REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR: 8605160108 DOC. DATE: 86/05/04 NOTARIZED: NO DOCKET #
FACIL: 50-331 Duane Arnold Energy Center, Iowa Electric Light & Pow 05000331
AUTH. NAME AUTHOR AFFILIATION
MCGAUGHY, R. W. Iowa Electric Light & Power Co.
RECIP. NAME RECIPIENT AFFILIATION
DENTON, H. R. Office of Nuclear Reactor Regulation, Director (post 851125

SUBJECT: Submits info re mod to load sequencing of ECCS equipment result of 850822 loss of transformer concurrence w/LOCA that could have defeated load sequencing logic of diesel update.

DISTRIBUTION CODE: A001D COPIES RECEIVED: LTR 1 ENCL 1 SIZE: 3
TITLE: OR Submittal: General Distribution

NOTES:

	RECIPIENT ID CODE/NAME		COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME		COPIES LTTR	COPIES ENCL
	BWR ADTS		1	0	BWR EB		1	1
	BWR EICSB		2	2	BWR FOB		1	1
	BWR PD2 PD	01	5	5	THADANI, M		1	1
	BWR PSB		1	1	BWR RSB		1	1
INTERNAL:	ADM/LFMB		1	0	ELD/HDS2		1	0
	NRR/DHFT/TSCB		1	1	NRR/ORAS		1	0
	REG FILE	04	1	1	RGN3		1	1
EXTERNAL:	24X		1	1	EG&G BRUSKE, S		1	1
	LPDR	03	1	1	NRC PDR	02	1	1
	NSIC	05	1	1				

TOTAL NUMBER OF COPIES REQUIRED: LTTR 24 ENCL 20

Iowa Electric Light and Power Company

May 9, 1986
NG-86-0548

Mr. Harold Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License No: DPR-49
Load Sequencing of ECCS Equipment
Reference: LER 85-36
File: A-118b

Dear Mr. Denton:

On August 22, 1985, Iowa Electric personnel declared both Emergency Diesel Generators inoperable when we determined 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 Loss-of-Coolant Accident (LOCA), could have defeated the load sequencing logic of the Emergency Diesel Generators (reference LER 85-36). As a result of lowered voltage on the Startup Transformer, the alternate electrical lineup was made to reduce the potential for a degraded voltage trip due to minor grid fluctuations.

Following this determination, discussions were held with members of your staff in the then-titled Power Systems Branch. We were asked to provide them with our plans for permanently correcting this problem. As scheduled in our November 4, 1985 Integrated Plan Semiannual Update, the modification was completed prior to March 31, 1986. This submittal provides the requested information.

Under the original pump start design, the core spray (CS) and residual heat removal (RHR) pumps would start simultaneously on receipt of a LOCA signal if the output voltage of either the standby or startup transformer exceeded 65% of nominal voltage and no degraded bus voltage condition existed. These starts would occur regardless of the power source energizing the essential buses. If a Loss-of-Offsite-Power (LOOP) event occurred, the CS and RHR pump start circuitry would cause the pumps to sequence onto their respective diesel generators at five (5) second intervals. Sequencing is required to meet minimum starting voltages on the buses so that simultaneous high pump starting currents would not possibly stall the diesel engines. A LOOP signal is initiated only if the output voltage of both the standby and startup transformers drops to 65% or less of nominal voltage or if a

A001
1/1

degraded bus voltage condition occurs. Therefore, if the essential loads were powered by the standby transformer and a LOCA occurred at the same time as the standby transformer failed, the output voltage of the startup transformer would have prevented the LOOP detection logic from sending a LOOP signal to the pump start circuitry. This would have caused all CS and RHR pumps to load to their respective diesel generators simultaneously.

A design change was made to correct the problem described above permanently. The automatic CS and RHR pump start circuitry was modified so that the pumps sequence on at all times following a LOCA signal regardless of the status of offsite power. The design change disconnected one wire leading to each K-2A (Division I) and K-2B (Division II) relay coil, thereby preventing actuation of the K-2A and K-2B relays under any condition (see Attachment 1, left side). Disconnecting these relays bypasses the automatic instantaneous start feature (K-2A/B relay contacts remain open) on the pumps and directs the LOCA pump start signal to the appropriate time delay pickup (TDPU) relay (Attachment 1, right side). As a result, the pumps will sequence onto their respective buses.

