Consumers Power
POWERING MICHIGAN'S PROGRESS
Palisades Nuclear Plant: 27780 Blue Star Memorial Highway, Covert, MI 49043

February 15, 1996

U S Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT
LICENSEE EVENT REPORT 96-003 - AUXILIARY SHUTDOWN PANEL INVERTER LOW VOLTAGE CUT-OFF SETTING RESULTS IN UNAVAILABILITY OF PANEL

Licensee Event Report (LER) 96-003 is attached. This condition is reportable to the NRC in accordance with 10CFR50.73(a)(2)(ii) as a condition outside the plant design basis.

SUMMARY OF COMMITMENTS

This letter contains 2 new commitments as follows:

> Revise Technical Specification surveillance procedure QO-23, "Auxiliary Hot Shutdown Panel Checks", to include periodic testing and adjustment of the low voltage cut-off setpoint for the alternate shutdown panel inverter or develop another procedure to test this setpoint.

260070

JE22

Determine whether other, similar equipment setpoints exist which can cause inverters or battery chargers to shut down, and verify that appropriate testing is performed.

Richard W Smedley
Manager, Licensing

CC Administrator, Region III, USNRC
Project Manager, NRR, USNRC
NRC Resident Inspector - Palisades

Attachment

ATTACHMENT

CONSUMERS POWER COMPANY
PALISADES PLANT
DOCKET 50-255

LICENSEE EVENT REPORT 96-003
AUXILIARY SHUTDOWN PANEL INVERTER LOW VOLTAGE CUT-OFF SETTING RESULTS IN UNAVAILABILITY OF PANEL

NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Consumers Power Company Palisades Plant	0 5 0 0 0 2 5 5	1 OF 0 7

TITLE (4) LICENSEE EVENT REPORT 96-003 - AUXILIARY SHUTDOWN PANEL INVERTER LOW VOLTAGE CUT-OFF SETTING RESULTS IN UNAVAILABILITY OF PANEL

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (6)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	
									N/A	0 5 0 0 0
0 1	1 5	9 6	9 6	0 0 3	0 0	0 2	1 5	9 6	N/A	0 5 0 0 0

OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check one or more of the following)* (11)			
N		20.402(b)	20.405•	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10)		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71•
1 0 0		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	below and in Text,
		20.405(a)(1)(iv)	X 50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	NRC Form 366A)
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
William L Roberts, Licensing Engineer	AREA CODE 6 1 6 7 6 4 - 8 9 1 3

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS	
A	E I	I N V T	X 9 9 9	Y							

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (*If yes, complete EXPECTED SUBMISSION DATE*)	X NO				

ABSTRACT (*Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines*) (16)

On January 15, 1996, at 1330 hours, with the plant operating at 100% power, it was discovered that during the performance of work on September 27, 1995, technicians found the low voltage cut-off for the Alternate Shutdown Panel inverter set at approximately 120 volts DC input. The current Appendix R calculation for battery capacity shows that the initial battery terminal voltage will be less than 120 volts DC at the onset of a fire requiring use of the alternate shutdown panel, coincident with a loss of offsite power and a loss of battery chargers. Based upon this calculation, the alternate shutdown panel would not have operated as the battery voltage would not have been high enough to overcome the 120V low voltage setpoint. Fires in the Electrical Equipment Room, 1-D Switchgear Room, Cable Spreading Room and Auxiliary Building 590' corridor which require use of the alternate shutdown panel also have the potential to cause a loss of the station battery chargers. This circumstance would result in the alternate shutdown panel being powered directly from the station batteries to effect safe shutdown outside the Control Room. During the September work, the low voltage cut-off was reset to resolve the issue. The setpoint discrepancy was not identified as putting the plant outside its design basis until the work order was reviewed under the ongoing Appendix R enhancement program.

EVENT DESCRIPTION

On September 27, 1995, the plant was operating at 100% power and Technical Specification Test QO-23, "Auxiliary Hot Shutdown Panel Checks" was in progress. During the power-up sequence for the alternate shutdown panel, the DC input breaker to the panel tripped open. Repeated attempts to power the Alternate Shutdown Panel provided the same results.

