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)
Fort St. Vrain, Unit No. 1	0 5 0 0 0 2 6 7	1 OF 1 0

TITLE (4) Failure Of Diesel Generator To Close-In During Loss Of Outside Electrical Power Test SR 5.6.1b-SA

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)
1 2	1 8	8 4	8 4	0 1 4	0 0	0 1	1 7	8 5	N/A	0 5 0 0 0
										0 5 0 0 0

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

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Jim Eggebroten, Technical Services Engineering Supervisor	AREA CODE 3 0 3 7 8 5 - 2 2 2 4

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
X	E I I	B I T I R I Y	E I 3 I 5 I 5	Y					
X	E I K	T I S	L I 8 5	Y					

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
XX YES (If yes, complete EXPECTED SUBMISSION DATE)	NO		0 4	1 7	8 5

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

On December 18, 1984, at 1200 hours, with the reactor shutdown and the PCRV depressurized, SR 5.6.1b-SA, the Loss of Outside Power and Turbine Trip semi-annual surveillance, was initiated by station personnel. Upon initiation of the test, the diesel generator engines of both diesel generator sets started automatically, as expected, and automatic load shedding was completed from the three essential 480V busses. However, both diesel generator tie breakers failed to close and diesel trouble alarms were received. Power was manually restored to 480V Bus 1 from 4160V Bus 1, and to 480V Bus 2 via the Bus 1-2 tie breaker. Subsequently, 480V Bus 2 was tied back to 4160V Bus 2 and 480V Bus 3 was restored to 4160V Bus 3.

The event was reported to the Nuclear Regulatory Commission Operations center at 1500 hours on December 18, 1984, as a "four hour report", in accordance with 10 CFR 50.72(b)(2)(iii) and is being reported herein, in accordance with 10 CFR 50.73 (a)(2)(v).

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

BACKGROUND:

Each diesel generator set is comprised of two diesel engines which are clutched to the associated generator set. In the event that an engine should fail to start or operate properly, it is automatically declutched from the generator to minimize drag on the remaining diesel engine of that generator set, and to maximize the generator's output at one-half capacity. Any two of the four diesel engines in any combination can be utilized to provide the requisite electric power for the minimum essential loads required for a safe reactor shutdown.

The standby Diesel Generator sets are tested on a weekly basis (SR 5.6.1a-W) to demonstrate operability. This test includes manual starting of the four diesel engines, accelerating the generators to 60 Hertz synchronous speed, applying excitation, synchronizing with the 480V AC essential busses, loading onto the essential busses, and assuming at least one-half load for a minimum of two hours. This test was completed successfully on December 17, 1984 for both standby generator sets and all four diesel engines.

The diesel protective functions are calibrated annually (SR 5.6.1cd-A), and the exhaust temperature "shutdown" and "declutch" functions are tested monthly (SR 5.6.1d-M), and calibrated annually (SR 5.6.1cd-A). The diesel protective functions were last calibrated May 1, 1984, on standby generator set 1A and on May 14, 1984, on standby generator set 1B. The exhaust temperature switch "shutdown" and "declutch" functions were last tested on September 5, 1984.

The test sequence on December 18, 1984, called for blocking out the 1A generator set from being selected as the first operating set, and hence prevent picking up the "A" sequence 480V essential loads. The 1B generator set did not successfully complete the requisite logic to be selected as the first operating set and did not load onto its 480V bus. The failure of the 1B generator set to complete logic to be selected as the first operating set (with 1A generator set intentionally blocked from being selected as first operating set) also prevented 1A set from being able to be selected as the second operating set and automatically loading onto 480V Bus 1. Sometime after its initial start, Engine 1C of generator set 1B and Engines 1A and 1B of generator set 1A tripped and declutched. A faulty cell in Station Battery 1A caused a low output voltage trip on Inverter/Static Transfer Switch 1A and caused the loss of 120V AC instrument power to the exhaust temperature switches on 1A generator set. Both engines on set 1A tripped following the manual restoration of 4160V power to Bus 1, as restoration of power to Bus 1 also resulted in restoration of instrument power to the exhaust temperature switches. The exhaust temperature switches fail downscale upon loss of power, and don't achieve setpoint fast enough to prevent a trip from occurring. A faulty temperature switch on Engine 1C of generator set 1B resulted in a false "Low Exhaust Temperature" trip and declutch on that set, also.