A safety evaluation was performed in accordance with 10 CFR 50.59 and we determined that no unreviewed safety question exists. The results of this safety evaluation will be reported in accordance with our required annual 50.59 report.

Should you have any questions, please contact this office.

Very truly yours,

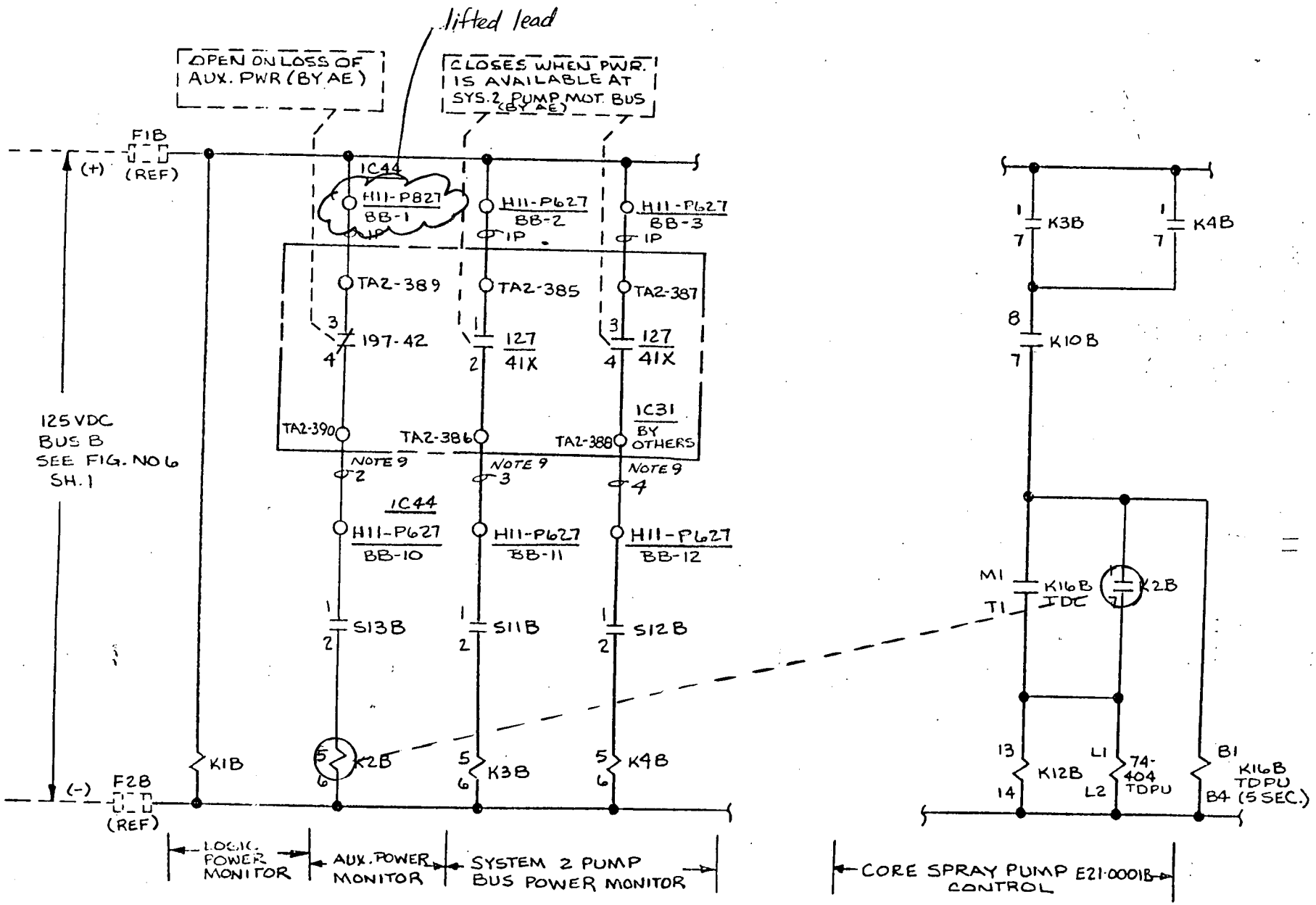
David L. Wilson for

Richard W. McGaughy
Manager, Nuclear Division

RWM/SAR/ta*

Attachments: 1) Scheme 2R201
2) LER 85-36

cc: S. Reith
L. Liu
L. Root
M. Thadani
NRC Resident Office



Representative of RHR and Core Spray

SCHEME 2R201

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)
Duane Arnold Energy Center	0 5 0 0 0 3 3 1	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	MONTH	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
										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 8 8	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	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)	X 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
William J. Miller, Technical Services Superintendent	AREA CODE 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	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	

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 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.