QO-23 was aborted, the panel declared inoperable, the appropriate LCO entered and an investigation into this failure to transfer control to the alternate shutdown panel was initiated. The investigation revealed that the Alternate Shutdown Panel inverter alarm board [EJ;INVT] had failed and needed to be replaced. During this trouble shooting it was also discovered that the inverter low voltage cut-off setpoint was set too high. Both of these problems were resolved, the equipment returned to service, and testing successfully completed under QO-23. A plant condition report was initiated to evaluate the discrepancies. The evaluation should have discovered that the inverter low battery cut-off setpoint would have rendered the Alternate Shutdown Panel incapable of performing it's design basis function. This low voltage setpoint problem was, however, not addressed in the plant condition report evaluation.

On January 15, 1996, during a review of the work order under the ongoing Appendix R Enhancement Program, it was discovered that during the evaluation of the work completed in September that the low voltage cut-off for the Alternate Shutdown Panel inverter was not addressed. Further review determined that the current Appendix R calculation for battery capacity shows that the initial battery terminal voltage will be less than 120 volts DC at the onset of a fire requiring use of the Alternate Shutdown Panel coincident with a loss of offsite power and a loss of battery chargers. Based upon this calculation, it was concluded that the Alternate Shutdown Panel would not have operated as the battery voltage would not have been high enough to overcome the 120V low voltage setpoint. Therefore, in the event of a fire in the Electrical Equipment Room, 1-D Switchgear Room, Cable Spreading Room and Auxiliary Building 590' Corridor which causes a loss of station battery chargers, the Alternate Shutdown Panel would not have been available to effect a plant safe shutdown from outside the Control Room. During the September work, the low voltage cut-off was properly reset to resolve the issue.

CAUSE OF THE EVENT

1. Reviews have determined that the low voltage cut-off setpoint for the Alternate Shutdown Panel has not been identified as a variable whose setting is necessary to assure operability of the panel. No specific setting or tolerance can be confirmed to have been specified during the initial panel installation and checkout, and verifying this setpoint has not been a part of the periodic testing of the panel. Inadequate post modification and subsequent surveillance testing is one root cause of the event.

2. When the repair work order was reviewed there was a failure to recognize that the low voltage setpoint could be a safety significant issue. The low voltage condition was not addressed as part of the evaluation of the deficiencies repaired under the work order.

3. A contributing cause is the lack of a thorough evaluation of industry experience information. As part of the evaluation of this low voltage event, it was discovered that a 1985 Industry Experience and Assessment document identified that a particular manufacturers inverter had a low shutoff voltage problem. A more questioning attitude with regards to this industry experience report could have led to the realization that the low voltage shut-off set point could be significant to inverter operation, and that we didn't monitor the low voltage cut-off setpoint for the Alternate Shutdown Panel.

ANALYSIS OF THE EVENT

10 CFR 50.48, Appendix R requires that an Alternate Shutdown Panel be designed and installed to provide a station where the plant could be brought to hot shutdown in the event that the control room could not be used as a result of a fire. The postulated fire may make the control room uninhabitable or disable enough of the control room equipment to render it not useful to control the plant. At Palisades, the fires that we have identified in this scenario result in postulated consequences that require using the Alternate Shutdown Panel. During this postulated scenario, the Alternate Shutdown Panel is being powered from the station batteries and the battery chargers are maintaining a high voltage on the battery system. If the postulated fire also renders both battery chargers inoperable, then the Alternate Shutdown Panel would be fed directly from the station batteries at a somewhat lower voltage. With the Alternate Shutdown Panel inverter low voltage setpoint cut-off set to a voltage higher than what the station batteries alone can provide, the Alternate Shutdown Panel could not be energized per procedure.

The failure of the Alternate Shutdown Panel to energize was discovered on September 27, 1995 during Technical Specification Surveillance Test QO-23 " Auxiliary Hot Shutdown Panel Checks ".

