

REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

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 FACIL: 50-387 Susquehanna Steam Electric Station, Unit 1, Pennsylvania 05000387
 50-388 Susquehanna Steam Electric Station, Unit 2, Pennsylvania 05000388
 AUTH. NAME AUTHOR AFFILIATION
 CURTIS, N.W. Pennsylvania Power & Light Co.
 RECIPIENT NAME RECIPIENT AFFILIATION
 SCHWENCER, A. Licensing Branch 2

SUBJECT: Forwards addl info on electrical sys requested by NRC at
 820628 meeting, Util installed Class IE scheme to trip
 Unit 2 Class IE electrical sys for LOCA signal generated in
 Unit 1.

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	LIC BR #2 LA	1	0	PERCH,R. 01	1	1
INTERNAL:	ELD/HDS4	1	0	IE FILE	1	1
	IE/DEP EPDS 35	1	1	IE/DEP/EPLB 36	3	3
	NRR/DE/CEB 11	1	1	NRR/DE/EOB 13	3	3
	NRR/DE/GB 28	2	2	NRR/DE/HGEB 30	2	2
	NRR/DE/MEB 18	1	1	NRR/DE/MTEB 17	1	1
	NRR/DE/QAB 21	1	1	NRR/DE/SAB 24	1	1
	NRR/DE/SEB 25	1	1	NRR/DHFS/HFEB40	1	1
	NRR/DHFS/LQB 32	1	1	NRR/DHFS/OLB 34	1	1
	NRR/DHFS/PTRB20	1	1	NRR/DSI/AEB 26	1	1
	NRR/DSI/ASB 27	1	1	NRR/DSI/CPB 10	1	1
	NRR/DSI/CSB 09	1	1	NRR/DSI/ETSB 12	1	1
	NRR/DSI/ICSB 16	1	1	NRR/DSI/PSB 19	1	1
	NRR/DSI/RAB 22	1	1	NRR/DSI/RSB 23	1	1
	NRR/DST/LGB 33	1	1	<u>REG FILE</u> 04	1	1
	RGN1	2	2	RM/DDAMI/MIB	1	0
EXTERNAL:	ACRS 41	10	10	BNL (AMDTS ONLY)	1	1
	DMB/DSS (AMDTS)	1	1	FEMA-REP DIV 39	1	1
	LPDR 03	2	2	NRC PDR 02	1	1
	NSIC 05	1	1	NTIS	1	1



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Norman W. Curtis
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July 6, 1982

Mr. A. Schwencer, Chief
Licensing Branch No. 2
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

SUSQUEHANNA STEAM ELECTRIC STATION
ADDITIONAL INFORMATION ON ELECTRICAL SYSTEM
ER 100450 FILE 841-2
PLA-1167

Docket Nos. 50-387
50-388

Dear Mr. Schwencer:

The attached information was requested by NRC during a meeting on June 28, 1982. In addition, PP&L has installed a class 1E scheme to trip the Unit 2 class 1E electrical system for a LOCA signal generated in Unit 1. This scheme will be in place throughout the period of Unit 2 construction.

Very Truly yours,

N.W. Curtis
Vice President-Engineering & Construction-Nuclear

DPM

cc: R. L. Perch - NRC

Attachment

13001

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PDR ADOCK 05000387
A PDR



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PP&L Voltage Study of One Unit Operation

The following is a description of several factors included in PP&L's voltage study for one unit operation at Susquehanna SES.

The study assumed that the startup transformer automatic tap changer adjusted the plant voltages to normal prior to a LOCA event. The $\pm 15\%$ range of the startup transformers was verified to be sufficient to support the most severe plant loading condition for a minimum transmission grid voltage of 215 KV when one startup transformer is out of service. The minimum anticipated grid voltage is 225 KV.

In addition to studying normal plant electrical distribution system configurations, the voltage study examined the system with one startup and one ES transformer out of service as the limiting case for minimum plant voltages under the LOCA loading. Lowest voltages occur when the electrical distribution system is supplied via Startup Transformer 10 and ES transformer 101, and the power supply from Startup Transformer 10 is unavailable.

Transformer tap selections were made on the basis of not exceeding + 10% equipment voltage ratings under light loading conditions. The tap settings of related transformers used in the voltage study are listed in Attachment 1.