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

EVENT DESCRIPTION:

On Tuesday, December 18, 1984, at approximately 1200 hours, with the reactor shutdown and depressurized, the semi-annual "Loss of Outside Power and Turbine Trip" surveillance, SR 5.6.1b-SA, was initiated by station personnel. This test simulates the simultaneous loss of outside power and a turbine generator trip to demonstrate operability of the standby diesel generator automatic controls and load sequence programmers. The automatic actions consist of three separate phases:

1. The stripping of loads from all three essential 480V busses and opening of their supply and bus tie breakers;

2. The starting of the emergency diesel generator sets and loading them onto their respective busses; and,

3. The sequential programmed loading of the essential equipment loads onto the essential busses.

In the event that the plant should experience a total loss of power resulting from the simultaneous loss of all outside 230KV power and the tripping of the turbine generator, the two standby diesel generators (1A, K9201 and 1B, K9202) will automatically start (see Figure 1). The first normally functioning unit will be automatically selected to pick up the programmed load of essential equipment on its 480V bus (480V Bus 1 for Generator 1A and 480V Bus 3 for Generator 1B), and also the essential load on 480V Bus 2 (load sequence "A"). The second functioning unit will then be automatically tied to its 480V bus and pick up the programmed load of essential equipment for that bus (load sequence "B").

During performance of SR 5.6.1b-SA, one section of the test procedure requires that the failure of an engine to start on a generator set be simulated in order to test the proper operation of the lock-out relay logic associated with the other standby generator set. Referring to Figure 2, the test performed on December 18, 1984, simulated the failure of an engine on standby generator set 1A (1) to start. This would have then forced standby generator set 1B (2) to appear to reach normal operating conditions first, completing the logic (3) to start program sequence timers T1 and T2 (4). The "AND" gate of the logic is completed by a match on the intake manifold ΔP's for both engines on a generator set. On December 18, 1984, all four engines started normally, and it is believed that for set 1B, this logic should have been successfully completed to start timers T1 and T2 (4). The identical logic for generator set 1A had been intentionally disabled by lifting the wire for the "AND" gate on set 1A, thereby creating a simulated engine failure condition.

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

It has been subsequently determined that timer T1 was malfunctioning and that the timer's motor would not turn. Redundant timer T2 has been tested and found to operate properly and should have operated as designed; a control signal should have successfully passed through contact 286G1A (closed due to lifting the wire on 1A set), immediately followed by energizing lock out relay 286G1B (5) and control relay CR-9204 (6), closing the Bus 3-2 Tie Breaker 252BT32 (7) and generator 1B-Bus 3 breaker 252DG1B (8).

The 480V bus tie breakers, 252BT12 (9) and 252BT32 (7) would have opened automatically during load shedding (if not already opened at the time the loss of outside power occurred). The closure of generator set 1B-480V Bus 3 breaker 252DG1B (8) energizes contacts creating a permissive for generator set 1A indicating that set 1A was being selected as the second generator set and could pick up the programmed loads on 480V Bus 1. The permissive energizes TR-9201 (10), closing generator 1A-480V Bus 1 breaker 252DG1A (11) onto 480V Bus 1.

In the "Loss of Outside Power and Turbine Trip" surveillance ran on December 18, 1984, neither generator set closed onto its respective 480V bus, and power was manually restored to the 480V busses via the 4160V breakers (see Figure 1). Some difficulty was encountered restoring power to the 480V busses from the 4160V busses due to a previously identified problem with the undervoltage relay system logic preventing the 4160V breakers from closing onto a de-energized 480V bus. The problem was immediately recognized, and the fuses for the undervoltage logic power supply were pulled, allowing power to be restored to 480V busses. There is currently a Change Notice prepared to allow a manual over-ride of this logic from a handswitch to be placed at the synchroscope in the Control Room. During the test, personnel entering the diesel generator room found that both Engine 1A and 1B on generator set 1A (1) had shutdown and declutched, and that Engine 1C on generator set 1B (2) had shutdown and declutched.

