

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1) Fort St. Vrain, Unit No. 1		DOCKET NUMBER (2) 0 5 0 0 0 2 6 7	PAGE (3) 1 OF 0 5
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TITLE (4)  
Effects On 480 VAC Essential Switch Gear Due To Loss Of DC Bus 1

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)		
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES		DOCKET NUMBER(S)
0 7	1 5	8 6	8 6	0 2 2	0 0 0	8 1	4 8	6	N/A		0 5 0 0 0

OPERATING MODE (9) N

POWER LEVEL (10) 0 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR § (Check one or more of the following) (11)

<input type="checkbox"/> 20.402(b)	<input type="checkbox"/> 20.405(c)	<input type="checkbox"/> 50.73(a)(2)(iv)	<input type="checkbox"/> 73.71(b)
<input type="checkbox"/> 20.405(a)(1)(i)	<input type="checkbox"/> 50.36(e)(1)	<input checked="" type="checkbox"/> 50.73(a)(2)(v)	<input type="checkbox"/> 73.71(e)
<input type="checkbox"/> 20.405(a)(1)(ii)	<input type="checkbox"/> 50.36(e)(2)	<input type="checkbox"/> 50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text NRC Form 366A)
<input type="checkbox"/> 20.405(a)(1)(iii)	<input type="checkbox"/> 50.73(a)(2)(ii)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)	
<input type="checkbox"/> 20.405(a)(1)(iv)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)	
<input type="checkbox"/> 20.405(a)(1)(v)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)	

LICENSEE CONTACT FOR THIS LER (12)

NAME Judd M. Sills, Technical Services Supervisor	TELEPHONE NUMBER 3 1 0 3 6 2 1 0 - 1 1 2 0 1 1
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COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRPDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRPDS

SUPPLEMENTAL REPORT EXPECTED (14)

YES (If yes, complete EXPECTED SUBMISSION DATE)

NO

EXPECTED SUBMISSION DATE (15)

MONTH	DAY	YEAR

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

On July 15, 1986, with the plant shutdown for an Environmental Qualification outage, PCRV pressure at 45 PSIA, "A" and "B" circulators operating on pelton drives, Loop I Economizer Evaporator Superheater cooling supplied by condensate, and Loop II shutdown, a single failure point in the 480 VAC essential Bus 1 and Bus 2 undervoltage relay logic was identified.

A single failure of 125V DC Bus 1 would prevent the undervoltage relay logic on essential 480 VAC Bus 1 and Bus 2 from operating if a sustained undervoltage condition or a complete loss of voltage were to occur at the essential 480 VAC Buses. This single failure would prevent automatic load shedding, automatic restoration of AC voltage to the essential 480 VAC load centers from the emergency diesel generators (EDGs), and automatic load sequencing. In addition, the single failure would also prevent the operation of the automatic throwover feature between 480 VAC Buses 1 and 2 and prevent a loss of voltage input to the plant protective system to initiate a reactor scram.

The cause of the deficiency was due to a misunderstanding of the basic design requirements. Training has been conducted to correct this misunderstanding and design changes will be implemented to correct the single failure problem.

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		86	022	00	02	OF	05

TEXT (If more space is required, use additional NRC Form 366A's) (17)

BACKGROUND:

Each 480 VAC essential Bus has three ITE 27H high speed undervoltage relays set at 416 plus or minus 20 volts (86.7% of 480 VAC nominal) arranged in two-out-of-three logic, one relay per phase. These relays are individually alarmed, and connected to 120 plus or minus 5 second timers. In the event of a degraded power situation where two of the three Bus relays trip and remain tripped for a 120 second time period, the main power circuit breaker for that Bus is opened. De-energizing a 480 VAC essential Bus by initiating the 120 second time delay or voltage dropping below 372 plus or minus 11 volts (77.5% of 480 VAC nominal) in less than 120 seconds will actuate Westinghouse CV-2 inverse time delay undervoltage relays arranged in a two-out-of-three logic on each Bus. These relays will attempt to restore power to the affected Bus by automatic throwover to its neighboring 480 VAC essential Bus. Interlocks are provided to prevent connecting more than two 480 VAC essential Buses together. On a loss of 480 VAC Bus voltage caused by the loss of all outside power, a second set of Westinghouse CV-2 inverse time delay undervoltage relays set at 328 plus or minus 10 volts (68.3% of 480 VACs nominal) and arranged in a two-out-of-three logic on each Bus will be tripped. Loss of voltage on two-out-of-three 480 VAC essential Buses or tripping of two-out-of-three main power circuit breakers caused by the degraded voltage 120 second time delay relays will:

1. Trip all three main power circuit breakers.
2. Start the diesel generators.
3. Load shed on all three Buses.
4. Close both diesel generator breakers and sequence the loads onto the 480 VAC essential Buses.

The tie breakers between 480 VAC essential Bus 2 and Bus 1 or Bus 2 and Bus 3 will be tripped as part of the load shedding process, regardless of whether the tie breaker was open or closed. The tie is established or re-established to the 480 VAC essential Bus which is first energized by the emergency diesel generator. Essential Bus 2 is interlocked so it can be connected to only one of the other two 480 VAC essential Buses at a given time. Each 480 VAC essential Bus has three additional ITE 27H high speed undervoltage relays set at 288 plus or minus 14.4 volts (60% of 480 VAC nominal), arranged in a two-out-of-three logic on each Bus and connected to a 30 plus or minus 1.5 second time delay which is an integral part of the plant protective system. Should power not be restored on two-out-of-three of the 480 VAC essential Buses before the 30 second time delay times out, a reactor scram will be initiated.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

EVENT DESCRIPTION:

The undervoltage single failure problem was confirmed on July 15, 1986. The problem was discovered during the preparation of CN-2191, which involved the change-out of potentially defective AR 440 Westinghouse relays in the essential 480 VAC undervoltage relay logic.

