

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

December 14, 1988

NRC INFORMATION NOTICE NO. 88-96: ELECTRICAL SHOCK FATALITIES AT NUCLEAR  
POWER PLANTS

Addressees:

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

Purpose:

This information notice is being provided to alert addressees to events involving fatalities from electrical shock that have occurred at nuclear reactor facilities. In addition to causing tragic personnel loss, some of these events have had significant nuclear safety implications because of the loss or potential loss of safety-related equipment. 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 do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

At Wolf Creek on September 13, 1988, an electrician, who was attempting to add new wires to a 3/4-inch conduit containing 480-volt energized circuits, was electrocuted. The electrician had difficulty inserting a nonconducting snake through the conduit fire seals. Some of the energized wires in the conduit were damaged during either a previous modification or attempts to remove the fire seals. The electrician disconnected the conduit from a junction box in order to remove the fire seals. At this point, the ungrounded conduit apparently came in contact with the damaged energized wires, becoming energized itself. The electrician, who was standing on some piping holding the conduit, provided the missing ground and was electrocuted.

An electrocution occurred under similar circumstances at Quad Cities Unit 1, on July 16, 1971. An electrician was pulling a new conductor into position in the high pressure coolant injection (HPCI) room, and for some reason the cable became energized, causing the death of the electrician.

At Wolf Creek, on October 14, 1987, an electrical technician, who was cleaning the potential transformer cubicles on the 'B' train emergency safety features switchgear, came in contact with a 4160-volt energized line and was electrocuted. Miscommunication regarding the equipment that was to be deenergized,

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failure to follow work procedures requiring voltage checks on supposedly deenergized equipment, and the defeating of safety features built into the potential transformer drawers all contributed to the cause of this tragedy.

Wolf Creek has two redundant 4160-volt safety features busses (NB01 and NB02, shown in Figure 1), each fed from separate transformers. Each of these transformers also feeds an alternate crossover line to the other bus to permit powering this opposite bus in case the normal power source for the bus fails. In order to permit the "B" train switchgear to be cleaned, inspected and tested, a shift supervisor prepared a clearance to deenergize the switchgear. In doing this, he left the normal transformer (XNB02) for the "B" train switchgear energized. He reasoned that this transformer should be left energized to provide redundant power to the "A" train via the alternate line, and he believed that he had the concurrence of the Electrical Department for this configuration. The electrical supervisor with whom he discussed this matter, however, believed that the shift supervisor was referring to the fact that the alternate line to the "B" side from the "A" side transformer (XNB01) was to be left energized, as this line could not be deenergized without shutting down the "A" bus also. Thus the incoming lines from both transformers to the "B" train switchgear remained energized, but the electricians believed that the line from the "B" side transformer had been deactivated.

This misunderstanding would have been discovered if the workmen had followed the maintenance procedure for this work, which required that all of the stationary disconnects in each cubicle be checked using high voltage gloves and a voltage tester to ensure that no voltage was present. In this case, the day-shift electricians who were doing this part of the procedure only checked a few of the disconnects.

The night shift was working by the time the electricians got to the cleaning of the potential transformer drawers. These drawers are arranged such that when they are pulled out the exposed part of the drawer is deenergized, regardless of the electrical status of the rest of the switchgear. However, the electrical technician, who was doing the cleaning, and his supervising electrician decided to pull the tops off the potential transformer cubicles in order to facilitate the work.

While the electrical technician was working on the potential transformer on the switchgear (NB0209) for the line from the normal "B" train transformer, he came in contact with an energized potential transformer stub and was electrocuted. The breaker (PA0201) in the line feeding the "B" side transformer apparently tripped immediately after the energized stub was contacted. However, the victim was in contact with the cabinet (NB0212) for the energized line from the "A" side transformer. His sleeve, ignited by arcing current, was on fire. This apparently led other electricians in the area who responded to the emergency to believe that the victim was still in contact with energized equipment. Using belts and hoses, the electricians tried unsuccessfully to remove the victim. At this point, the Halon fire protection system in the switchgear room was initiated by the fire, forcing the electricians out of the room temporarily.

The electricians in the switchgear area relayed incorrect information to the control room that a man was hung up on the breaker (NB0212) for the still-energized alternate line from the "A" side transformer. In their haste to free the victim, the operators opened the breaker (NB0112) downstream from the point at which the alternate line to the "B" bus (NB02) leaves the line from the "A" side transformer (XNB01). Consequently, this action deenergized the "A" bus (NB01), but not the alternate line to the "B" bus. This action caused the "A" side diesel generator (NE01) to start, repowering the "A" bus. However, when the control room personnel were informed that the alternate line to the "B" side was still energized, they disconnected all power sources, including the running diesel for both busses by opening breakers 13-48 and NB0111. As a result, all of the emergency safety systems, including the operating residual heat removal system, were deactivated.

