

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1) Duane Arnold Energy Center										DOCKET NUMBER (2) 0 5 0 0 0 3 3 1										PAGE (3) 1 OF 0 9																																							
TITLE (4) Emergency Diesel Generators Sequencing Design Anomaly																																																											
EVENT DATE (5)										LER NUMBER (6)										REPORT DATE (7)										OTHER FACILITIES INVOLVED (8)																													
MONTH			DAY			YEAR			YEAR			SEQUENTIAL NUMBER			REVISION NUMBER			MO			DAY			YEAR			FACILITY NAMES										DOCKET NUMBER(S)																						
0 8			2 8			8 5			8 5			0 3 6			0 0 0			9 2 0			8 5			None										0 5 0 0 0																									
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OPERATING MODE (9) N										THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 5. (Check one or more of the following) (11)																																																	
POWER LEVEL (10) 0 8 8										20.402(b)										20.406(a)										50.73(a)(2)(iv)										73.71(b)																			
										20.406(a)(1)(i)										50.36(a)(1)										50.73(a)(2)(v)										73.71(a)																			
										20.406(a)(1)(ii)										50.36(a)(2)										50.73(a)(2)(vi)										OTHER (Specify in Abstract below and in Text, NRC Form 308A)																			
										20.406(a)(1)(iii)										50.73(a)(2)(i)										50.73(a)(2)(vii)(A)																													
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LICENSER CONTACT FOR THIS LER (12)																																																											
NAME William J. Miller, Technical Services Superintendent																				TELEPHONE NUMBER 3 1 9 8 5 1 - 7 2 1 5																																							
COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)																																																											
CAUSE					SYSTEM					COMPONENT					MANUFAC. TURER					REPORTABLE TO NPROS					CAUSE					SYSTEM					COMPONENT					MANUFAC. TURER					REPORTABLE TO NPROS														
SUPPLEMENTAL REPORT EXPECTED (14)																																																											
YES (If yes, complete EXPECTED SUBMISSION DATE)																				X NO										EXPECTED SUBMISSION DATE (15)										MONTH DAY YEAR																			
ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)																																																											
<p>On August 22, 1985, at 1330 hours with the reactor at 88% power, both Emergency Diesel Generators (EDGs) were declared inoperable and in accordance with Technical Specifications 3.5.G.1, a twenty-four hour Limiting Condition for Operation (LCO) was declared. This action was taken due to the determination by plant personnel that in the then existing plant electrical lineup, the loss of one of two transformers that could supply vital power buses from offsite power, concurrent with a LOCA, could have defeated the load sequencing logic of the emergency diesel generators. Therefore, a core spray pump and two RHR pumps (per diesel) would have attempted to load simultaneously onto the diesel (once it obtained nominal voltage) rather than in 5 second sequenced intervals. The vital bus loads, in this situation, could have caused the diesel generators to trip during loading.</p> <p>To ensure bus vital loads always sequence upon bus transfers, keylock test switches were placed in the "test" position ending the LCO at 2240 hours. As the vital loads would then always sequence following transfer, (regardless of whether the diesel generators or a transformer was supplying the power) proper vital equipment operation was assured.</p> <p>The conservative declaration of the EDGs inoperable was based upon the determination that a credible event (loss of only one transformer), concurrent with a LOCA, could have introduced a common mode failure of the onsite emergency AC power supply system. This situation could have been more limiting than a design basis loss of offsite power event considered in accident analysis. However, operator action to transfer the vital buses to the Startup Transformer and continued non-vital equipment availability would limit the event's consequences.</p>																																																											

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U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104

EXPIRES 2/21/85

FACILITY NAME (1) Duane Arnold Energy Center	DOCKET NUMBER (2) 0500033185	LER NUMBER (6)			PAGE (3)		
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TEXT (if more space is required, use additional NRC Form 366A's) (17)

On August 22, 1985, at 1330 hours with the reactor in normal power operation, both Emergency Diesel Generators (EDGs, EIIS code EK) were declared inoperable and in accordance with Technical Specifications 3.5.G.1, a twenty-four hour Limiting Condition for Operation (LCO) was declared. This action was taken due to the determination by plant personnel that in the present plant electrical lineup, the loss of one of two transformers that could supply vital power buses from offsite power, concurrent with a LOCA, could have defeated the load sequencing logic of the emergency diesel generators. The effect would have been that a core spray (EIIS code BM) pump and two Residual Heat Removal (EIIS code BO) (RHR) pumps per diesel would attempt to load simultaneously onto the diesel (once it obtained nominal voltage) rather than sequence in 5 second intervals. The essential bus loads, in this potential situation, could have caused the diesel generators to trip during loading.