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.

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.

NRC Form 366 (9-83)

8509300544

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Duane Arnold Energy Center	0 5 0 0 0 3 3 1	8 5	— 0 3 6	— 0 0	0 2 OF 0 9

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).

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Duane Arnold Energy Center	0 5 0 0 0 3 3 1	8 5	— 0 3 6	— 0 0	0 3 OF 0 9

TEXT (If more space is required, use additional NRC Form 366A'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.

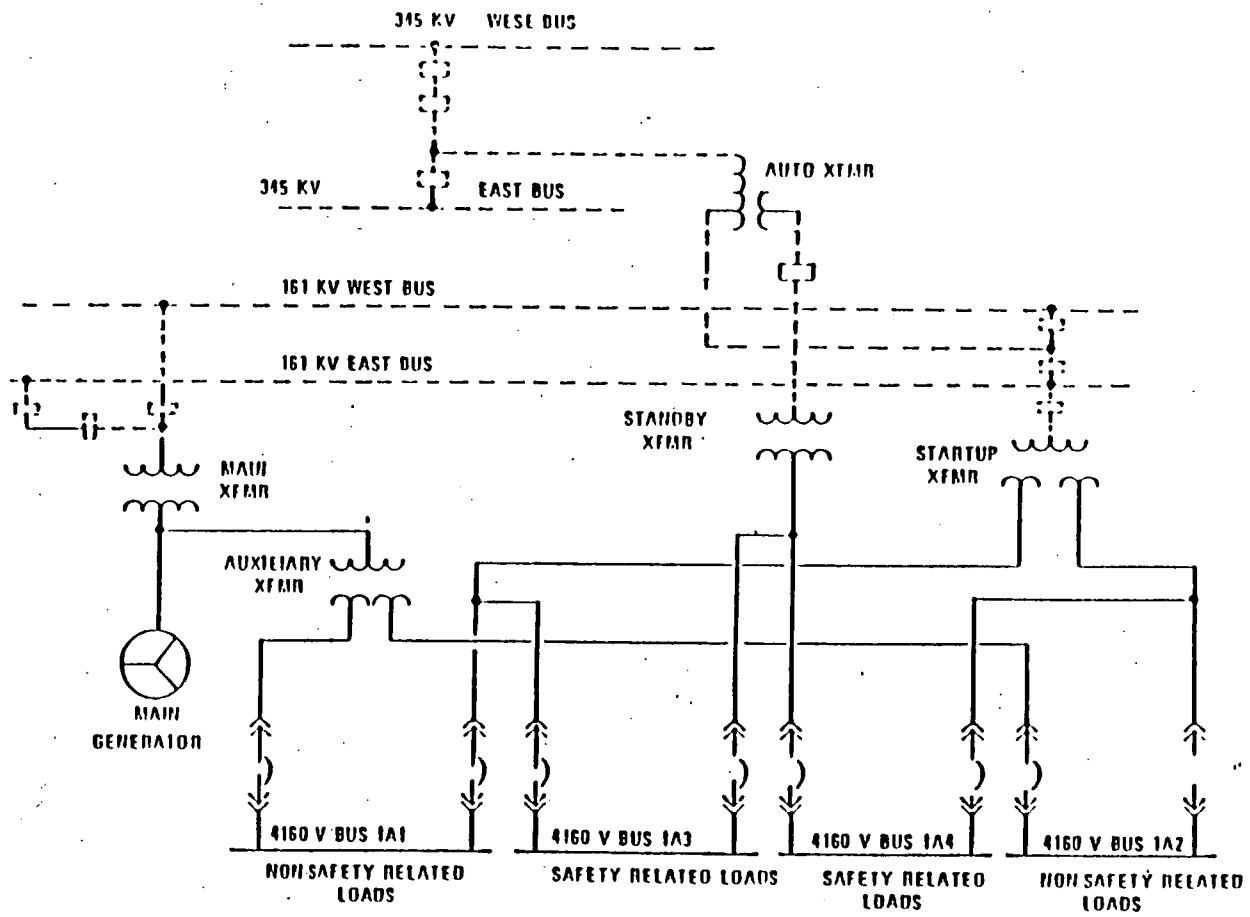
The action of placing these keylock switches in test was thoroughly reviewed by Engineering and Operations personnel to ensure other undesirable logic changes did not result. This included physical confirmation of in-plant wiring and relaying. Administrative controls have been implemented to visually 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.