ANALYSIS OF EVENT:

By virtue of the simulation of a failure of the 1A generator set to achieve operational conditions, the test created a situation whereby any failure of the 1B generator set engines to achieve normal operating conditions would have resulted in the failure of both generator sets to automatically load onto their 480V busses. This test was last completed on April 20, 1984, with the satisfactory simulation of a failure of the 1B generator set to achieve normal operating conditions.

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In the surveillance test ran on December 18, 1984, a faulty cell on Station Battery 1A resulted in the Inverter/Static Transfer Switch 1A inverter section (see Figure 3) tripping on low output voltage (less than 105V). This resulted in the loss of 120V AC Instrument Bus 1A. Load testing on the 1A Station Battery done after this event resulted in a similar trip occurring in approximately twenty seconds. The loss of Instrument Bus 1A eliminated power supply to the Low Exhaust Temperature Switches on engines 1A and 1B. The Low Exhaust Temperature Switches fail downscale on an AC instrument power loss. A thirty second timer operates to close the exhaust temperature time delay contacts in the Low Exhaust Temperature logic after thirty seconds elapsed time. These contacts are downstream in series with the Low Exhaust Temperature Switch contacts, which are closed on low temperature (also on a switch failure or loss of power to the switch). On a normal engine start and warm-up, exhaust temperature exceeds 175°F in approximately ten seconds, and the low exhaust temperature contacts are opened indicating a normally operating engine, hence, preventing the Low Exhaust Temperature engine trip and declutch after closure of the thirty second time delay contacts. The 125V DC Bus 1A, though operating at a degraded voltage, was not lost and after completion of the initial thirty second time delay, maintained time delay contacts in the closed position. Following the manual restoration of 4160V power, Instrument Bus 1A power to standby diesel generator engines 1A and 1B would have been immediately recovered via Battery Charger 1A (see Figure 3). Upon recovering instrument power, the contacts for the Low Exhaust Temperature Switches on engines 1A and 1B would have promptly closed due to the temperature switches having previously failed downscale, thus resulting in engine trip and declutch. The 4160V power was manually restored to 4160V Bus 1, and hence, Instrument Bus 1A approximately five minutes after test initiation.

Equipment testing has also indicated malfunctioning Low Exhaust Temperature Switches (TSL-92261 and TSL-92269) on Engine 1A of generator set 1A and Engine 1C of generator set 1B, respectively. Engine 1C also tripped and declutched, presumably due to the failure of temperature switch TSL-92269. The exact time that engines 1A, 1B, and 1C tripped and declutched is not known, though it appears that the Engine 1C failure should not have been a factor in preventing the completion of logic to identify generator set 1B as the first operating set. The trip of engine 1C should have occurred at approximately thirty seconds after the initial start signal was received by that diesel engine.

The failure of the generator set 1A 480V Bus 1 breaker (252DG1A) to close indicates that a permissive generated by CR-9204, (4) on Figure 2, was not received. However, the loss of Instrument Bus 1A could have been a factor in preventing 252DG1A (11) to close if Inverter/Static Transfer Switch 1A had tripped on low output voltage very early in the test. That trip would have removed the 120V AC instrument power supply required to power the logic for generator set 1A to be automatically selected as the second operating set and automatically tie onto 480V Bus 1.

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Had this been an actual loss of outside power with a turbine trip under the conditions described herein, generator set 1A could have been manually tied into bus 1. Engines 1A and 1B would have subsequently tripped and declutched, however, when 480V power was restored to Battery Charger 1A (Figure 3). Standby generator 1B would have still had one operating engine (engine 1D) and could have been manually tied into 480V Bus 3, with essential equipment loads being restored manually.