The Duane Arnold Energy Center has four 4160 V buses, two vital and two non-vital. (See attached drawing identified as Figure 8.2-6.) The normal plant lineup when in power operation has the two vital buses powered off the Startup Transformer (which is connected to offsite power) and the two non-vital buses powered from the Auxiliary Transformer (which is fed from the plant's main generator). A third transformer, the Standby, which can only supply the two vital buses remains idle. Should the Startup Transformer fail, the vital buses are automatically transferred to the Standby Transformer and the EDGs start. Should the Standby Transformer also fail to provide power to the vital buses, the EDGs will load.

In a LOCA condition (without loss of offsite power), the vital buses provide offsite power for the instantaneous startup of the Core Spray and RHR pumps. In a LOCA event with a concurrent Loss of Offsite Power (LOOP-LOCA), the Core Spray and RHR pump logics will sequentially load these pumps onto the vital buses now powered by the EDGs if their respective logics sense either: a) loss of power at both the Startup and Standby Transformers or b) a degraded bus voltage.

On November 4, 1984, the Auxiliary Transformer failed. (See LER 84-40.) This necessitated placing the plant in an alternate electrical lineup with the non-vital buses on the Startup Transformer. (Since the auxiliary transformer receives power from the generator this is a normal lineup for unit startups and hot standby.) With both the vital and non-vital buses on the Startup Transformer, the transformer voltage was reduced. To avoid causing the vital buses to shed (92.5% degraded voltage), and resultant scram from minor grid fluctuations, the vital buses were transferred to the Standby Transformer. In this alternate lineup (vital buses on the Standby Transformer) if the Standby Transformer fails, the vital buses are not (by design) automatically transferred to the Startup Transformer, but would instead be powered by the EDGs. Under this lineup, if a LOCA signal occurs and only the Standby Transformer fails, but there is no full loss of offsite power, the Core Spray and RHR pump logics would sense power at the Startup Transformer, and thus would not load-sequence when starting. The simultaneous start of all essential loads could then result in the EDGs tripping. However, in this partial LOOP, non-vital power would still be available (motor-driven feed pumps, etc).

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TEXT (if more space is required, use additional NRC Form 388A's) (17)

The specifics of the logic are as follows: (see attached partial schematics). On APED drawings (GE) the core spray and RHR pumps receive autostart signals through two parallel paths, K2A contacts or K70A TDC (time delay contacts - Note relay numbers differ for core spray and the other RHR pumps). The K2A relay coil is in series with relay 195-3 contacts and is energized (195-3 contacts closed, 195-3 deenergized) by 125 V DC unless both the Startup and Standby Transformers are less than 65% voltage on their secondaries. A degraded voltage relay (vital bus voltage, 92.5%) can also deenergize relay K2A (by energizing 195-3) when the logic is satisfied (8.5 seconds below 92.5% and either transformer output breaker are closed onto the vital bus). Were the vital buses on the Standby Transformer and were only this transformer to fail, the following sequence would occur. Since the Startup Transformer still would have normal output voltage on its secondaries, the series logic would not energize relay 195-3. Similarly, 195-3 would not energize on degraded voltage (92.5% with 8.5 second delay) since the vital bus breakers would be open. Therefore, K2A contacts would remain closed and the pumps would be immediately loaded onto the diesel when it achieved nominal output.

The resolution of this problem was to place two keylock test switches (per electrical division) in the RHR and Core Spray pump start logics in the test position. This always load sequences the pumps onto the vital buses in the event of a LOCA, with or without a concurrent loss of the Startup or Standby Transformers. The DAEC LOCA analysis considers, as a design basis event, a complete loss of offsite power with a concurrent LOCA, and therefore takes into account the time delays associated with the sequencing of these pumps. At 2240 hours on August 22, 1985, the test switches were placed in the test position, rendering both EDGs operable and cancelling the twenty-four hour Limiting Condition for Operation.

