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

October 9, 1991

NRC INFORMATION NOTICE 91-64: SITE AREA EMERGENCY RESULTING FROM A LOSS OF NON-CLASS 1E UNINTERRUPTIBLE POWER SUPPLIES

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 problems resulting from the common mode failure of uninterruptible power supplies used in nonsafety-related applications at Unit 2 of the Nine Mile Point Nuclear Station. 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 August 13, 1991, Nine Mile Point Unit 2 was operating at full power when a fault occurred on phase B of the main transformer which caused the generator, turbine, and reactor to trip. Station loads were transferred automatically from the normal station service transformer, which receives power from the generator, to the reserve station transformer, which receives power from the grid. During the transient which lasted for about 12 cycles, voltage on the station's phase B buses decreased to approximately 50 percent of normal value before returning to normal.

The voltage transient resulted in loss of the power output from five of eight nonsafety-related uninterruptible power supplies. Loss of these power supplies caused the loss of control room annunciators, indication of control rod positions, the core thermal limits computer, the process computer, the safety parameter display system computer, the feedwater control system, some instrumentation for balance-of-plant systems, some instrument recorders, the plant radio and paging systems, and some of the lighting for the plant. Some of the instrument recorders that were lost failed "as is." For example, the average power range monitors continued to indicate 100% after the reactor tripped. Nevertheless, control room operators were able to verify from average power range meters and local power range lights mounted on back panels and from other indications that the reactor actually had tripped and was shut down.

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Because of the loss of control room annunciators and the reactor transient resulting from automatic tripping of the generator, turbine, and reactor, Niagara Mohawk Power Corporation (the licensee) declared a site area emergency in conformance with the emergency plan. The operators shut down the plant in accordance with emergency operating procedures. Thirty-four minutes after the trip, plant personnel had restored power output from the five nonsafety-related uninterruptible power supplies using the alternate maintenance power sources. Thirteen hours after the trip, the reactor was in the cold shutdown condition, and an hour later, the licensee ended the site area emergency.

As shown in Attachment 1, each uninterruptible power supply cabinet receives 3-phase 600-Vac power from the plant's electrical distribution system. This system is connected to either the generator or the grid. Inside the cabinet, the 600-Vac input power passes through an ac-to-dc converter to obtain approximately 140-Vdc power which then passes through an inverter to generate quality 3-phase 208/120-Vac power that is within specified limits for voltage amplitude, frequency, and phase. The output from the cabinet is distributed to critical loads, many of which are sensitive to the voltage irregularities that are sometimes present with normal ac power. To prevent the interruption of power to these loads when the normal supply of power is lost, a 125-Vdc battery is connected to the uninterruptible power supply between the ac-to-dc converter and the dc-to-ac inverter.

The uninterruptible power supply cabinet also receives three-phase 208/120-Vac maintenance power. This power is provided through a voltage regulator and is used to supply critical loads when the supply of uninterruptible power from the inverter is not available. Within the cabinet, a control logic system selects either inverter or maintenance power for distribution to the critical loads.

Prior to and at the time of the event, the control logic power supply normally received power from phase B of the maintenance power source. If maintenance power was not available, the input for the control logic power supply automatically transferred to the output of the inverter. However, on August 13, 1991, the control logic tripped the uninterruptible power supply in response to the transient on phase B of the maintenance power source. The licensee had expected that the control logic power supply would transfer to the output of the inverter and, when inplant electrical distribution system voltages returned to normal, would transfer back to the maintenance source. Had this happened, the uninterruptible power supply would have continued to supply the critical loads.

If the control logic power supply had been wired to receive its normal power from the inverter and backup power from the maintenance source, the control logic would have had a continuous source of power and the loss of power output from the uninterruptible power supplies would not have occurred. The control logic power supplies for the three nonsafety-related and the two safety-related uninterruptible power supplies that were not lost during the event normally receive dc power for control logic through a dc-to-dc converter.