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.



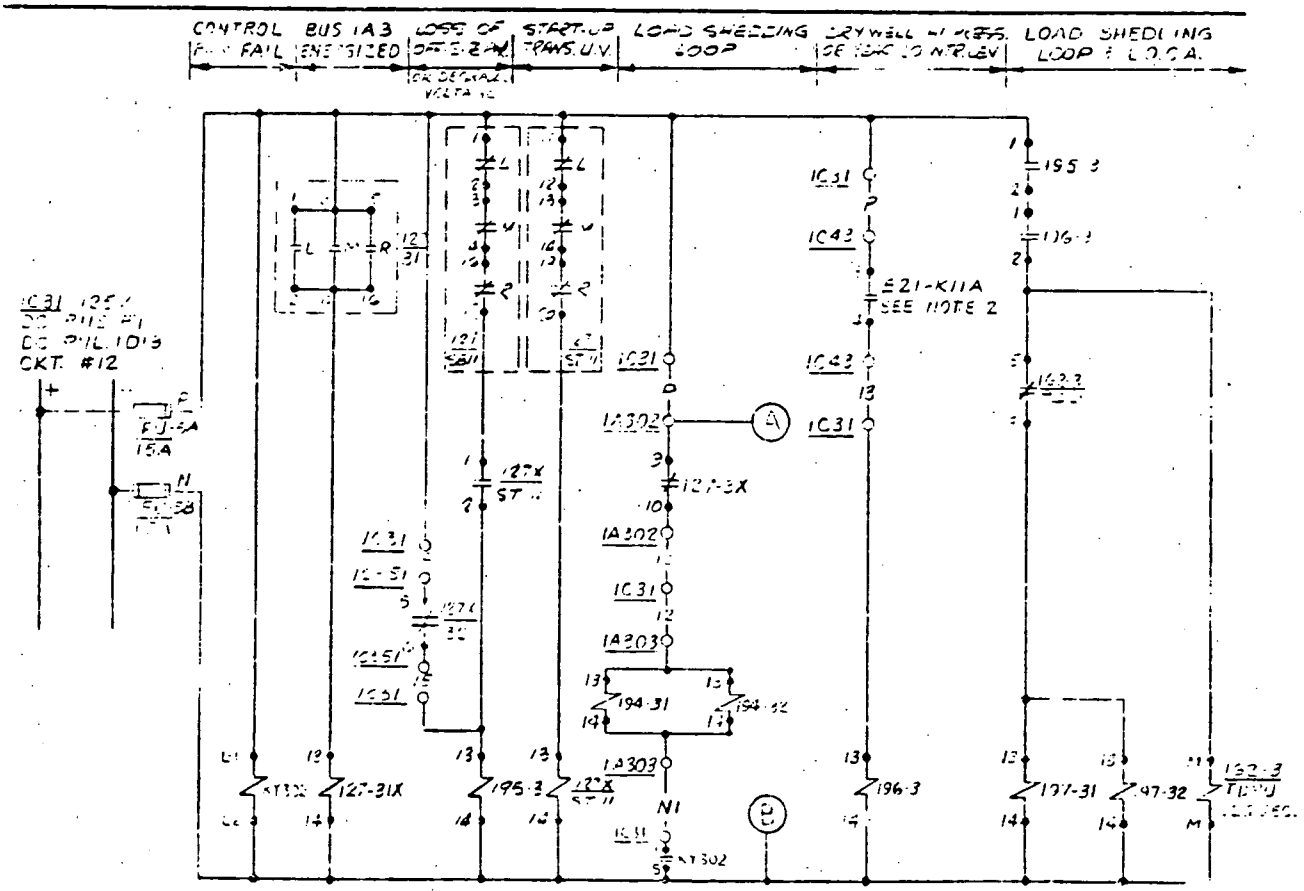
DUANE ARNOLD ENERGY CENTER
IOWA ELECTRIC LIGHT & POWER COMPANY
UPOATED FINAL SAFETY ANALYSIS REPORT