The action of placing these keylock switches in test was thoroughly reviewed by Engineering and Operations personnel to ensure other undesirable logic changes did not result. This included physical confirmation of in-plant wiring and relaying. Administrative controls have been implemented to visually confirm, on a shiftly basis, the proper positioning of these test switches. Further, operating and surveillance procedures were reviewed to ensure technical accuracy and lack of interactive affect of the logic change and the method in which it was implemented. The interim administrative controls will remain in affect until a formal design change is implemented.

The engineering review of this problem also focused upon ensuring that related functions of this circuitry were not impaired or degraded. This review concluded that in both the as-found circuitry configuration, as well as the modified, other design functions such as diesel generator start, load shed logic, and degraded voltage design features were not impaired in either configuration.

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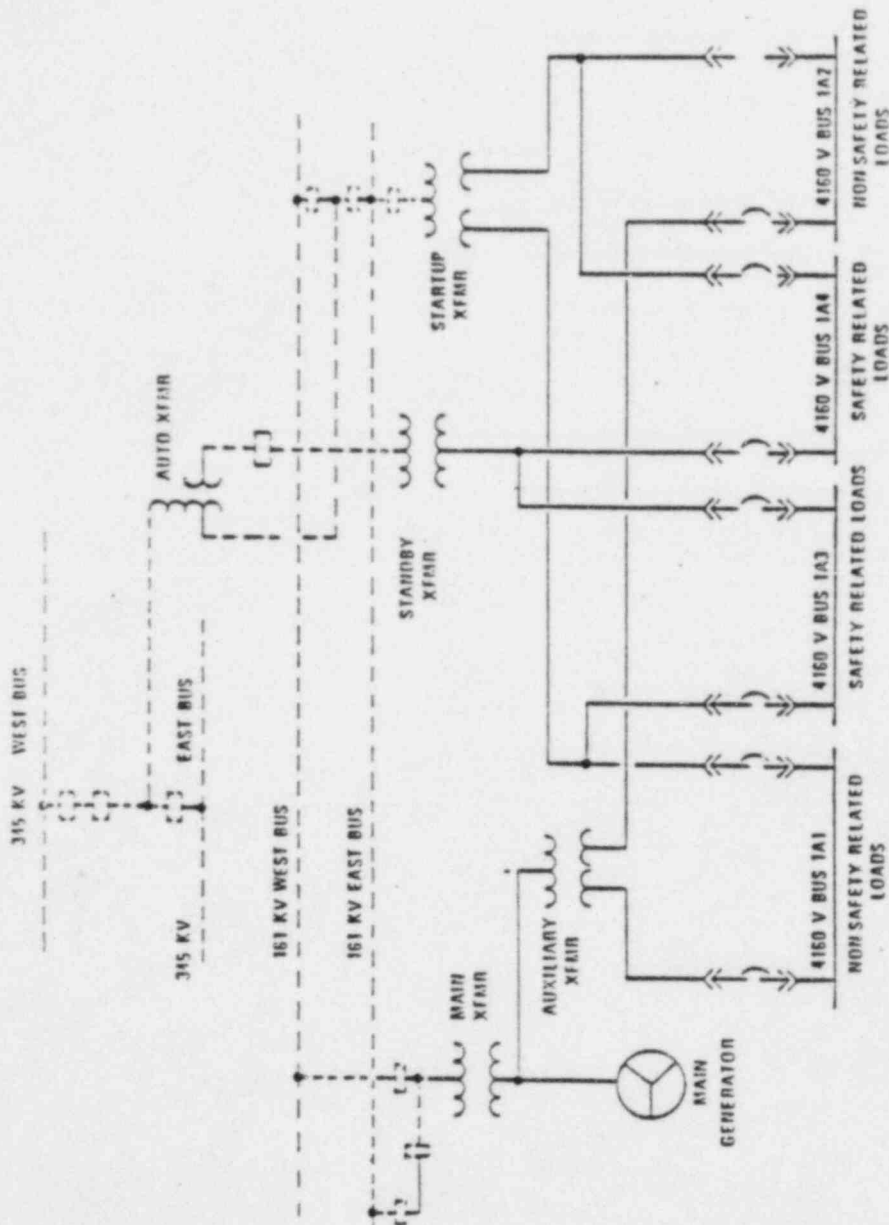
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Given the generic implications of this situation, Iowa Electric initiated parallel activity to disseminate information about our design and to alert other operating plants. Through both General Electric and Bechtel, details of our logic and design configuration were reviewed and compared to other BWRs. An engineering description of the configuration and logic response was disseminated to the nuclear industry through the INPO "Network" system. In addition, the NRC was kept apprised of the situation and the details of our design configuration.