Six battery packs, each consisting of 3 small rechargeable lead-acid cells within the uninterruptible power supply, provide power to the control logic and the indicator lights when no other power is available. If the battery packs had been functional during the transient, they would have provided sufficient power to the control logic for the necessary time to have prevented loss of the uninterruptible power supplies. After the event, the licensee found that the electrolyte in the lead-acid cells was dry.

Although the preventative maintenance section in the vendor's manual does not address the battery packs, another section of the manual states that they should be replaced every 4 years. The vendor had installed the battery packs in the units in 1984. Subsequently, the licensee determined that the battery packs should be replaced more frequently because of the environmental conditions within the cabinets.

The licensee obtained the uninterruptible power supplies from Exide Electronics in 1981. In 1985, the licensee obtained a revised manual for the uninterruptible power supplies from Exide Electronics which recognized the importance of reversing the connections of normal and backup power for the control logic power supplies. New units supplied by Exide Electronics did have the connections reversed. However, Exide Electronics did not specifically advise the licensee of this change. The licensee had obtained the uninterruptible power supplies as commercial grade products.

The licensee has modified the uninterruptible power supplies to provide normal input power to the control logic power supplies from the output of the inverter and alternate power from the maintenance source. The licensee has also replaced the battery packs for the control logic and has established an annual replacement schedule. The licensee intends to evaluate the performance of the switching circuitry for supplying input power to the control logic under various conditions and to process appropriate changes to the vendor's manual.

Discussion

The transformer fault caused the generator, turbine, and reactor trips. The transformer fault also led to a momentary degradation of voltage on the plant's electrical distribution system and, in turn, the common mode failure of the five uninterruptible power supplies. Because of the loss of control rod position indicators due to loss of the uninterruptible power supplies, the operators could not immediately verify that all control rods had fully inserted into the reactor core. This resulted in some difficulty in implementing the emergency procedures. However, the reactor was in a safe condition at all times, and operators were able to monitor all safety parameters, except for control rod positions, throughout the event. The two safety-related uninterruptible power supplies were not lost. Had a design basis accident occurred in conjunction with this event, power would have been available for the instrumentation and control components in the required safety systems.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation project manager.

Charles E. Rossi

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

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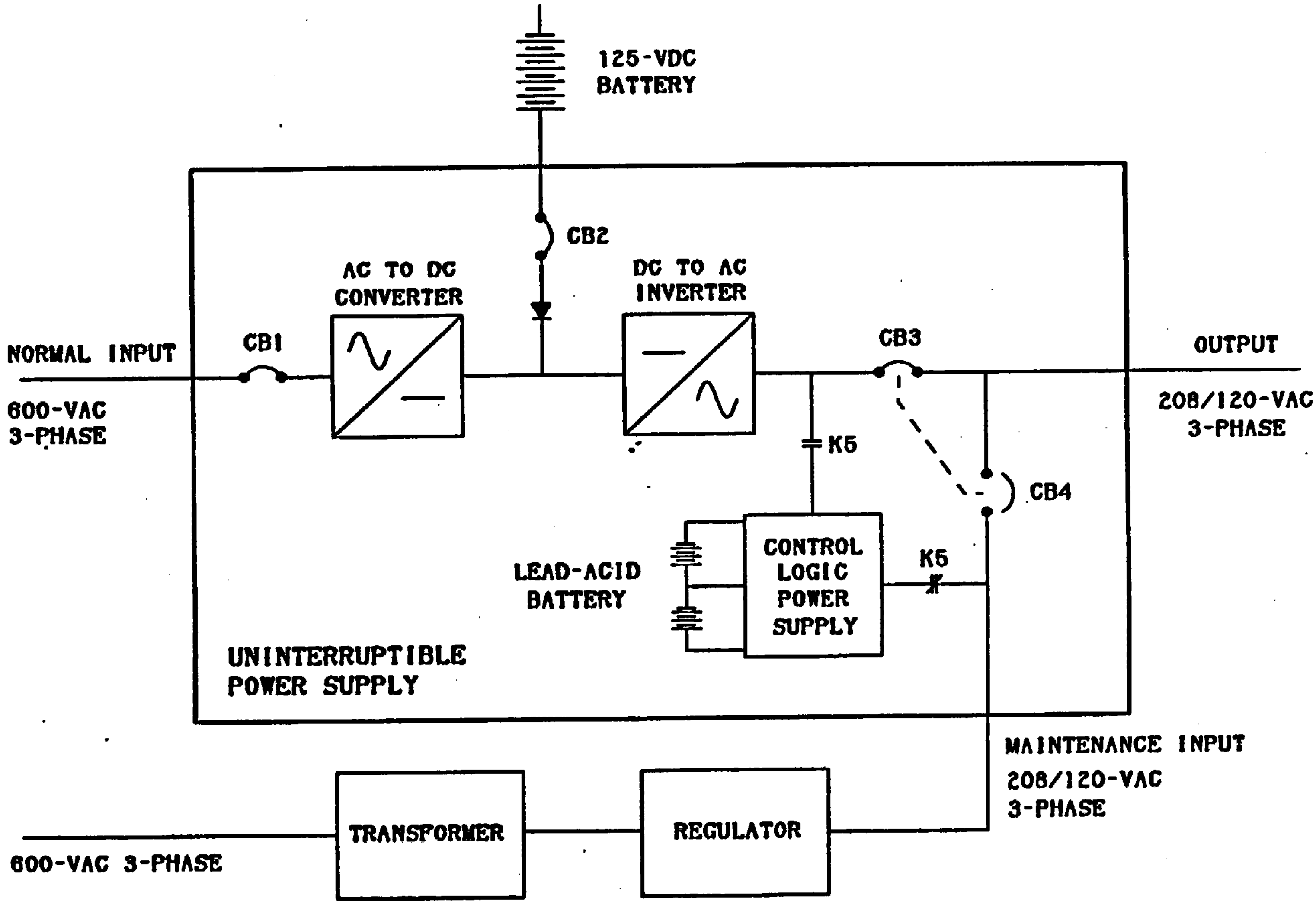
Roger Woodruff, NRR
(301) 492-1152