CAUSE DESCRIPTION:

The cause for failure of the 1B standby generator to complete the logic to be identified as the first operating generator and to load onto 480V Bus 3 and close the bus 3-2 tie breaker is not known. Plant electricians are currently testing all relays and contacts in the generator set 1B logic. Testing to this point indicates that contact sticking in the logic for the intake manifold ΔP comparisons on Engines 1C and 1D was at fault.

The cause for the failure of Station Battery 1A to supply adequate DC output for Inverter/Static Transfer Switch 1A has been determined to be a faulty cell on the battery. This cell has been jumpered out of service, and Station Battery 1A restored to service. The 480V/120V transformer on Battery Charger 1A was damaged during testing (unrelated) after Station Battery 1A was placed back in service. Repairs to this transformer are not expected to be completed until later in January, 1985, delaying the rescheduling of SR 5.6.1b-SA.

CORRECTIVE ACTION:

The weekly start and load surveillance tests (SR 5.6.1a-W) have been successfully run, verifying the ability to manually load the essential 480V busses with the standby generator sets. Following detailed investigations of the failure of 1B standby generator logic, and restoration of Battery Charger 1A to service, SR 5.6.1b-SA will be rerun to verify system operability.

The faulty cell on station Battery 1A has been jumpered out of service, and malfunctioning temperature switches have been replaced. Relays and contacts on the 1B generator set are currently being tested to identify the precise cause of B set not being able to complete logic for selection as first operating set prior to the trip of Engine 1C.

The exhaust temperature switches (TSL-92261 and TSL-92269) replaced during the early stages of investigation of this event are to be subjected to further bench testing to evaluate the conditions of their failure.

Investigations are currently in progress to evaluate means of improving reliability and avoiding similar false low exhaust temperature trips.

A supplemental report will follow.

Related Reports: RO 82-018, RO 81-035, RO 81-031, RO 80-53, RO 79-25, RO 79-20, RO 79-05, AO 76/16.