An extensive review was performed of the individual loads connected to the various busses to determine what loads would be running and the loads that would be started at various times during a LOCA. The findings of this review provided the data base for the loads in the voltage study. Included in the loading are the non-Class IE loads connected to the Class IE busses that would be running or started during a LOCA.

Attachment 2 provides the sequence of the major events that occur following a LOCA. Note, that at $t = 45$ seconds the turbine generator trips as a result of the generator's anti-motoring relay. By this time the RHR and Core Spray pumps have started and accelerated to rated speed. The effect of the unit trip on the transmission system voltage at the startup transformer has been studied and included in our voltage study. Also note that the effect on the plant voltage by the Auxiliary Bus loads transferred to the Startup Bus when the generator trips was also included in the study.

Unit 2 construction load was not included in this study because of the trip scheme of the Unit 2 Class IE switchgear for a Unit 1 LOCA signal.

The voltage criteria for the Class IE equipment is as follows:

- ± 10% continuous voltage on equipment rating
- 80% accelerating voltage on motor base
- 71% transient voltage on running equipment

The 3/20/82 voltage verification test showed that the voltage criteria had to be adjusted to account for error between analysis results and actual test data. The adjusted minimum voltage criteria to compare the predicted voltages from the voltage study is as follows:

Continuous

- 3815 V (91.7%) for 4160 V equipment
- 442 V (92.1%) for 480 V equipment

Accelerating

- 3308 V (82.7%) for 4000 V motors
- 382 V (83.0%) for 460 V motors

Transient

- 2948 V (73.7%) for 4000 V motors
- 340 V (74.0%) for 460 V motors

Attachment 3 provides the loading sequence voltage profile determined by the voltage study. The startup transformer automatic tap changer was assumed to remain at the pre-LOCA tap position throughout the entire profile. The profile is compared to the above adjusted minimum voltage criteria for acceptability.

The plant design meets the adjusted voltage criteria at all voltage levels throughout the period of automatic LOCA loading of the plant distribution system assuming the startup transformer automatic tap changer does not operate. The only criteria not met is the continuous 480 V equipment criteria of 442 V when all manually started loads are eventually sequenced onto the system. The analysis predicts a voltage of 438 V versus the 442 V criteria (4 volt difference) under this condition. This non-compliance is not considered significant for several reasons:

1. Running equipment ratings are lower than bus ratings (460 V versus 480 V) such that continuous voltage will be above the -10% rated voltage limit at the terminals of the device.
2. No credit has been taken for conservative margins built into motor starter circuits and starter ratings.
3. No credit has been taken for decreased loading on RHR and Core Spray pumps or other manual actions taken by the operator which would reduce bus loads.
4. No credit has been taken for startup transformer automatic tap changer operation.

As a result of the comprehensive study coupled with the 3/20/82 voltage verification test, PP&L concludes that the existing plant design provides acceptable plant voltages to safety related equipment under the worst case plant configuration. The worst case plant configuration assumes the loss of one offsite power supply and one ES transformer. The plant design also provides acceptable voltages to safety related equipment making the added conservative assumption to the worst case plant configuration of a failure of the startup transformer automatic tap changer under load.

A. B. Kuku
6/30/82

Attachment 1

Transformer Tap Ratios

Startup Transformers 10 and 20 Main Tap - 219.4/13.8 KV

Automatic Tap Changer Setpoint - 14.17 KV

Startup Bus Regulated Bandwidth - 14.02 to 14.32 KV

Engineered Safeguards Transformers 101 and 201 - 13.54/4.16 KV

Class IE Load Center Transformer - 4160/480 V

ATTACHMENT 2

LOCA WITHOUT LOOP

TIMERS

RHR PUMPS C&D 7.5" AFTER INITIATION, CORE SPRAY PUMPS 15"
AFTER INITIATION, ANTIMOTING RELAY TRIP IN 30"

PRE LOCA: UNIT 1 AT FULL POWER AND OPERATING AT AN ABNORMALLY
LOW LEVEL (LEVEL 3) STARTUP TRANSFORMER LTC CONTROL
SET AT 14,170V ALL UNIT #2 LOAD OFF

