevent freezing, did not specifically prohibit it at other times. Therefore, a safety evaluation, per procedure No. AP-0155, was not viewed as necessary.

Following the valve lineup change, during a scheduled diesel generator test, the licensee observed that the cooling flow through the diesel generator was below the minimum specified (90%) by the applicable procedure. The observation was identified to PORC which, based upon calculated cooling flow requirements, reduced the flow requirements of the procedure to 60-90%. The cooling flow rates observed through EDG "A" and "B" during the LOOP event were approximately 32% and 42%, respectively. Although these flow rates were far less than those specified by the procedure and recommended by the vendor, they were higher than those calculated for limiting conditions by the licensee during the inspection. Nonetheless, as a result of the observations and the outcome of the tests conducted, the licensee decided to return the service water discharge flow to the circulating water discharge.

The valve lineup change without an adequate safety evaluation, particularly after the observed flow reduction, is an apparent violation of 10CFR 50.59 which states, in part, that the records of changes to the facility "must include a written safety evaluation which provides the bases for the determination that the change does not involve an unreviewed safety question" (50-271/91-13-04).

2.5 (Closed) Unresolved Item No. 50-271/91-13-05 regarding the adequacy of the Service Water System surveillance testing.

The licensee's evaluation of the problems experienced with the service water flow during the LOOP event indicated that they were the consequence of increased discharge pressure resulting from several contributing factors. These factors included: (1) discharge to the cooling tower basin; (2) pipe corrosion and tuberculation; and (3) simultaneous operation of service water and residual heat removal service water pumps. As indicated in the AIT report the existing procedures specify individual surveillance tests for the EDGs, the SW, and the RHRSW individually. Therefore, these tests are unable to predict the effects of these systems when they are simultaneously activated, automatically realigned and operated in response to a specific abnormal event. This was the case with the Vermont Yankee LOOP event.



During the current inspection, the NRC reviewed the licensee's corrective actions to ensure adequacy of the SW system surveillance tests and determined that alternative requirements had been identified and were under review. Revision of the applicable surveillance procedures is scheduled for completion by December 31, 1991.

The steps taken by the licensee to ensure operability of vital plant equipment will be reviewed during a later inspection (see Section 2.6 below).

2.6 (Closed) Unresolved Item No. 50-271/91-13-06 relative to the status of the long term corrective actions associated with the Service Water System and Switchyard problems.

In a presentation at the exit meeting for the AIT inspection, on May 14, 1991, the licensee identified several issues requiring review on a long term basis. The licensee recommended list of actions was included in Appendix G of the AIT report. Following the inspection, the licensee divided the recommendations into 77 individual activities and assigned completion dates ranging from June 1991 to June 1992. The more significant of these activities and the related completion dates were identified in a letter to the NRC, dated July 15, 1991.

During the current inspection, the NRC reviewed the list of activities identified by the licensee, the status of several activities, and the mechanism that had been established to track the status of the activities to completion. This review indicated that the licensee's program for addressing the problems experienced during the LOOP event was thorough and well underway with several activities already completed. In view of the above, the long term corrective actions issue is considered closed. However, since the resolution of several significant activities was still incomplete at the time of the inspection, these activities will be reviewed during future NRC inspections. For ease of tracking, they are assigned individual open items as described below:

- a. Revision of the service water hydraulic flow model to account for corrosion and tuberculation effects. (50-271/91-21-01)
- b. Revision of service water surveillance procedure to include monitoring and equipment configuration requirements to confirm operability of vital plant equipment during abnormal and accident conditions. (50-271/91-21-02)
- c. Evaluation of potential voltage transients affecting the dc buses and changes necessary to tolerate the effects of such transients. (50-271/91-21-03)

- d. Evaluation of potential common mode/common cause failures affecting the protection of the switchyard equipment. (50-271/91-21-04)
- e. Review of all static protective relays to determine vulnerabilities and manufacturer recommended design enhancements to increase surge withstand capabilities. (50-271/91-21-05)

A review of the calibration and preventive maintenance frequencies of the service water and diesel generator performance monitoring devices resulted in the observations discussed in Section 3.0 of this report.

2.7 (Closed) Unresolved Item No. 50-271/91-13-07 pertaining to the event reportability discrepancies during the April 23, 1991 Loss of Offsite Power.

During the Augmented Inspection Team review of the April 23, 1991 LOOP, Vermont Yankee and the NRC identified several discrepancies pertaining to event reportability in accordance with 10 CFR Part 50.72. These discrepancies included: (1) failure to report an engineered safety system actuation; (2) failure to make a non-emergency report within the required one-hour period; and (3) failure to provide adequately characterized follow-up information. Detailed information regarding the April 23, 1991 LOOP event classification and notification is contained in the AIT inspection report.