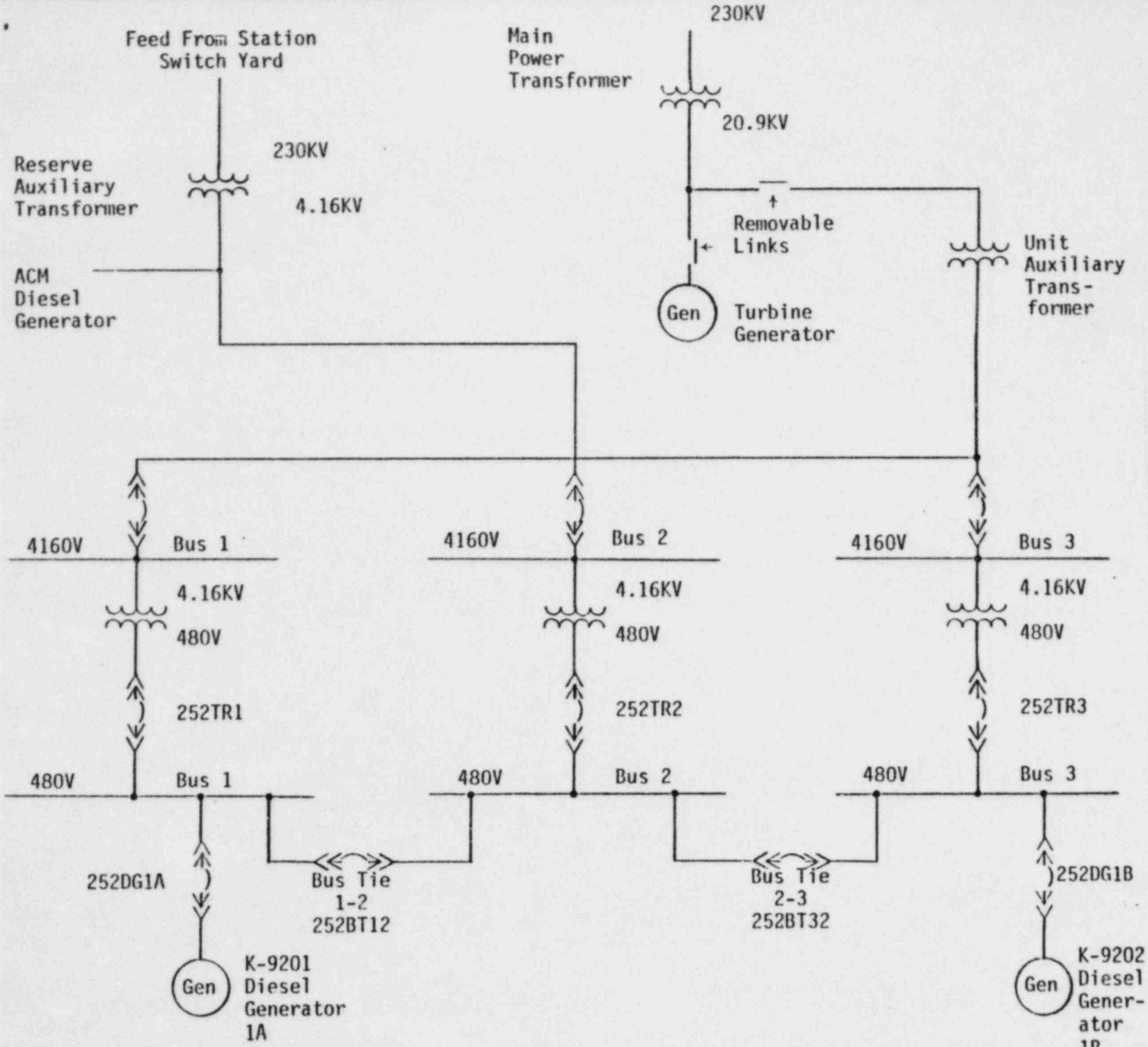
Feed From Station Switch Yard
230KV
Reserve Auxiliary Transformer
4.16KV
ACM Diesel Generator
Main Power Transformer
230KV
20.9KV
Removable Links
Gen
Turbine Generator
Unit Auxiliary Trans-former
4160V
Bus 1
4.16KV
480V
252TR1
480V
Bus 1
4160V
Bus 2
4.16KV
480V
252TR2
480V
Bus 2
4160V
Bus 3
4.16KV
480V
252TR3
480V
Bus 3
252DG1A
Bus Tie 1-2 252BT12
Bus Tie 2-3 252BT32
252DG1B
Gen
K-9201 Diesel Generator 1A
Gen
K-9202 Diesel Gener-ator 1B