- t = 0 Reactor Recirc Line Break Occurs - high drywell pressure signal
- start: diesel generators, DG air compressors, OV201A, OV109A, OV101A & OE143A
 - trip D.G. space heaters
- t = 2" Reactor at Level 2 (-58")
- ATWS initiated, 10" delay until reactor recirc. pump trip
 - MSIV closure initiated (MSIV 3-5" to close)
 - trip: 1P210A, 1P210B, RHR service water (if running)
- t = 5.3" Reactor at Level 1 (-149")
- initiate RHR and core spray start
 - trip reactor and turbine building chillers
 - start RHR pumps A & B
- t = 6" (11") MSIV 100% Closed
- steam supply to turbine generator shut off (8-10" delay until pressure = 0)
- t = 12" Reactor Recirc. Pump Trips by ATWS
- t = 12.8 RHR Pumps C & D Start
- t = 15" (+2") Steam Pressure at Turbine Generator = 0
- Anti motoring relay begins to time out (30" delay)
- t = 20.3" 4 Core Spray Pumps Start
- t = 22.8" Reactor Pressure at 400 PSI (Set point 430 PSI +30)
- permissive for core spray and RHR injection valves
 - RHR injection valves 1F015 A&B Start from ISO MG Set (24" valve)



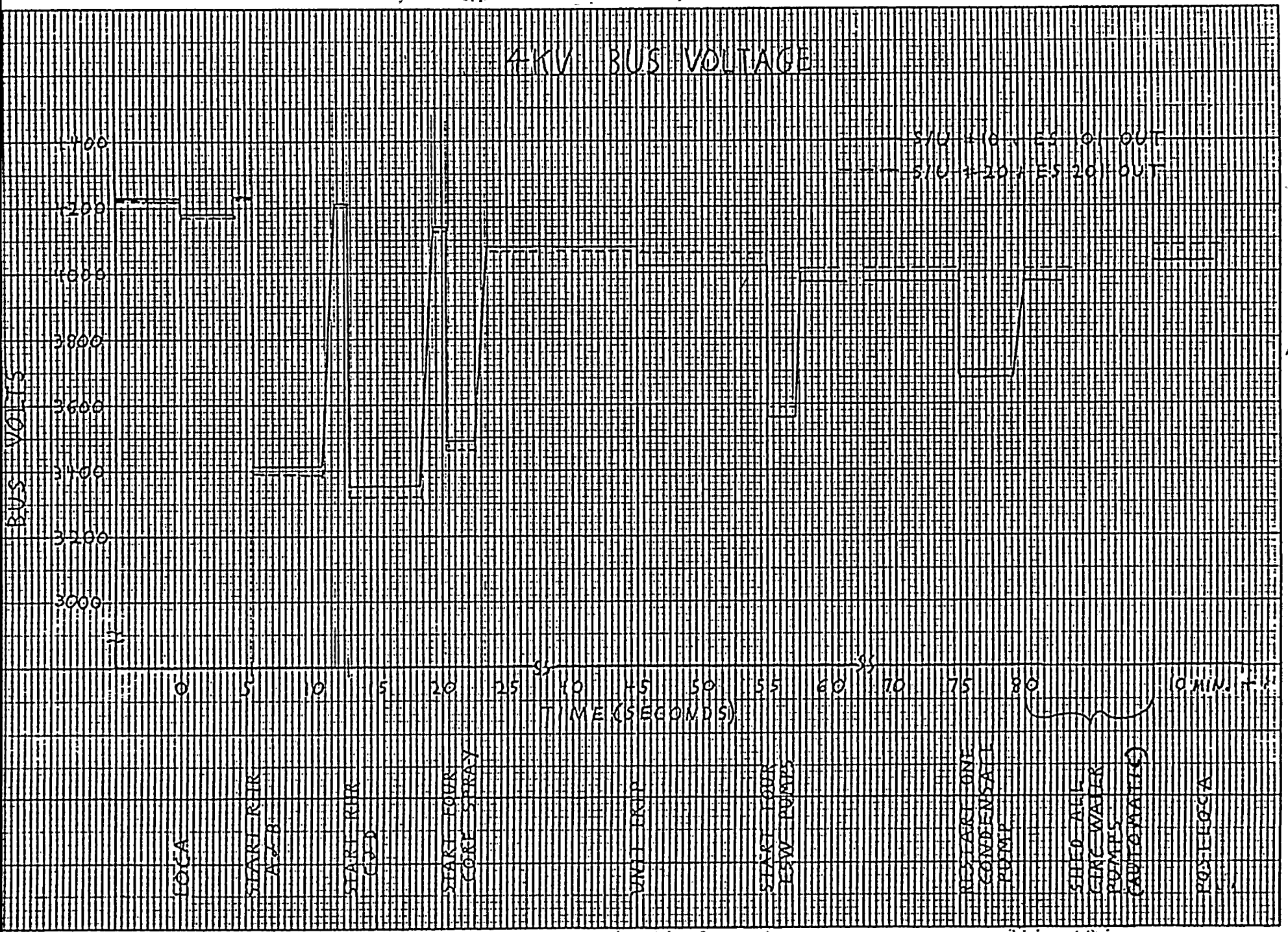
ATTACHMENT 2

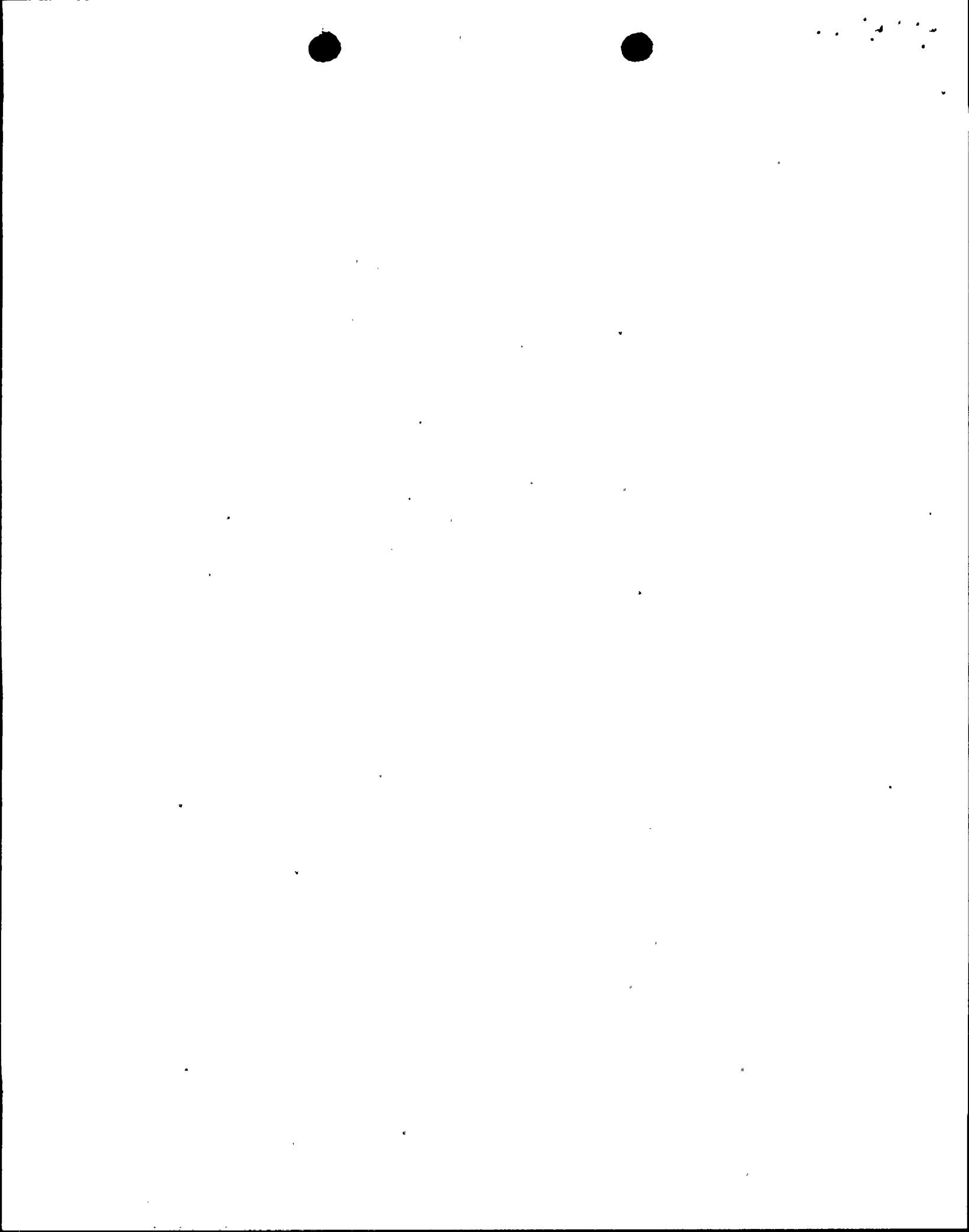
LOCA WITHOUT LOOP

- t = 23.8" Core Spray Pumps Running