Following identification of this problem and implementation of the interim solution, considerable effort has been focused upon determining how the diesel generators would have responded in an actual LOCA without the sequencing logic. Our efforts have included attempted modeling of the integrated diesel/electrical response, review of original DAEC test data and technical discussion with diesel-generator manufacturers. To date, these efforts are inconclusive as to whether the diesels would trip or whether they would achieve rated output under these severe loading conditions.

This event is being reported pursuant to the intent of 10CFR50.73(a)(2)(ii)(B) as a condition that was outside the design basis of the plant. The conservative declaration of the EDGs inoperable was based upon recognition that a credible event (loss of one transformer only), concurrent with a LOCA, could introduce a common mode failure of the onsite emergency AC power supply system. This situation could be more limiting than design basis full loss of offsite power events considered in accident analysis. However, operator action to transfer the vital buses to the Startup Transformer coupled with continued nonvital equipment availability would limit the event's consequences.

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DUANE ARNOLD ENERGY CENTER
 IOWA ELECTRIC LIGHT & POWER COMPANY
 UPDATED FINAL SAFETY ANALYSIS REPORT

DAEC Electrical System
 Figure 8.2-6

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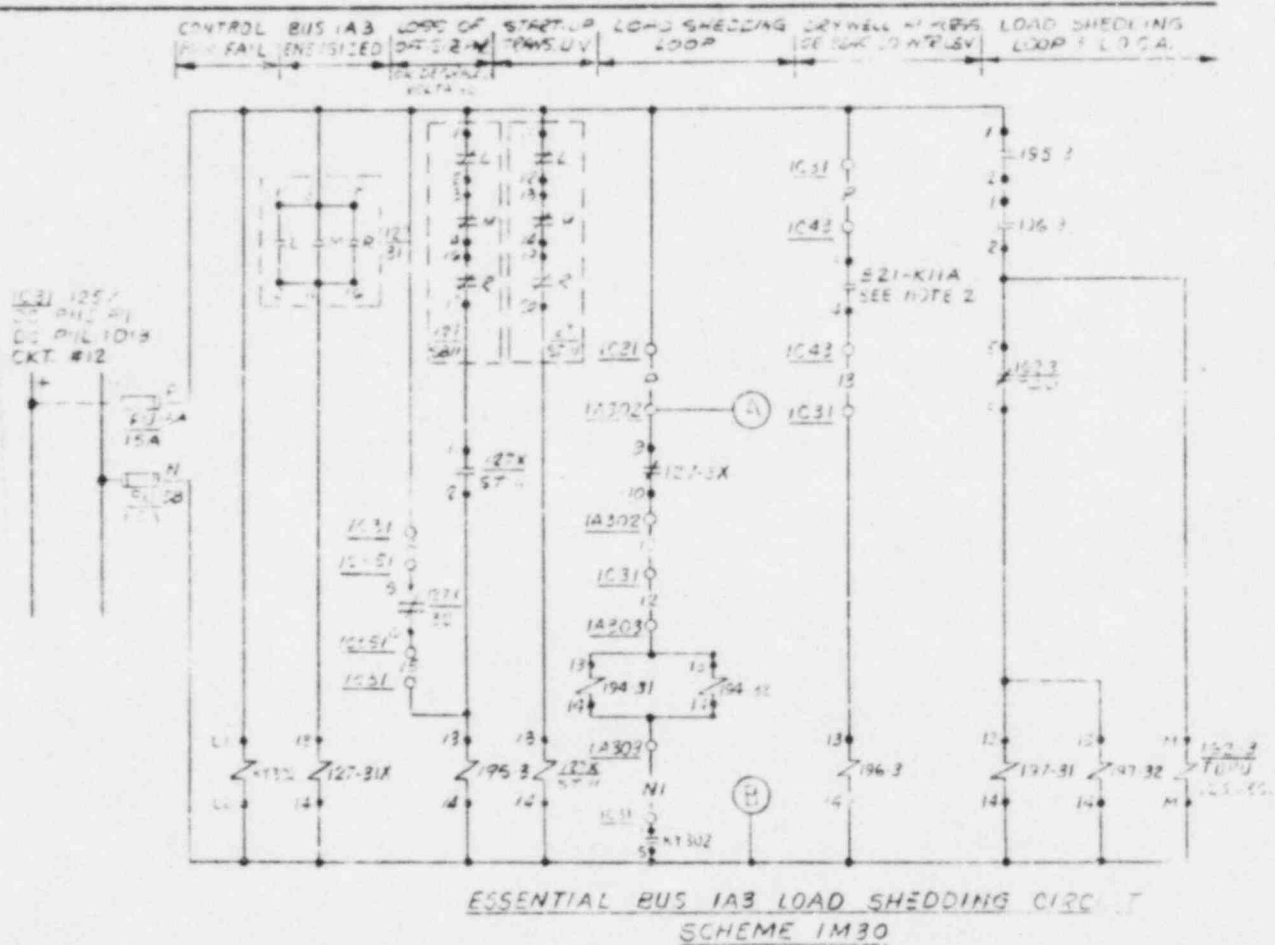
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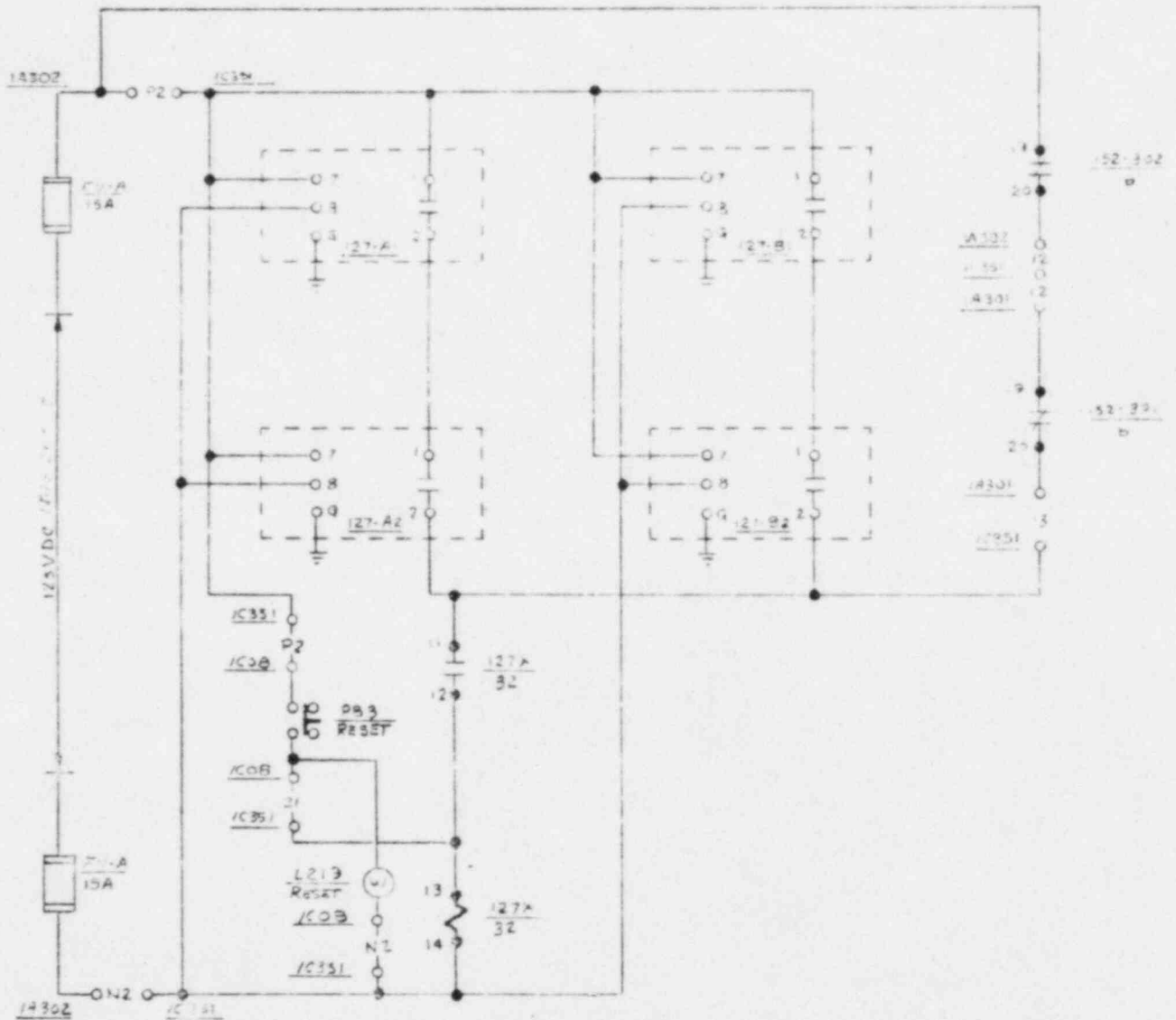
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ESSENTIAL BUS IAB DEGRADED VOLTAGE DETECTION CIRCUIT
SCHEME 1M32