FIGURE 1

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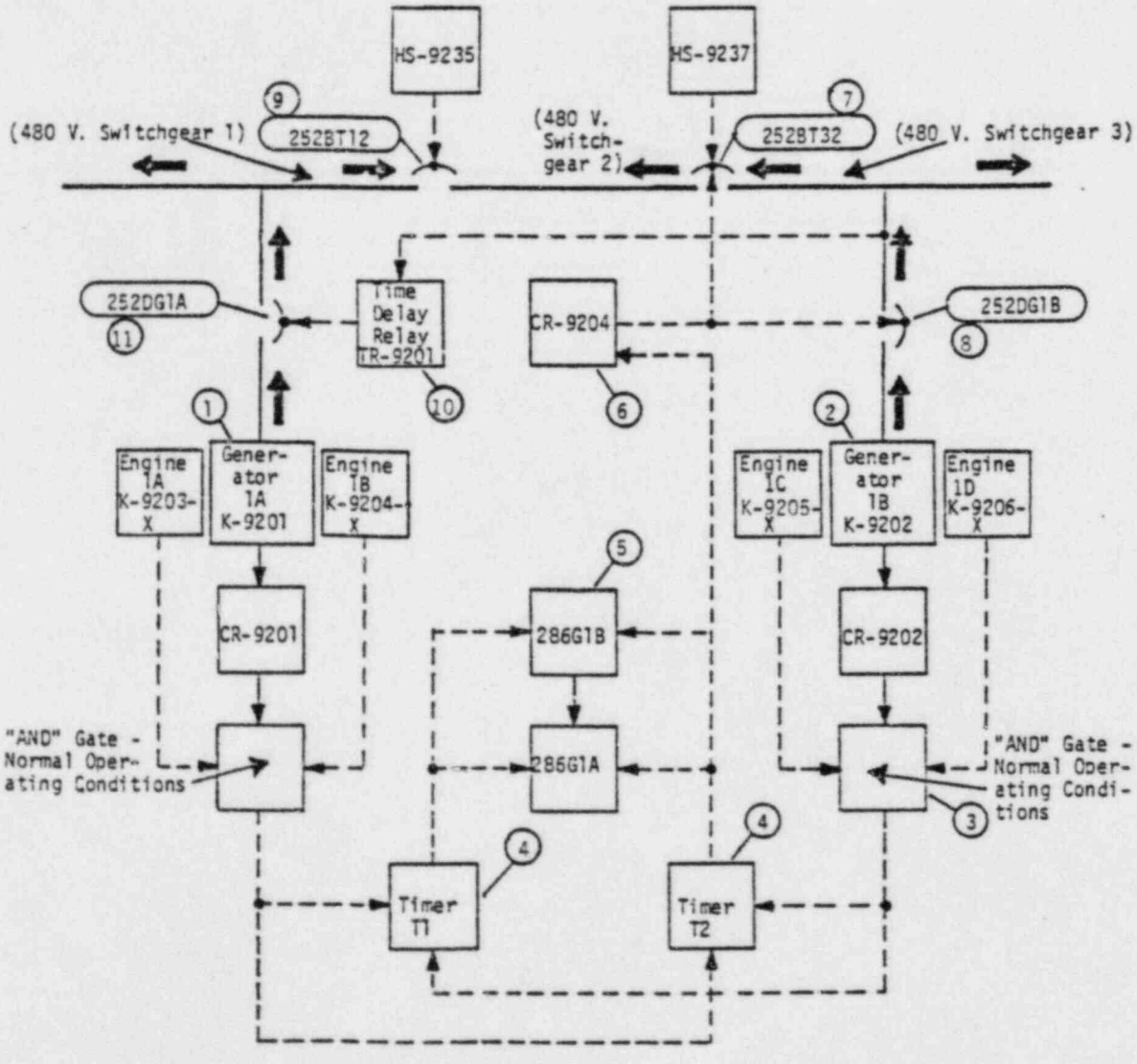
TEXT (If more space is required, use additional NRC Form 366A's) (17)