After the victim had been removed, the operators tried to repower the "A" bus (NB01) by closing the breaker (NB0111) to the still running diesel but discovered that the diesel generator controls had to be reset in the diesel generator room first. The "A" bus was then repowered from its normal transformer (XNB01). The residual heat removal system was out of service for 17 minutes during this event. However, the core was only partially loaded with fuel at the time, and the reactor coolant temperature rise was negligible. The Wolf Creek staff have since provided a modification to the diesel controls to permit them to be reset from the control room after the diesel power has been interrupted from the control room.

This Wolf Creek event also has a similar precedent. An electrical worker was electrocuted at the San Onofre Nuclear Power Plant on November 22, 1980 when he came in contact with a 4-kv line while he was cleaning breaker cubicles.

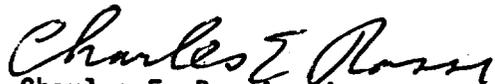
#### Discussion:

Working on or around live circuits is common practice at nuclear power plants. As these events show, this practice can not only be very hazardous to personnel, but because of the need to take extraordinary actions during emergency situations, it can have a serious impact on reactor safety as well. Licensees are encouraged to review their maintenance practices to ensure that the following considerations are applied to electrical maintenance activities:

1. Equipment clearance procedures assure that work on live circuits is undertaken only when absolutely necessary and that when this is the case, proper consideration is given to the potential for electrical shock and the loss of safety-related equipment.
2. Procedures for pulling new cables or wires past energized wires include provisions to prevent damage to the existing wires, prohibitions against the ungrounding of conduits and junction boxes containing live wires, and provisions to isolate the electrical workers from the energized wires.
3. Clearance procedures assure that when work on or around energized equipment is necessary, the operators and everyone involved with the actual work clearly understand exactly which equipment is out of service and which equipment is to be left energized.

4. Maintenance supervision ensures that everyone working on electrical equipment is aware of the importance of following safety procedures, as those that require checking for voltage on contacts that are expected to be deenergized. This safety procedure is particularly important if more than one crew is involved in the work.
5. Maintenance safety procedures include warnings against defeating protective features designed to deenergize equipment when it is serviced.

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Charles E. Rossi, Director  
Division of Operational Events Assessment  
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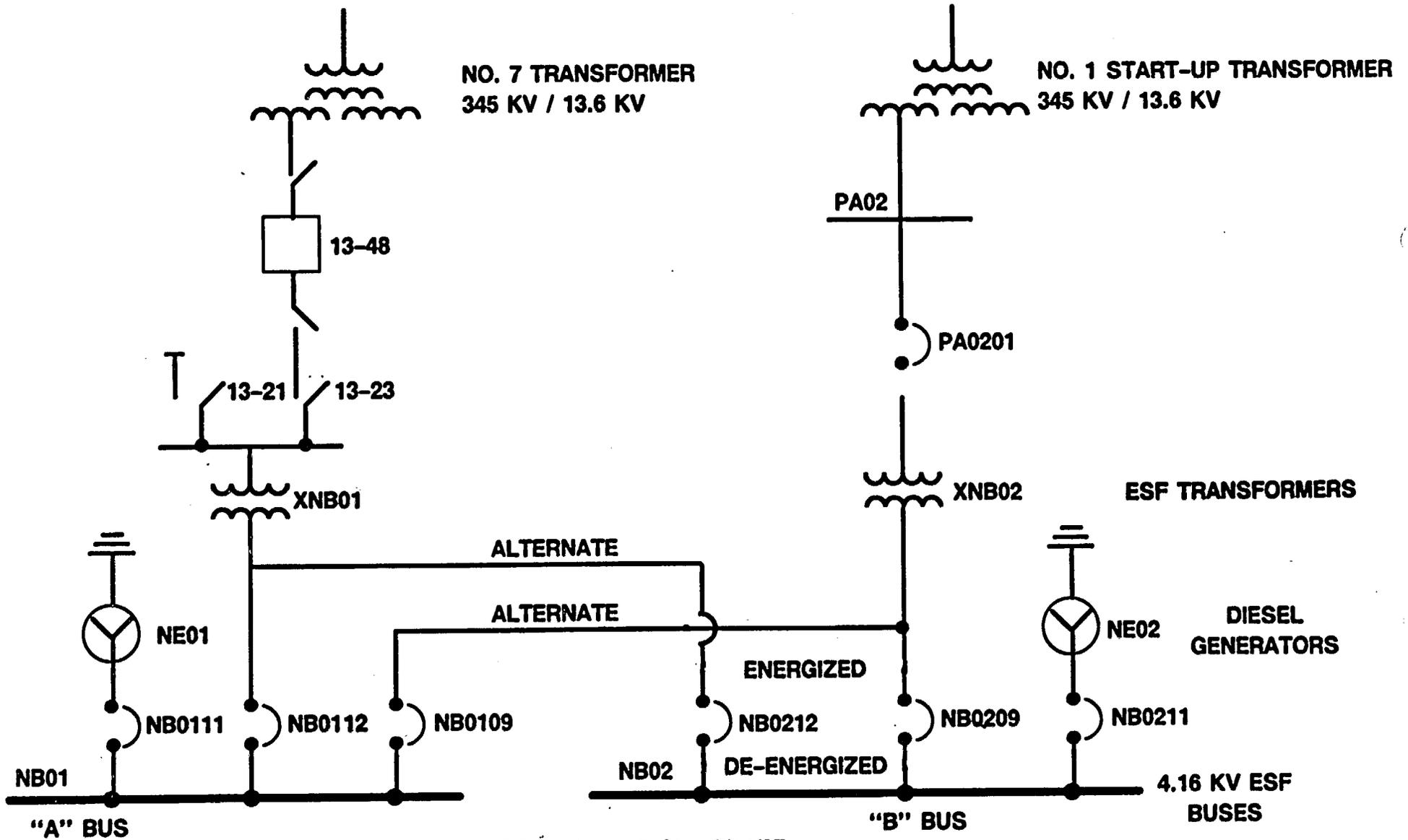
Technical Contacts: R. Vickrey, RIV  
(817) 860-8239