At the conclusion of the AIT inspection, the NRC resolved that Vermont Yankee, through the 10CFR 50.72 notifications and the event briefings, kept the NRC management adequately aware of changing plant condition and provided sufficient technical details for an independent NRC assessment. The inspectors also determined that the licensee had completed a critical self-assessment of the event reportability and identified appropriate corrective actions. The event reportability discrepancies were discussed at the PORC meeting and the immediate corrective actions were timely, thorough and appropriate. In addition, to ensure appropriate and timely NRC notifications in the future, the licensee identified the need to revise Procedure AP-0156, "Notification of Significant Events". This revision will include requirements to notify the NRC when additional entry conditions for Emergency Action Levels exist and will provide a checklist of Engineered Safety Feature actuation.

Failure to provide timely and appropriate notification of significant events constitutes a violation of 10CFR 50.72. In accordance with the NRC Enforcement Policy, 10CFR Part 2, Appendix C, this is a violation of Severity Level V (Supplement I). However, because the safety significance of the violation is minor, corrective actions were initiated prior to the end of the inspection period, and the criteria specified in Section V.A of 10CFR Part 2, Appendix C, were satisfied, the violation is not being cited (50-271/91-13-07).

### 3.0 SURVEILLANCE OF DIESEL GENERATOR INSTRUMENTS

While addressing the Service Water concerns discussed above, the inspector reviewed the quality of instrumentation available to monitor the emergency diesel generator performance and the frequency of calibrations. This review revealed that most of the instruments did not carry a calibration sticker and that, where a sticker was affixed, the date did not reflect the latest calibration. Discussions with the licensee indicated that the use of calibration stickers had been discontinued approximately two years earlier and that approval for the practice had been secured following the PORC meeting of September 27, 1989. In a memorandum, dated July 5, 1989, the licensee explained that one of the reasons for discontinuing this practice was the fact that surveillance and PM "procedures are tracked via AP 4000 which provides directions as to the frequency of calibration." The inspector reviewed both the procedure addressing calibration of diesel generator instruments, OP 5361, and administrative procedure AP 4000.

Regarding OP 5361, the inspector observed that it still required affixing the stickers. However, the discrepancy was attributed to the fact that the procedure was approved at approximately the same time as the discontinuance of the stickers was approved. In addition, the inspector observed some inconsistencies with respect to record keeping. In this case, the discrepancies were the result of the licensee's recent upgrading of their tracking mechanism from the old Visi-card to a computerized data base. Completion of this effort should resolve the inconsistencies observed and improve the tracking mechanism.

Regarding procedure AP 4000, the inspector noticed that it allows the interval of administrative tests, i.e. tests that are not required by the Technical Specification, to be exceeded by 50%. In conjunction with this observation, the inspector determined that the test interval of emergency diesel generator B instruments had been exceeded and that the surveillance tests had been rescheduled for the following refueling outage. No evaluation was available that justified the acceptability of the rescheduling.

Discussions with the licensee indicated that procedure AP 4000 did permit rescheduling of tests and that this was under the control of the surveillance test coordinator. The inspector had no concerns regarding the method for controlling surveillance tests. However, he was concerned about the deferral of tests without an appropriate justification since the calibration of many instruments, while not directly required by the Technical Specification, supports the operability determination of other Technical Specification equipment, e.g. emergency diesel generator.

The licensee did not consider the rescheduling of the calibration tests a safety concern. They indicated that they were currently reviewing all instruments to establish appropriate testing intervals.

The lack of surveillance for the diesel generator B instruments is a violation of 10CFR 50, Appendix B, Criterion XII. In accordance with the NRC Enforcement Policy, 10CFR Part 2, Appendix C, this is a violation of Severity Level V (Supplement I). However, because the safety significance of the violation is minor, appropriate corrective actions had already been initiated by the licensee, and the criteria specified in Section V.A of 10CFR Part 2, Appendix C, were satisfied, the violation is not being cited (50-271/91-21-06).

#### 4.0 EXIT MEETING

The inspector met with the licensee representatives denoted in Attachment 1 of the report at the conclusion of the inspection, on August 22, 1991. At that time, the scope of the inspection and the inspection results, as described above, were summarized. The apparent violations were further discussed with the licensee, by telephone, on November 25, 1991.

ATTACHMENT I

PERSONS CONTACTED

Vermont Yankee Nuclear Power Corporation

* B. R. Buteau	Engineering Director
* G. Cappuccio	ME&C Supervisor
* D. A. Dyer	Quality Services Group
R. P. Grippardi	Quality Assurance Supervisor
* S. J. Jefferson	Assistant to Plant Manager
* R. P. LoPriore	Maintenance Supervisor
H. M. Metell	Principal Engineer
* R. D. Pagodin	Technical Services Superintendent
* D. L. Phillips	Elec. Engrg. & Construction Supervisor
* R. J. Wanczyk	Operations Superintendent
* T. A. Watson	I&C Supervisor

\* Indicates personnel present at the exit meeting.