- Remaining injection valves start when voltage recovers (core spray injection 1F004A&B, 1F005A&B 12" to open; RHR INJ 1F0017A&B if closed require 24" to open)
- t = 26.8" Reactor Pressure at 280 PSI
(Set Point 310 PSI +30)
- permissive for closure of reactor recirc. discharge valve (1F031A,B 30" for closure)
- t = 32.0" Core Spray Inj Valve 68% Open
- core spray at design flow
- t = 35.8" Core Spray Inj Valve Fully Open
-
- t = 45" (+2") Unit Trip by Anti Motoring Relay
- dip in grid voltage
- load shedding initiated
- all load to be shed trip except circulating water pumps
- aux load, including circ water pumps transfer to startup bus
- t = 47.8" Both RHR injection valves fully open
- t = 55.0" Start 4 - Emergency service water pumps
- t = 56.8" Reactor Recirc Discharge Valve fully closed
- LPIC at full flow
- t = 65" (+2") Circulating Water Pump 1A is Shed
- Circ Water Pump Shedding is initiated at 45". Interlock prevents trips until each pump discharge valve is 100% closed (20" valve). Pump A will shed @ t = 50.4" (45" + 5.4") if valve is initially in the "minimum flow" position, i.e. 27% open.
- Remaining pumps will shed at 2.0 min. intervals.
- t = .75" One Condensate pump restarts automatically
- t = 7 min. All Circulating Water Pumps are shed