DAEC Electrical System

Figure 8.2-6

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Duane Arnold Energy Center	0 5 0 0 0 3 3 1	8 5	0 3 6	0 0	0 6 OF 0 9

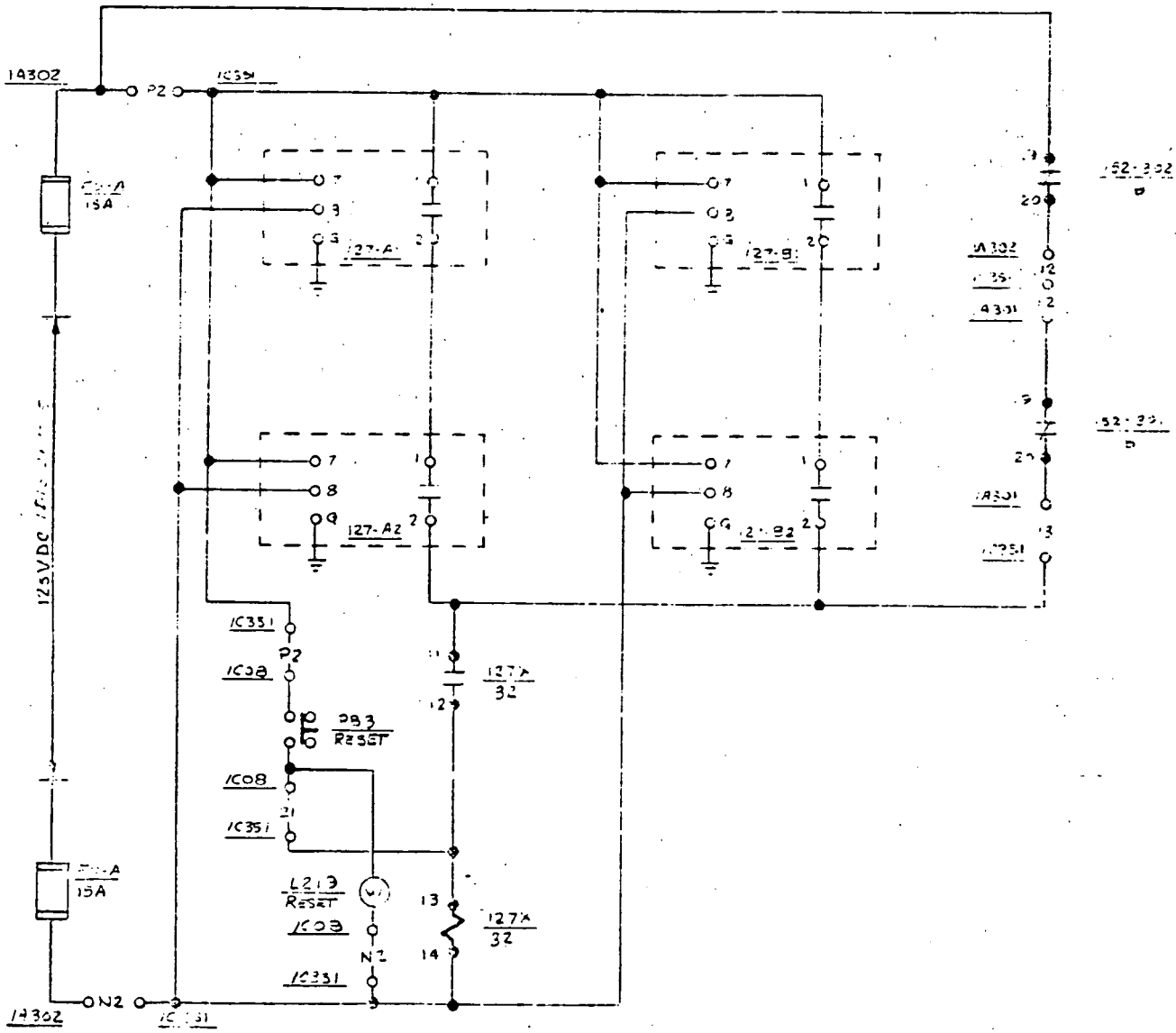
TEXT (If more space is required, use additional NRC Form 366A's) (17)