A plant condition report was written to document this condition and troubleshooting was initiated. At 2143 hours on September 27, the Alternate Shutdown Panel was declared inoperable and the plant was placed in a 7 day LCO per the requirements of Technical Specification 3.7.5. Two separate issues were identified that could cause the identified undervoltage problems. They were:

1. Component(s) within the inverter alarm undervoltage board failed causing the under voltage circuitry to spuriously activate even when the incoming DC voltage was held above the low voltage cut-off setpoint.

2. The low voltage cut-off setpoint was set at approximately 120 VDC.

ISSUE # 1

Two circuit boards make up the inverter control logic, the inverter logic board and the alarm logic board. The inverter logic board sets the frequency of the output waveform, regulates voltage, and controls inverter turn-on/turn-off. In addition, the inverter logic board supplies +15VDC control power and +6.2VDC reference voltage to the alarm logic board. The alarm logic board is responsible for lighting lamps and controlling the status of alarm contacts to annunciate conditions existing within the inverter. In addition to its alarm functions, the alarm logic board is also responsible for monitoring DC input voltage to the inverter and will initiate a low voltage shutdown signal to the inverter logic board upon reaching the DC input voltage low voltage cut-off setpoint (adjustable on the alarm logic board).

I&C Technicians, in conjunction with a representative from the inverter manufacturer, and systems engineers were successful in troubleshooting the inverter failure down to component(s) on the inverter alarm board. The alarm board was signaling a low voltage cut-off shutdown to the inverter logic board even with the DC input voltage being held constant and well above the low voltage cut-off setpoint.

ISSUE # 2

During the initial troubleshooting of the inverter, it was discovered that the inverter low battery setpoint was set at approximately 124 VDC input, and the low voltage cut-off was set at approximately 120 VDC input. The low voltage cut-off was set to the minimum acceptable setting of 100.3 VDC, a value that was determined to be the optimum for the design. The evaluation of the setting discrepancy was left for review under the plant condition report.

The review also assessed whether a potential electrical deficiency could have caused the low voltage cut-off setpoint to be driven to the out of design level that it was. After reviewing the data available, it appears that a undervoltage current failure was unlikely, and the two problems appear to be unrelated. It is possible though, that a component failure downstream of this potentiometer (capacitor/op-amp/transistor), could have caused an increase in the low voltage cut-off setpoint. Further troubleshooting of the board would be required to support this, but the defective board had been discarded. Even if we were able to attribute the setting deficiency to another electrical problem, it is apparent that the low voltage cut-off setpoint has never been verified since the Alternate Shutdown Panel was installed.

Our reviews also determined that a 1985 Industry Experience and Assessment, General Electric Service Information Letter NO. 418, "Topaz Inverter Low Voltage Shutoff", chronicles a similar low voltage cut-off scenario for a Topaz inverter. It was identified that the review at the time only addressed the manufacturer of the inverter. Since we had no Topaz inverters on-site, no further reviews for this issue were recommended. This can be viewed as a missed opportunity to identify that

the low voltage cut-off problem could have generic implications, which might have led to the discovery that the low voltage cut-off setpoint for the Alternate Shutdown Panel was not being properly monitored.

SAFETY SIGNIFICANCE

With the low voltage cut-off for the Alternate Shutdown Panel inverter set at approximately 120 volts DC and a known initial battery terminal voltage of less than 120 volts DC, it is reasonable to conclude that the panel would not have operated. Therefore, in the event of a fire in the Electrical Equipment Room, 1-D Switchgear Room, Cable Spreading Room, or the Auxiliary Building 590' corridor concurrent with a loss of offsite power and the loss of the station battery chargers, the Alternate Shutdown Panel would not have been available. For a fire in any of these areas, both the existing and new Appendix R analysis credit the Alternate Shutdown Panel as being available.

