

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR REACTOR REGULATION  
WASHINGTON, D.C. 20555

December 16, 1991

NRC INFORMATION NOTICE 91-81: SWITCHYARD PROBLEMS THAT CONTRIBUTE TO  
LOSS OF OFFSITE POWER

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to several problems associated with plant switchyards. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

On April 23, 1991, a complete loss of offsite power occurred at the Vermont Yankee Nuclear Power Station as a result of maintenance activities in the switchyard. Maintenance workers were installing a new battery for one of the two non-1E 125 VDC buses. The two normally independent buses were cross tied through the swing battery charger 4A-5A after defeating a mechanical interlock (Figure 1). Furthermore, the licensee was paralleling the battery chargers on bus DC-4A without a battery on this bus. When the 4A-5A battery charger output breaker feeding bus DC-5A was opened prior to connection of the new battery 4A to bus DC-4A, a voltage transient propagated through the switchyard DC control system that caused all but one of the 345kV and 115kV circuit breakers to trip and lock open. The loss of offsite power which occurred caused a main turbine and automatic reactor trip. Restoration of full offsite power took thirteen hours.

The NRC dispatched an augmented inspection team (AIT) to investigate this event, and the following generic concerns were identified by the team in its report (50-217/91-13): (1) a lack of preventive maintenance on battery chargers, (2) presence of sensitive components in logic cards making them susceptible to failure, (3) switchyard protective relays that were susceptible to a single failure, and (4) a lack of clear authority over the switchyard during emergency conditions.

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### Lack of Preventive Maintenance

Three of the four non-1E battery chargers (4A, B, and 4A-5A) in the switchyard DC control system were in a degraded condition at the time of the event. In each of the degraded battery chargers, manufactured by Exide, the output filter circuit was not functional. The problems included blown fuses in one filter circuit, blown and wrong-sized fuses in another, and a failed capacitor in the third filter circuit. If the 4A-5A battery charger output filter circuit had been functional, the effect of the voltage transient may have been mitigated and loss of offsite power might have been prevented. The problems resulted directly from infrequent preventive maintenance on the battery chargers. The licensee had no regular maintenance program for the chargers and it appeared that the last maintenance was performed in 1985. These battery chargers are not safety related and no surveillance testing or preventive maintenance is required. However, at this facility, the switchyard battery system, including the switchyard batteries, their associated chargers, and associated distribution panels, is part of the auxiliary electrical power system and is required to be operable by the plant's Technical Specifications.

### Sensitive Components in Logic Cards

The voltage spike in the switchyard DC control system destroyed zener diodes in the stuck breaker failure units (SBFUs) of two switchyard circuit breakers which led to a chain reaction that caused most of the breakers in the 345kV and 115kV switchyard to trip and lock open. These SBFUs are manufactured by ASEA Brown Boveri, and previous models were made by the Westinghouse Electric Corporation. The manufacturer has developed new units that are not as susceptible to voltage spikes because the new units do not contain zener diodes.

### Protective Relays Subject to a Single Failure

All of the SBFU relays are powered from a single bus (DC-4A) even though two DC buses are available in the switchyard DC control system. This design is subject to a single failure. Other facilities may have similar protective relaying designs that could be vulnerable to a common cause failure.

### Authority Over the Switchyard Under Emergency Conditions

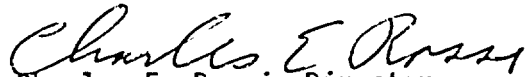
The restoration of offsite power was delayed because of a lack of communications between plant staff and the transmission and distribution (T&D) personnel. Under normal conditions, T&D is responsible for operating the switchyard. The licensee's procedure specifies that, under emergency conditions, the responsibility is transferred to the plant staff. However, the procedure does not define "emergency." These operational problems suggest the need to clarify switchyard authority during a loss of offsite power or other emergency conditions when timely switchyard activities are important.

### Additional Example of Switchyard Communication Problems

Another example of communication problems in the switchyard can be seen in an event that took place at the McGuire Nuclear Generating Station, Unit 1, on February 11, 1991. The unit tripped from 100% power when T&D personnel caused

a loss of all offsite power while testing a modification to the protective relay circuitry in the 230 kV switchyard. Since the majority of the switchyard is outside of the plant equipment boundary, the T&D personnel did not notify the station operations personnel that work was in progress even though switchyard activities can impact the station. Prior to this event there was no agreement between station operations and T&D personnel on how to handle switchyard activities outside the plant equipment boundary. Subsequent to this event, a work control policy was established to provide improved communication between the station operations personnel and T&D personnel.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

  
Charles E. Rossi, Director  
Division of Operational Events Assessment  
Office of Nuclear Reactor Regulation

Technical contacts: Cliff Anderson, Region I  
(215) 337-5376

Peter Kang, NRR  
(301) 504-0779

David Skeen, NRR  
(301) 504-1174

Attachments:

