

COOPER NUCLEAR STATION
NEBRASKA PUBLIC POWER DISTRICT

VOLTAGE DROP ANALYSIS
COMPUTATIONS

W. O. 3401-27

OCTOBER 31, 1979
(Rev. 1)

BURNS AND ROE, INC.
ENGINEERS AND CONSTRUCTORS
WOODBURY, NEW YORK

Prepared by

N. J. P. Schenck

Checked by

John H. McCutcheon

Approved by

John C. [Signature]

for Chief Electrical
Engineer

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 Drawing No. _____ Calc. No. 2-15-01 Sheet 1 Cont. on Sheet 2
 By PSHENNY Checked John McCarty 10/30/79 Approved [Signature] 10/31/79
 Title NPPD/CNS - VOLTAGE DROP STUDY - LEAD SHEET

THE CHECK PERFORMED IN ACCORDANCE WITH ENGG. STANDARD
 POB10561 DATED JAN 79; RESULTS ARE SATISFACTORY

John McCarty 10/30/79

1. PURPOSE: TO DETERMINE ANALYTICALLY IF THE OFFSITE
 POWER SYSTEM AND THE ONSITE DISTRIBUTION
 SYSTEM IS OF SUFFICIENT CAPACITY AND CAPABILITY
 TO AUTOMATICALLY START AS WELL AS OPERATE
 ALL REQUIRED SAFETY LOADS WITHIN THEIR
 VOLTAGE RATINGS IN THE EVENT OF: 1) AN
 ANTICIPATED TRANSIENT (SUCH AS A UNIT TRIP), OR
 2) AN ACCIDENT (SUCH AS LOCA)

2. REFERENCES:

A. BURNS & ROE APPROVED COMPUTER PROGRAM
 NO. EL 0110.

B. BURNS & ROE ONE LINE DIAGRAMS:

DWG NOS; 3001 REV. 10, 3006 REV. 17
 3002 REV. 23, 3007 REV. 24
 3005 REV. 13,

C. NRC GUIDELINES; ATTACHMENT TO NRC LETTER
 DATED AUG 2, 1979, "RE: ADEQUACY OF STATION ELECTRIC
 DISTRIBUTION SYSTEMS VOLTAGES"; ATTACHED

3. DESIGN REQUIREMENTS:

A. MOTOR TERM. VOLTAGES SHALL BE COMPUTED WITH OFFSITE
 VOLTAGES AT HIGH & LOW VALUES RECORDED
 DURING THE OPERATION OF COOPER NUCLEAR
 STATION.

B. MOTOR TERMINAL VOLTAGES SHALL BE COMPUTED
 UNDER THE FOLLOWING MODES OF PLANT OPERATION
 INCLUDING TRANSIENT & ACCIDENTS:

POOR ORIGINAL

PLANT ON HOT STAND BY

PLANT COLD SHUTDOWN

PLANT ON LOCA SHUTDOWN

PLANT NORMAL OPERATION

PLANT NORMAL OPERATION & LOCA SHUTDOWN.

THE MOTOR TERMINAL VOLTAGE SHALL BE WITHIN $\pm 10\%$ OF NAME
 PLATE RATING DURING "RUN" & -20% OF NAME PLATE RATING DURING

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C. LOADS REQUIRED TO OPERATE UNDER VARIOUS MODES OF PLANT OPERATION ARE AS SHOWN IN TABLE BELOW:

CERTAIN LOADS NOT REQUIRED, BUT USEFULL IF AVAILABLE, ARE INCLUDED FOR MAX. VOLTAGE DROP & ARE MARKED "N/R"

EQUIPMENT	HP OR KVA EACH	No. OF UNITS	NO. OF UNITS REQUIRED TO OPERATE			
			NORMAL PLANT	LOCA	HOT STANDBY	COLD SHUTDOWN
STATION SERVICE WTR PP.	300	4	0	2+2(N/R)	2	1+1(N/R)
RHR PUMP	1090 (BHP)	4	0	2	0	1+1(N/R)
RHR SW. BOOSTER PP.	1000	4	0	1**	0	2+2(N/R)
CORE SPRAY PUMP	1090 (BHP)	2	0	1+1(N/R)	0	0
CONTROL ROD DRIVE	250	2	1+(N/R)	1+1(N/R)	1	1+1(N/R)
STN. AIR COMPRESSOR	125	3	1+(N/R)	1+1(N/R)	1	1+1(N/R)
MCC "K" LOADS	600	-	600	600	SUBSTN. "IF"	600
MCC "LX" LOADS	475	-	475	475		-480
MCC "TX" LOADS	100	-	100	100	SUBSTN. "IG"	100
MCC "S" LOADS	480	-	480	480		-150
MCC "CA" OR "CB" *	-	-	-	-	-	-
<u>NON-CRITICAL LOADS:</u>						
CIRC WTR PUMP	1750	4	4	0	2	0
COND. BOOSTER PUMP	2500	3	2	0	1	0
CONDENSATE PUMP	800	3	2	0	1	0
REACT. RECIRC MG	7000	2	2	0	1+1(N/R)	0
480V SUBSTN. "IA"	1200	-	1200	0	1200	0
"IB"	1000	-	1000	0	1000	0
"IC"	300	-	300	0	300	0
"ID"	300	-	300	0	300	0
"IE"	400	-	400	0	400	0
MCC	500	-	500	0	INCLUDED IN SUBSTN. "IF & IG"	0
M	240	-	240	0		0
N	430	-	430	0		0
P	400	-	400	0		0
U	200	-	200	0		0
V	320	-	320	0		0
W	200	-	200	0		0
MR	200	-	200	0		0
OGI	235	-	235	0	0	