ATTACHMENT 3

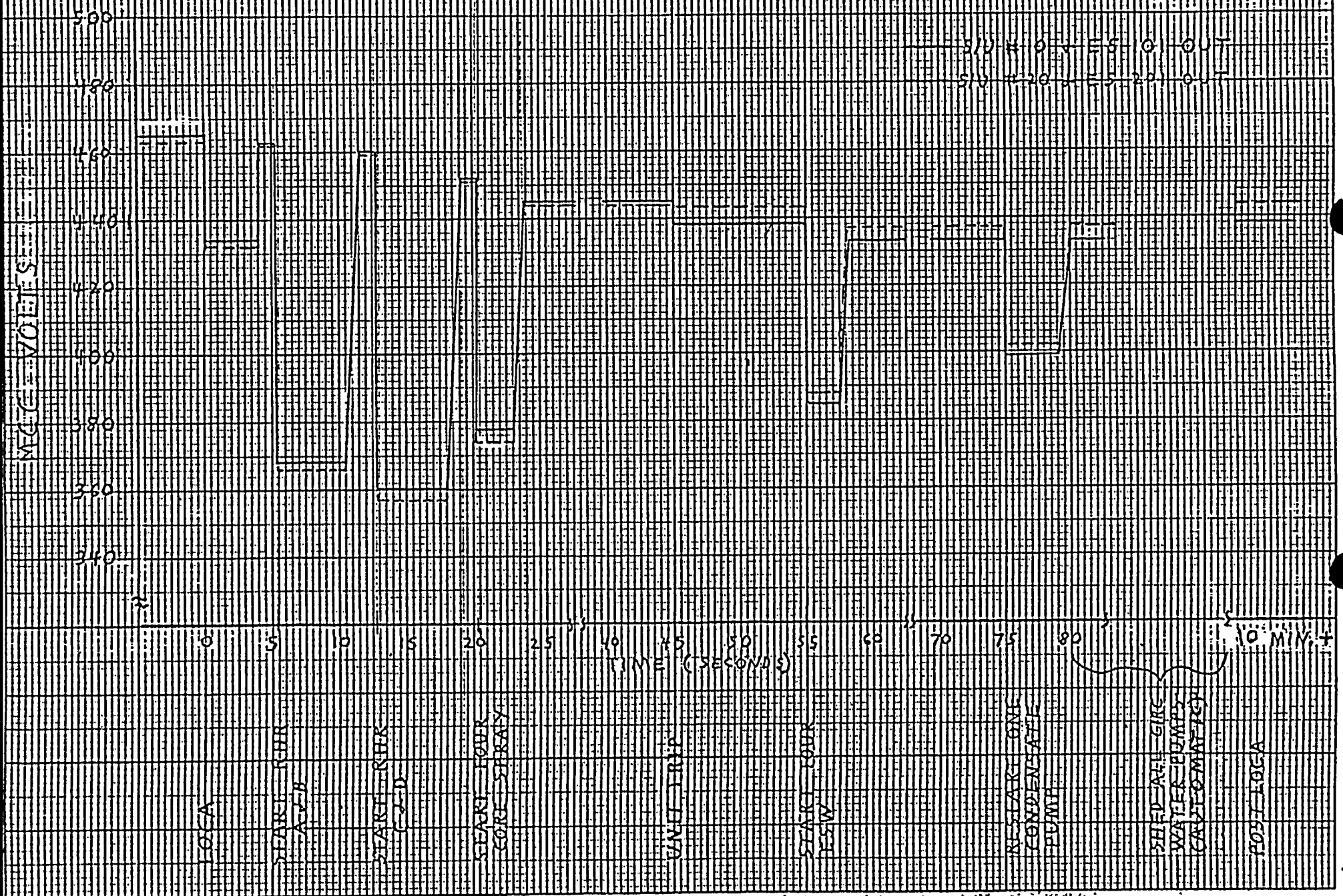
4KV BUS VOLTAGE





ATTACHMENT 3

VOLT AT MCC OB 36



ATTACHMENT 3
 CALCULATED VOLTAGES
 STARTUP #10 & ES 201 OUT
 (UNIT #2 LOAD OFF)

RUN	S/U TR TAPS #10/#20	S/U BUS KV	4 KV BUS VOLTS	LC 1B230 VOLTS	MCC 0B136 VOLTS	
<u>NORMAL LOAD</u>	-2.81/4.69	14.01	4231	472	465	MCC 0B517 = 456
<u>LOCA t = 0+</u>						
t = 0+ Start OV101A, OV201A OV109A, D.G. AIR COMP.		13.95	4181	449	434	
RUN OV101A ECT.		14.01	4235	473	463	
START RHR PUMP A & B		13.05	3415	378	368	RHR A&B (3400V)
RUN ABOVE		13.98	4210	470	460	
START RHR PUMP C & D		12.96	3348	370	360	RHR PUMP C = 3334V
RUN ABOVE		13.89	4141	462	452	
START 4 CORE SPRAY		13.10	3486	386	377	
RUN ABOVE		13.80	4081	455	445	
<u>UNIT TRIP</u>						
AUX LOAD TRANSF TO S/U		13.61	4019	448	438	UNIT AUX & S/U LOAD IS SHED
START 4 ESW PUMPS		13.04	3562	395	385	
RUN ABOVE		13.54	3970	442	433	
RESTART CONDENSATE PUMP		12.66	3683	409	399	
RUN ABOVE		13.56	3975	443	433	
<u>POST LOCA</u>						
NO MANUAL LOAD SHEDDING		13.85	4037	448	438	