FIGURE 2



NRC Form 366A
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

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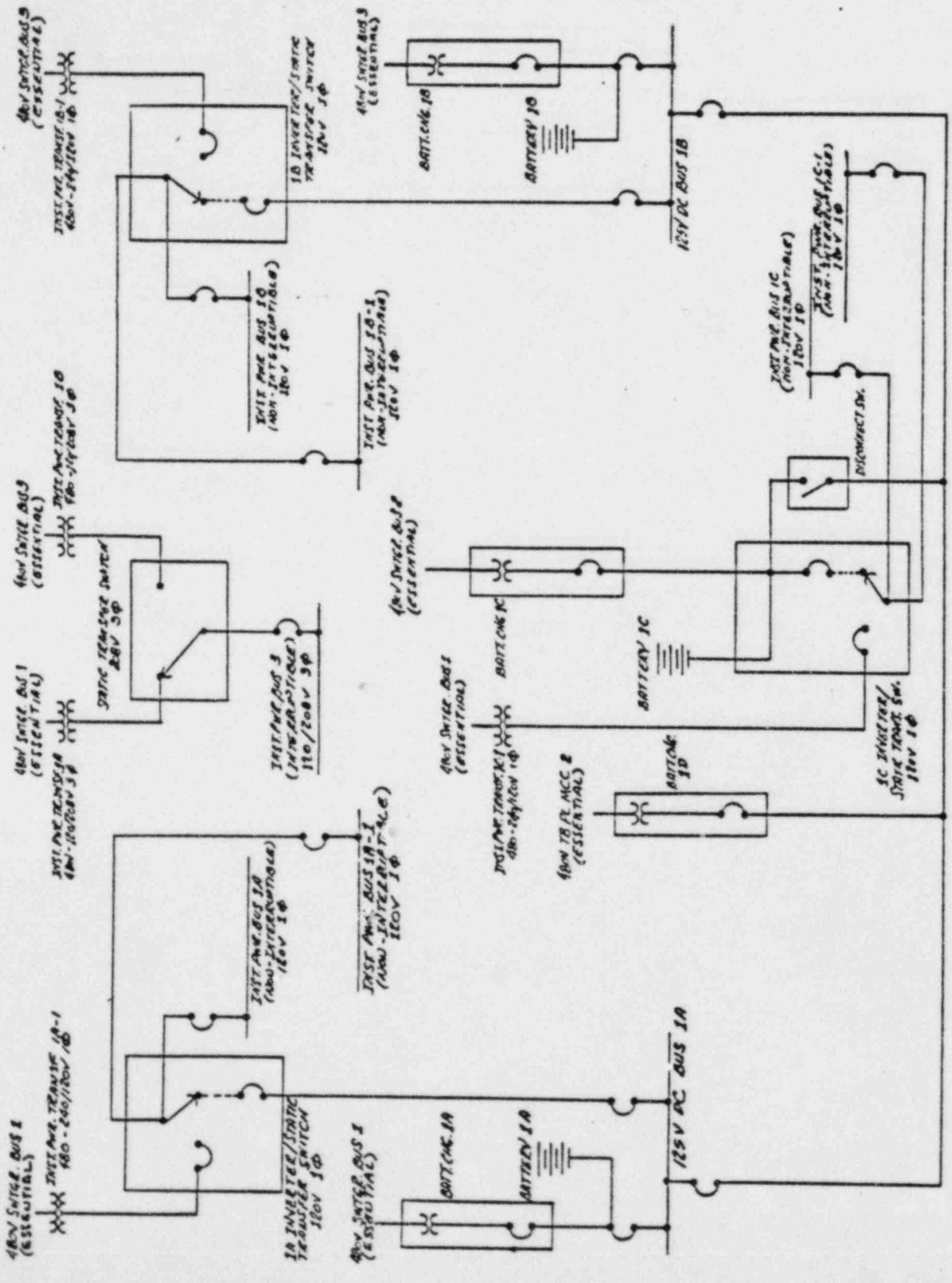
TEXT (If more space is required, use additional NRC Form 366A's) (17)

FIGURE 3



Judd M. Sills
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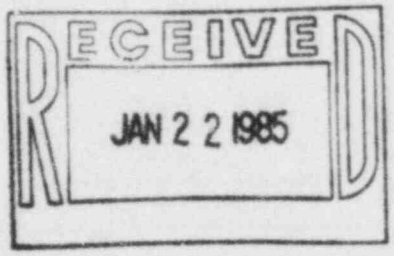
16805 WCR 19 1/2, Platteville, Colorado 80651

January 17, 1985
Fort St. Vrain
Unit #1
P-85014



Regional Administrator
ATTN: Mr. E. H. Johnson
U.S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

Docket No. 50-267

REFERENCE: Facility Operating License No. DPR-34

SUBJECT: Licensee Event Report 84-014

Dear Mr. Johnson:

Enclosed please find a copy of Licensee Event Report No. 50-267/84-014, Preliminary, submitted per the requirements of 10 CFR 50.73(a)(2)(v).

Sincerely,

J. W. Gahm
Manager, Nuclear Production

Enclosure

cc: Director, MIPC

JWG/djm

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