* NOT CONSIDERED FOR THIS STUDY, AS SYS. SERVED NOT IN OPERATION
 ** REQUIRED AFTER ONE RHR PUMP SHUT-DOWN (10MIN AFTER LOCA) & NOT CONSIDERED

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- D. EVENTHOUGH ONE OF THE TWO CRITICAL BUSES ARE REQUIRED DURING A SHUTDOWN, BOTH BUSES MAY BE OPERATING BECAUSE OF AUTOMATIC OPERATION AND CONSEQUENT HIGHER VOLTAGE DROP. HENCE, OPERATION OF BOTH CRITICAL BUSES ARE INCLUDED DURING PLANT SHUTDOWN MODE.
- E. ONLY A FEW LOADS THAT WILL PRODUCE MAXIMUM VOLTAGE DROP ARE CONSIDERED FOR MOTORS LESS THAN 100 HP MOTORS THAT ARE CONNECTED TO MCCS.
- F. LOCA LOADS ARE STARTED SEQUENTIALLY ON LOCA DETECTION SIGNALS. LOADS OF SAME CAPACITY OR LOWER ARE LEFT OUT FROM START & RUN VOLTAGE DROP CONSIDERATION BASED ON - IF WORST CASE IS ACCEPTABLE, OTHER LESS SEVERE CASES WILL ALSO BE ACCEPTABLE.
- G. EXISTING TAP SETTING FOR TRANSFORMERS IS PER TELECON - J. PHILBRICK TO P. SHENOY DATED 9.7.79 :
- MAIN TRANSFORMER : + 2.5% TAP
 NORMAL STATION TRANSF. : 0% TAP
 STARTUP TRANSFORMER : - 5% TAP
 EMERGENCY TRANSFORMER : - 5% TAP
- H. ACTUAL FLUCTUATION IN OFFSITE VOLTAGES DURING PLANT OPERATION, PER TELECON J. PHILBRICK TO P. SHENOY DATED 9.7.79 :
- | | HIGH | LOW |
|---------------|-------|-------|
| 161KV STARTUP | 161KV | 154KV |
- J. NO FLUCTUATION IN EMERGENCY OFFSITE VOLTAGE DURING PLANT OPERATION, PER TELECON J. HAGGE TO P. SHENOY DATED 12.12.79 : VOLTAGE @ FULL LOAD - 667KV

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K. NRC GUIDELINES PER ATTACHMENT TO NRC LETTER DATED AUG. 8, 1979 "RE: ADEQUACY OF STATION ELECTRIC DISTRIBUTION SYSTEM VOLTAGES". THESE GUIDELINES WERE FOLLOWED AS DETAILED BELOW:

<u>NRC GUIDE LINE NO.</u> (SEE PAGE 1, SHS 11 & 12)	<u>ADHERENCE TO GUIDELINE</u>
1.	YES, FULLY.
2.	NOT APPLICABLE TO CNS, AS IT IS A SINGLE UNIT.
3.	ANALYSIS IS BASED ON AUTO-SEQUENCING FOR LOCA LOADS AND AUTOMATIC LOAD SHEDDING DUE TO BUS UNDERVOLTAGE ONLY.
4.	NO MANUAL SHEDDING IS ASSUMED.
5.	YES, FULLY.
6.	SEPARATE ANALYSIS IS MADE FOR MINIMUM AND MAXIMUM GRID VOLTAGES. THE MINIMUM GRID VOLTAGES ARE PER THE NRC GUIDELINE, AS FURNISHED BY THE UTILITY. FURTHER EXPLANATIONS ARE NOTED IN THE REPORT.
7.	COMPUTATIONS PROVIDE THIS INFORMATION, HOWEVER VOLTAGES AT SAFETY LOADS

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NRC GUIDELINE NO.