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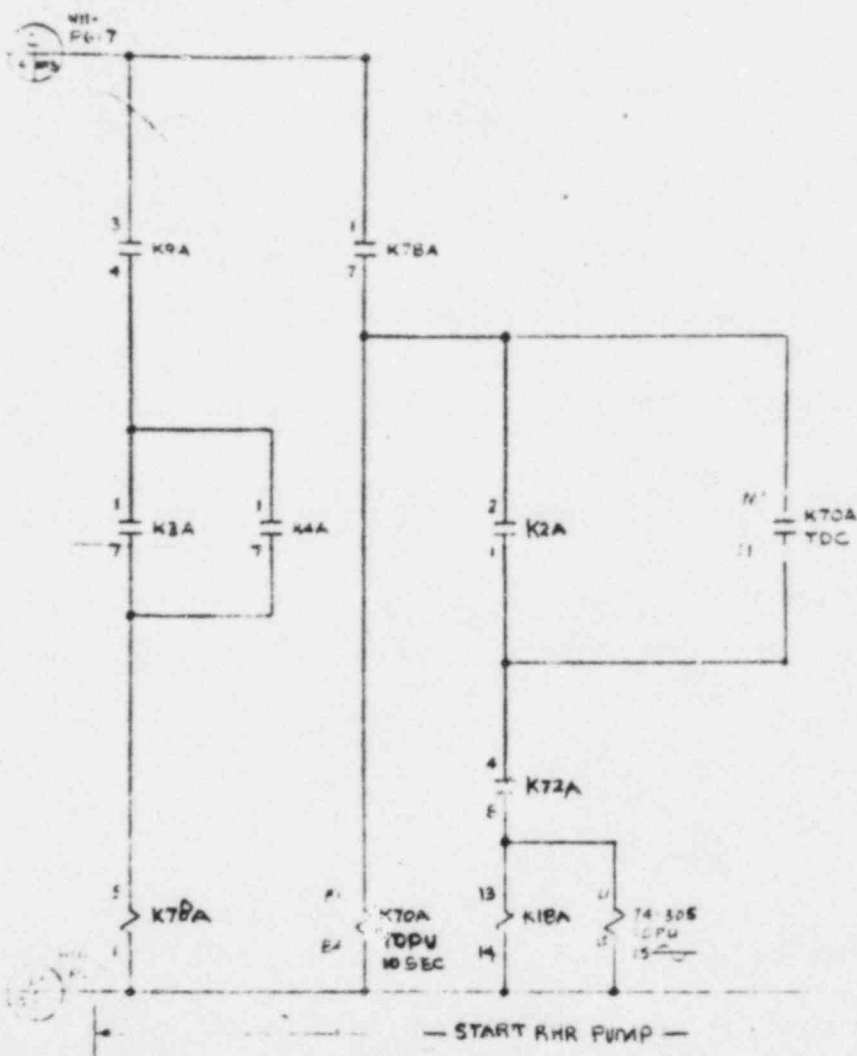
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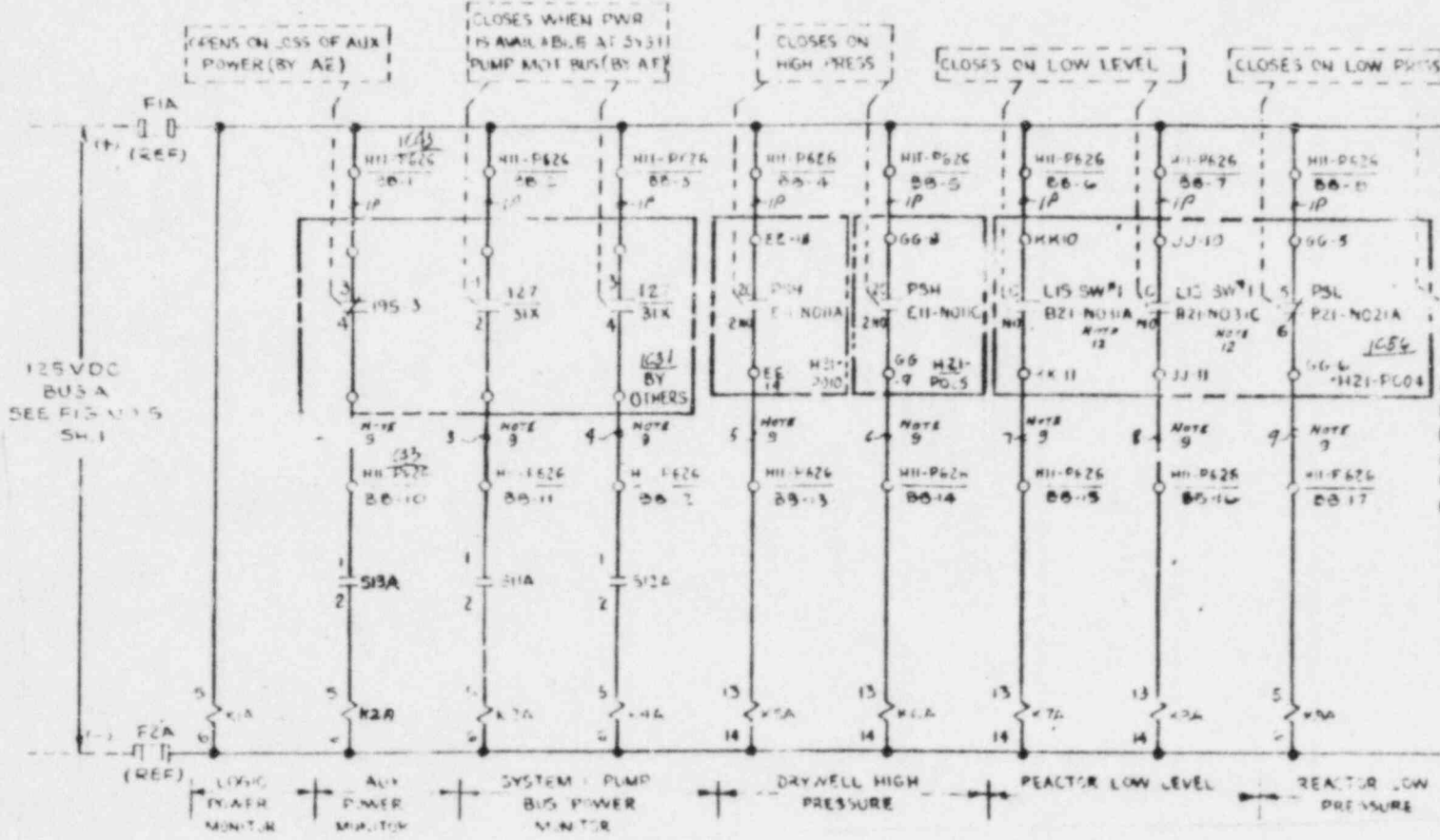
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Duane Arnold Energy Center

TEXT (If more space is required, use additional NRC Form 386A's (17))

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Iowa Electric Light and Power Company

September 20, 1985
DAEC-85-787

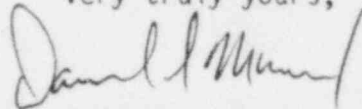
U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555

Subject: Duane Arnold Energy Center
Docket No. 50-331
Op. License DPR-49
Licensee Event Report No. 85-036

Gentlemen:

In accordance with 10 CFR 50.73 please find attached a copy of the
subject Licensee Event Report.

Very truly yours,



Daniel L. Mineck
Plant Superintendent - Nuclear
Duane Arnold Energy Center

DLM/WJM/kp

attachment - LER 85-36

cc: Mr. James G. Keppler
Regional Administrator
Region III
U. S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

NRC Resident Inspector - DAEC

File A-118a

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