The 125V DC Bus 1 supplies the control voltage to the undervoltage relays on essential 480 VAC Buses 1 and 2. The 125V DC Bus 2 supplies the control voltage to the undervoltage relays on essential 480 VAC Bus 3. The loss of 125V DC Bus 1 will inhibit the energization of the undervoltage relay logic schemes associated with 480 VAC Buses 1 and 2. Therefore, the loss of 125V DC Bus 1 would prevent the following automatic actions from occurring upon a loss of outside power:

1. Degraded voltage relays on essential 480 VAC Buses 1 and 2 would not operate to trip the associated supply breakers.
2. Load shedding, autostart prohibit, emergency diesel generator autostart and load sequencing would not occur.
3. Loss of voltage relays for automatic throwover (ATO) on essential 480 VAC Buses 1 and 2 would not operate to close the Bus tie breakers.
4. Reactor scram undervoltage relays on essential 480 VAC Buses 1 and 2 would not operate to initiate Channel A and B reactor scram

CAUSE DESCRIPTION:

Design/Personnel Error

The basic design requirements were not clearly understood by the designer. The independent reviewer failed to identify the design deficiency.

ANALYSIS OF EVENT:

The postulated initiating event of a loss of outside power or sustained degraded voltage condition in the outside power system, concurrent with the loss of 125V DC Bus 1, would result in the inability to satisfy the automatic starting logic on the EDG Sets. Also, EDG 1A could not be started manually due to the loss of control power which is provided by 125V DC Bus 1. However, safe shutdown cooling could be accomplished by manually starting the redundant EDG Set 1B. Safe shutdown equipment could be powered from both essential 480 VAC Bus 2 and Bus 3 by manually closing the Bus 2 to Bus 3 tie breaker.

Since that portion of the undervoltage protection system, which is being supplied control power from 125V DC Bus 2 (associated with 480 VAC essential Bus 3) is operable, protective action will occur as designed to open the supply breaker to 480 VAC essential Bus 3, thus protecting equipment powered by this bus from an undervoltage condition.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

The supply breakers to 480 VAC essential Buses 1 and 2 could be manually opened, however the equipment powered from these Buses would not be automatically protected by the undervoltage relay logic.

The capability exists to perform manual load shedding and to manually start EDG Set 1B. The capability to manually energize required safe shutdown equipment has been previously analyzed and is described in FSAR Sections 3.2.3.5, 8.2.5.1 and in the following paragraph in FSAR Section 8.2.3.3.1:

"If the automatic load sequencing system fails, it is possible for an operator to manually load the generators with the essential loads necessary for safe reactor shutdown. This option further improves the overall reliability of the standby power supply because the HTGR plant can withstand some short-time loss of core circulation without damage that might prevent further cool down from taking place."

The Alternate Cooling Method (ACM) described in FSAR Section 8.2.8 is available to safely shut down the reactor as analyzed in FSAR Section 8.2.5.2 in the event of the permanent loss of both EDGs.

The automatic scram function of scram channels "A" and "B", due to a loss of 480 VAC at essential 480 VAC Buses 1 and 2, for a time period greater than 30 seconds, would be inhibited by a loss of 125V DC Bus 1. However, if the plant were operating at power, an automatic two loop trouble scram would most likely occur due to a loss of bearing water pumps which would result in helium circulator trips. In the event an automatic scram did not occur, the Reactor operator is required by Emergency Procedure EP-B-1 to immediately insert a manual scram in the event of two loop trouble or by Emergency Procedure EP-F-1 to insert a manual scram if the 480 VAC essential Buses are not energized within thirty seconds.

CORRECTIVE ACTION:

The designer and independent reviewer have been appraised of the oversight and have been reprimanded. The designers and independent reviewers have received training to ensure they clearly understand the design requirements.

Design work is in progress which will effect changes to the essential 480 VAC Buses undervoltage relay logic schemes. These changes will eliminate the single failure problem associated with the loss of 125V DC Bus 1 and the problem will be corrected prior to plant startup.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

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August 14, 1986  
Fort St. Vrain  
Unit No. 1  
P-86514

Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Docket No. 50-267

SUBJECT: Licensee Event Report  
86-022, Final Report

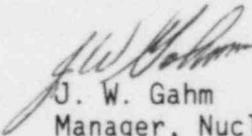
REFERENCE: Facility Operating  
License No. DPR-34

Gentlemen:

Enclosed please find a copy of Licensee Event Report No. 50-267/86-022, Final, submitted per the requirements of 10 CFR 50.73(a)(2)(v).

If you have any questions, please contact Mr. M. H. Holmes at (303) 480-6960.

Sincerely,



J. W. Gahm

Manager, Nuclear Production

Enclosure

cc: Regional Administrator, Region IV  
Attn.: Mr. J. E. Gagliardo, Chief  
Reactor Projects Branch

cc: Director of Nuclear Reactor Regulation  
Attn.: Mr. H. N. Berkow, Director  
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Projects Directorate

cc: Director, MIPC

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