The areas where a single fire may cause the loss of both battery chargers are Appendix R alternate shutdown areas. The Safe Shutdown Analysis is required by regulation to assume a loss of offsite power during the fire. In addition, the Appendix R fire is postulated to non-mechanistically affect all safe shutdown components in the area, even if the fire loading is not sufficient to cause such damage. Realistically, there is reasonable assurance that a fire in these areas would not progress to a state where safe shutdown equipment would be damaged. Any fire would be controlled by the installed automatic suppression system or fire brigade manual suppression such that either a loss of offsite power would not occur or that only one battery charger would be lost. Thus, the probability of a realistic fire causing both a loss of offsite power and a loss of both battery chargers in these areas is very low. The specific features for Fire Area 2 - Cable Spreading Room; Fire Area 3 - 1-D Switchgear Room; Fire Zone 13A - Auxiliary Building 590'-0" Corridor; and Fire Area 21 - Electrical Equipment Room are addressed below.

Fire Area	Fire Loading	Suppression Design Spray Density	Actual Suppression Spray Density	Fire Detection
Cable Spreading Room - FA 2	1.39 Hr	0.30 gpm/ft^2	0.60 gpm/ft^2	Yes
1-D Switchgear Room - FA 3	51 Min	0.20 gpm/ft^2	0.40 gpm/ft^2	Yes
Aux Bldg 590' Corridor - FZ 13A	33 Min	None in area Of concern	N/A	Partial Area
Elec Equip Room - FA 21	7 Min	0.30 gpm/ft^2	0.38 gpm/ft^2	Partial Area

From the above information, the two areas with a higher fire loading are the Cable Spreading Room and 1-D Switchgear Room. The combustible loading in both of these areas is composed of electrical cabling and electrical panels. However, both areas have automatic fire suppression provided over the cabling with an actual spray density of twice the design requirements. Also, separate automatic smoke detection is provided for these two areas that alarms in the Control Room. The postulated realistic fire in these areas would be a localized cable fire that should be quickly extinguished or controlled by the automatic suppression with twice the design spray density. The suppression spray would likely limit the fire size such that the redundant cables or battery chargers would not both be lost due to a single fire.

The Auxiliary Building 590' corridor rooms that contain the circuits of concern are very lightly loaded with combustible material. Specifically, the circuits are located in the Baler Room and Spent Fuel Pool Heat Exchanger Room which are within the Auxiliary Building 590' Corridor fire area.. The overall fire loading for the zone that includes these two areas is concentrated in the corridor that is outside a concrete wall or separated from these areas. However, no quantification has been made of the fire loading in these rooms. The partial area fire detection is localized in the concentrated area of cable routing in the corridor area. The light fire loading or transient combustibles brought into these areas would not likely create a fire large enough to damage the redundant circuits providing power to the battery chargers.

The Electrical Equipment Room has minimal fire loading and has a greater than 10 feet clear space between the redundant components and circuits located in this room. The automatic suppression and the partial detection is located directly over the in-situ combustibles. There is minimal likelihood of a realistic fire affecting redundant circuits in this room due to the physical separation and positioning of automatic suppression directly over the areas of concern.

While the non-mechanistic Appendix R fire is postulated to damage the redundant circuits or components in the alternate shutdown areas described above, it is highly unlikely that a realistic fire could cause such damage. In addition, the areas with a higher fire loading have automatic suppression systems with as-built water spray densities of twice that required by the design specifications.

CORRECTIVE ACTIONS

CORRECTIVE ACTIONS TAKEN

Upon discovery of the low voltage set point problem the set point was readjusted to the minimum acceptable setting of 100.3 V. This corrected the identified problem.

CORRECTIVE ACTIONS TO AVOID RECURRENCE

1. Revise Technical Specification Surveillance Procedure QO-23,"Auxiliary Hot Shutdown Panel Checks" to include periodic testing and adjustment of the low voltage cut-off setpoint for the Alternate Shutdown Panel inverter or develop another procedure to test this.

2. Determine whether other similar equipment setpoints exist which can cause inverters or battery chargers to shut down, and verify that appropriate testing is performed.