ESSENTIAL BUS 1A3 LOAD SHEDDING CIRC
SCHEME 1M30

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Duane Arnold Energy Center	0 5 0 0 0 3 3 1	8 5	— 0 3 6	— 0 0	0 7 OF 0 9

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

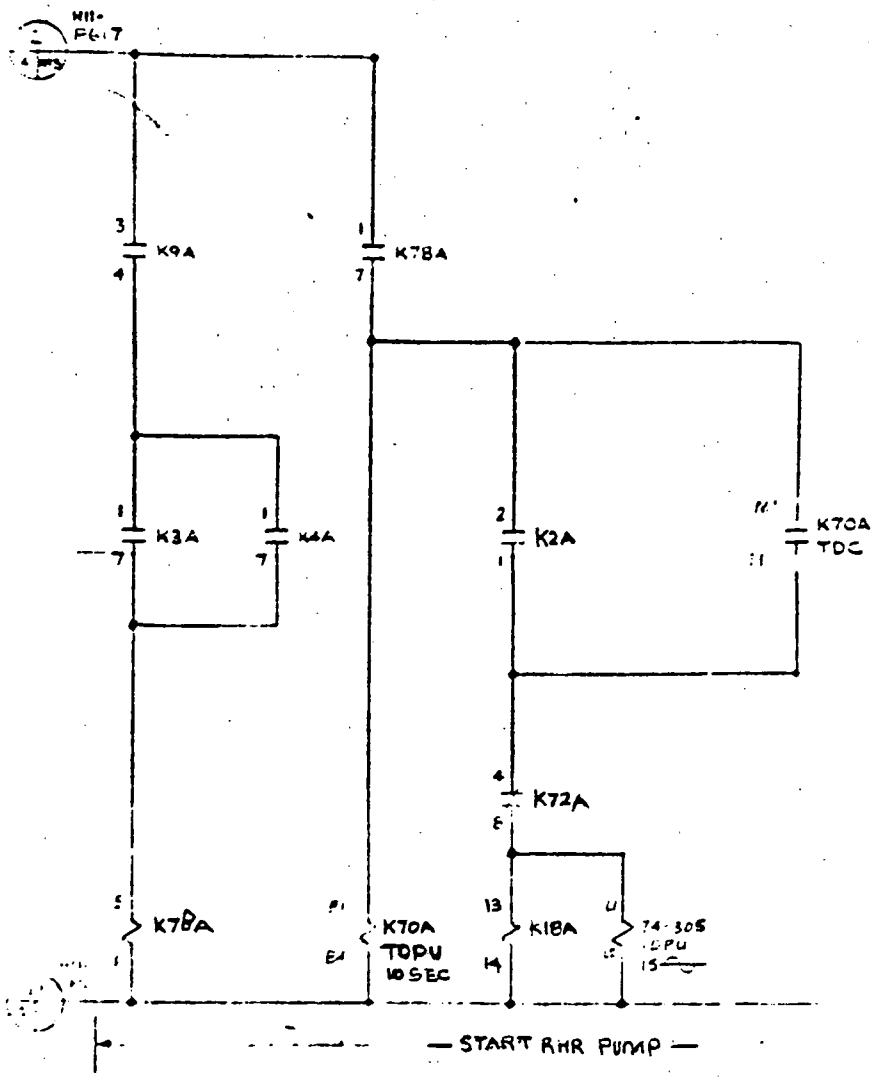


ESSENTIAL BUS 1A3 DEGRADED VOLTAGE DETECTION CIRCUIT

SCHEME 1M32

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Duane Arnold Energy Center	0 5 0 0 0 3 3 1	8 5	— 0 3 6	— 0 0	0 8 OF 0 9

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



FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Duane Arnold Energy Center	0 5 0 0 0 3 3 1	8 5	— 0 3 6	— 0 0	0 9 OF 0 9

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