Donald C. Kirkpatrick, NRR  
(301) 492-1152

Attachments:

1. Figure 1, Electrical One-Line Diagram
2. List of Recently Issued NRC Information Notices

# WOLF CREEK GENERATING STATION



**BREAKER STATUS BEFORE ACCIDENT ON 10/14/87**  
**CLOSED - NB0112, 13-23, 13-48, PA0201**  
**OPEN - NB0109, NB0209, NB0211, NB0212, NB0111**

**Figure 1 - Partial Emergency Safety Features Electrical One-Line Diagram**

LIST OF RECENTLY ISSUED  
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
88-95	Inadequate Procurement Requirements Imposed by Licensees on Vendors	12/8/88	All holders of OLs or CPs for nuclear power reactors.
88-94	Potentially Undersized Valve Actuators	12/2/88	All holders of OLs or CPs for nuclear power reactors.
88-93	Teletherapy Events	12/2/88	All NRC medical licensees.
88-92	Potential for Spent Fuel Pool Draindown	11/22/88	All holders of OLs or CPs for nuclear power reactors.
88-91	Improper Administration and Control of Psychological Tests	11/22/88	All holders of OLs or CPs for nuclear power reactors and all fuel cycle facility licensees who possess, use, import, export, or transport formula quantities of strategic special nuclear material.
88-90	Unauthorized Removal of Industrial Nuclear Gauges	11/22/88	All NRC licensees authorized to possess, use, manufacture, or distribute industrial nuclear gauges.
88-89	Degradation of Kapton Electrical Insulation	11/21/88	All holders of OLs or CPs for nuclear power reactors.
88-88	Degradation of Westinghouse ARD Relays	11/16/88	All holders of OLs or CPs for nuclear power reactors.
88-87	Pump Wear and Foreign Objects in Plant Piping Systems	11/16/88	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License  
 CP = Construction Permit

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*TECH ED	*C:ESB:DEST	*SAD:DEST	*D:DEST	*RIV	*RIV
Tech Editor	FRosa	ATHadani	LShao	RVickrey	JMilhoan
11/9/88	11/23/88	11/28/88	11/30/88	12/07/88	12/07/88
*OGCB:DOEA	*C:OGCB:DOEA	D.DOE			
DKirkpatrick	CHBerlinger	CERoss			
11/17/88	12/02/88	12/9/88			

Discussion:

Working on or around live circuits is common practice at nuclear power plants. As these events show, this practice can not only be very hazardous to personnel, but because of the need to take extraordinary actions during emergency situations, it can have a serious impact on reactor safety as well. Licensees are encouraged to review their maintenance practices to ensure that the following considerations are applied to electrical maintenance activities:

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