1. Figure 1: Switchyard House DC Distribution  
One Line Diagram
2. List of Recently Issued NRC Information Notices

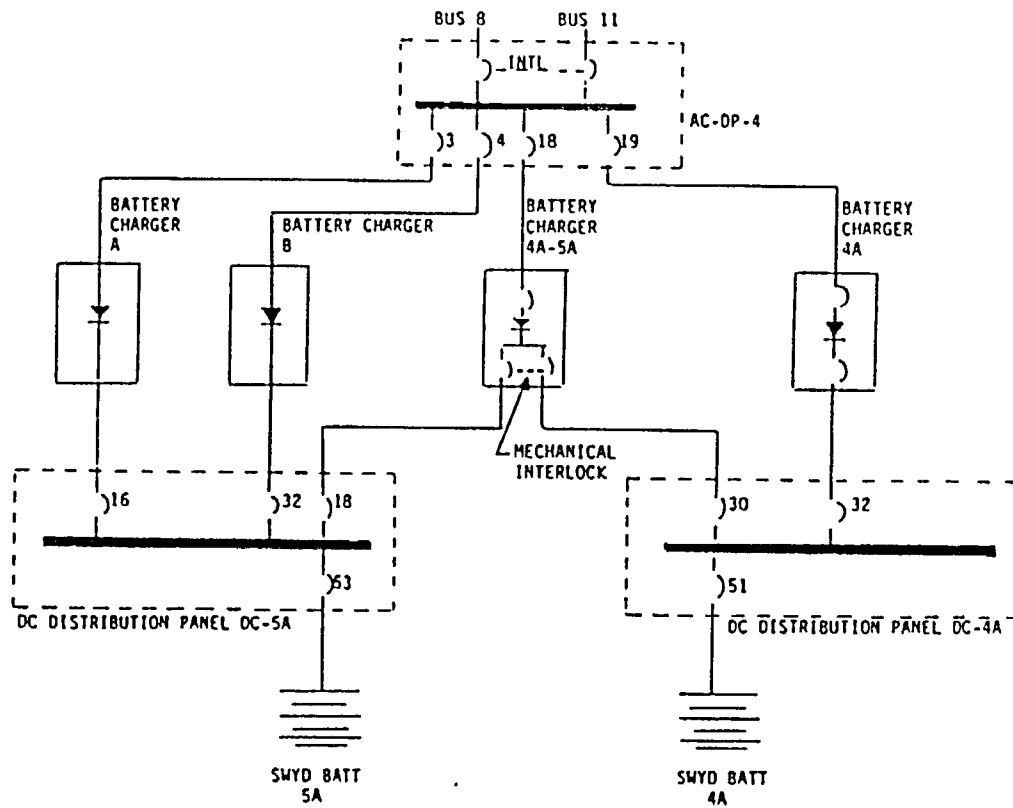


Figure 1: Switchyard House DC Distribution One Line Diagram

LIST OF RECENTLY ISSUED  
 NRC INFORMATION NOTICES

| Information Notice No. | Subject  | Date of Issuance | Issued to   |
|------------------------|--|------------------|---|
| 91-80                  | Failure of Anchor Head Threads on Post-Tensioning System During Surveillance Inspection        | 12/11/91         | All holders of OLs or CPs for nuclear power reactors.             |
| 91-79                  | Deficiencies in the Procedures for Installing Thermo-Lag Fire Barrier Materials                | 12/06/91         | All holders of OLs or CPs for nuclear power reactors.             |
| 88-92, Supp. 1         | Potential for Spent Fuel Pool Drindown   | 11/29/91         | All holders of OLs or CPs for nuclear power reactors.             |
| 91-78                  | Status Indication of Control Power for Circuit Breakers Used in Safety-Related Applications    | 11/28/91         | All holders of OLs or CPs for nuclear power reactors.             |
| 90-57, Supp. 1         | Substandard, Refurbished Potter & Brumfield Relays Represented as New                          | 11/27/91         | All holders of OLs or CPs for nuclear power reactors.             |
| 91-77                  | Shift Staffing at Nuclear Power Plants   | 11/26/91         | All holders of OLs or CPs for nuclear power reactors.             |
| 91-76                  | 10 CFR Parts 21 and 50.55(e) Final Rules   | 11/26/91         | All holders of OLs or CPs and vendors for nuclear power reactors. |
| 91-75                  | Static Head Corrections Mistakenly not Included in Pressure Transmitter Calibration Procedures | 11/25/91         | All holders of OLs or CPs for nuclear power reactors.             |
| 91-74                  | Changes in Pressurizer Safety Valve Setpoints Before Installation                              | 11/25/91         | All holders of OLs or CPs for nuclear power reactors.             |

OL = Operating License  
 CP = Construction Permit

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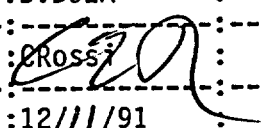
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 (301) 504-1174

Attachments:

1. Figure 1: Switchyard House DC Distribution One Line Diagram
2. List of Recently Issued NRC Information Notices

\*See previous concurrence

|      |            |             |                        |              |              |           |
|------|------------|-------------|------------------------|--------------|--------------|-----------|
| OFC  | :*OEAB:NRR | : *RI       | :*SC:OEAB:NRR:*ADM:RPB | :*C:SELB:NRR | :*C:OEAB:NRR | :         |
| NAME | :DSkeen    | : CAnderson | :RDennig               | :JMain       | :FRosa       | :AChaffee |
| DATE | :10/01/91  | : 10/01/91  | :11/05/91              | :10/01/91    | :11/05/91    | :11/14/91 |

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| NAME | :CBerlinger  | :  | : | : | : | : |
| DATE | :11/25/91    | :12/11/91   | : | : | : | : |

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The staff is providing this information as an early notification of a matter that could become significant and that the NRC staff is continuing to consider. Upon completing its evaluation, the staff may require licensees to take specific actions. No specific action or written response is required by this information notice. If you have any questions about this matter, please contact the technical contacts below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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*PER TELECON  
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| NAME | :DSkeens  | :CAnderson | :RDennig     | :JMain   | :FRosa      | :AChaffee   | : |
| DATE | :10/1/91  | : 10/1/91  | : / /91      | :10/1/91 | : / /91     | : / /91     | : |

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