Attachments:
1. Uninterruptible Power Supply Before Design Change
2. List of Recently Issued NRC Information Notices



UNINTERRUPTIBLE POWER SUPPLY BEFORE DESIGN CHANGE

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
91-63	Natural Gas Hazards at Fort St. Vrain Nuclear Generating Station	10/03/91	All holders of OLs or CPs for nuclear power reactors
91-62	Diesel Engine Damage Caused by Hydraulic Lockup Resulting from Fluid Leakage Into Cylinders	09/30/91	All holders of OLs or CPs for nuclear power reactors
91-61	Preliminary Results of Validation Testing of Motor-Operated Valve Diagnostic Equipment	09/30/91	All holders of OLs or CPs for nuclear power reactors and motor-operated valve (MOV) diagnostic equipment vendors identified herein.
91-60	False Alarms of Alarm Ratemeters Because of Radiofrequency Interference	09/24/91	All Nuclear Regulatory Commission (NRC) licensees authorized to use sealed sources for industrial radiography.
91-59	Problems with Access Authorization Programs	09/23/91	All holders of OLs or CPs for nuclear power reactors.
91-58	Dependency of Offset Disc Butterfly Valve's Operation on Orientation with Respect to Flow	09/20/91	All holders of OLs or CPs for nuclear power reactors.
91-57	Operational Experience on Bus Transfers	09/19/91	All holders of OLs or CPs for nuclear power reactors.
91-56	Potential Radioactive Leakage to Tank Vented to Atmosphere	09/19/91	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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Document Name: IN 91-64

*SEE PREVIOUS CONCURRENCES:

*OEAB	*ADM/RPB	*SC:OEAB	*BC:OEAB	*TL:IIT	*PM:PD11
RWWoodruff	JDMain	RLDennig	AEChaffee	JERosenthal	DSBrinkman
9/12/91	9/12/91	9/17/91	9/17/91	9/24/91	9/25/91
*BC:SICB	*BC:OGCB	*D:DOEA			
SNewberry	CHBerlinger	CERossi			
9/25/91	9/27/91	10/4/91			

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