RESTART ONE RHR PUMP MANUALLY		13.30	3583	395	386V	

ATTACHMENT 3
 CALCULATED VOLTAGES
 STARTUP #20. & ES 201 OUT
 (UNIT #2 LOAD OFF)

RUN	S/U TR TAPS #10/#20	S/U BUS KV	4 KV BUS VOLTS	LC 1B230 VOLTS	MCC OB136 VOLTS	
<u>NORMAL LOAD</u>	5.62/-2.81%	13.97	4222V	471	463	MCC OB517 = 455
<u>LOCA t = 0+</u>						
t = 0+ Start OV101A, OV201A OV109A, D.G. AIR COMP.		13.91	4172	448	432	
RUN OV101A ECT.		13.98	4227	471	462	
START RHR PUMP A & B		12.96	3393	375V	366	RHR PUMP A(3378V)
RUN ABOVE		13.94	4202V	468	459	
START RHR PUMP C & D		12.86	3323	367	357	RHR C (3310V)
RUN ABOVE		13.84	4129	460	451	
START 4 CORE SPRAY		13.02	3462	383	374	
RUN ABOVE		13.75	4066	453	444V	
<u>UNIT TRIP</u>						
AUX LOAD TRANSF TO S/U		13.73	4059	452	443	UNIT AUX & S/U LOAD IS SHED
START 4 ESW PUMPS		13.12	3586	398	388	
RUN ABOVE		13.66	4009	446	437	
RESTART CONDENSATE PUMP		12.71	3701	411	402	
RUN ABOVE		13.68	4014	447	438	
<u>POST LOCA</u>						
NO MANUAL LOAD SHEDDING		13.98	4083	453	444	
RESTART ONE RHR PUMP MANUALLY		13.40	3613	399	389	