ADHERENCE TO GUIDELINE (CONT.)

COMPUTED WERE LIMITED TO CASES YIELDING MAXIMUM VOLTAGE DROP AND THEREBY, CONCLUDING THAT ACCEPTABILITY FOR THE WORST CASES CAN BE GENERALIZED TO ALL SAFETY LOADS.

8.

DOCUMENTATION FURNISHED PER NPPD LETTER DATED JULY 18, 1977, NRC DOCKET NO. 50-298, DPR-46

9.

YES, WITH EXCEPTION MENTIONED IN ITEM 7.

10.

YES, FULLY.

11.

YES, FULLY.

12.

SEE ITEM 8.

13.

YES.

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4. ASSUMPTIONS:

- A. LOADING OF THE VARIOUS BUSES WERE SIMPLIFIED CONSERVATIVELY, BY DROPPING CERTAIN NORMAL PLANT LOADS SUCH AS LIGHTING, HVAC & OTHERS WHILE DETERMINING POSSIBLE OVERVOLTAGE AND ALL SUCH LOADS WERE ADDED-ON WHILE DETERMINING POSSIBLE UNDERVOLTAGE CONDITION.

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5. SUMMARY OF VOLTAGE DROP COMPUTATIONS

TABLE I - 69KV EMERGENCY OFFSITE POWER

PLANT OPERATING CONDITION	MOTOR STARTING CASES FOR MAX. UNDERVOLTAGE WITH ALL OTHER LOADS OPERATING	% MOTOR TERM. VOLTAGE (EM. TR. TAP: -5%)	
		RUN	START
CASE 1: EM. OFFSITE LINE VOLTAGE LOW (66.7KV) & LOCA SHUTDOWN LOADS ON AUTO SEQUENCE START	SUB-CASE 1: TWO CORE SPRAY PDS.	106.11	92.42
	2: TWO RHR PUMPS	106.11	92.42
	3: CRD PUMP 1A	102.21	92.62
	4: CRD PUMP 1B	103.12	93.41
	5: DRYWELL FAN COIL UNIT	106.1	99.31
	6: SW GLAND SEAL PPIA	106.67	103.0
CASE 2: EM. OFFSITE LINE VOLTAGE LOW (66.7KV) & COLD SHUTDOWN LOADS. MANUAL START	SUB-CASE 1: RHRB PUMP 1A	104.82	98.62
	2: RHRB PUMP 1B	104.82	98.62
	3: CRD PUMP 1A	101.58	92.05
	4: CRD PUMP 1B	102.49	92.83
	5: DRYWELL FAN COIL 1A	105.4	98.65
	6: SW GLAND SEAL PPIA	106.0	102.32
	7: RHR M.O.V. RHE16A	106.34	104.27
CASE 3: EM. OFFSITE LINE VOLTAGE HIGH (-) & LOCA SHUTDOWN LOADS	SEE NOTE 1	SEE NOTE 1	
CASE 4: EM. OFFSITE LINE VOLTAGE HIGH (-) & COLD SHUTDOWN LOADS	SEE NOTE 1	SEE NOTE 1	

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REMARKS: VOLTAGE LEVELS UNDER ALL CASES LISTED ABOVE ARE ACCEPTABLE: WITHIN ± 10% FOR MOTOR RUN & WITHIN - 20% FOR MOTOR START

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NOTE: COMPUTATIONS BASED ON HIGH VALUE IS NOT REQUIRED BECAUSE NON-FLUCTUATING VOLTAGE LEVEL AT THE EM. TRANSFORMER, PER TELECON MESSAGE TO PSHENNY, DATED 12/12/79

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SUMMARY OF VOLTAGE DROP
TABLE II - 161 KV START UP OFFSITE POWER

PLANT OPERATING CONDITION	MOTOR STARTING CASES FOR MAX. UNDERVOLTAGE WITH ALL OTHER LOADS RUNNING	% MOTOR TERM. VOLTAGE (START UP TR. TAP - 5%)	
		RUN	START
CASE 5: STARTUP OFFSITE LINE VOLTAGE HIGH (161KV) & PLANT ON HOT STANDBY MANUAL STARTING	SUBCASE 1: TWO CIRC. WTR PPS	106.52	96.96
	2: ONE COND. BOOSTER PP	106.45	93.89
	3: ONE REACT. RECIRC MG	107.08	92.21
	4: RHR M.O.V. SIGA	109.8	107.8
	5: R.B. CLO CLG WTR PPA	109.94	108.25
CASE 6: STARTUP OFFSITE LINE VOLTAGE LOW (154KV) & PLANT NORMAL OPERATION MANUAL STARTING	SUBCASE 1: TWO CIRC. WTR PPS	98.33	89.59
	2: ONE COND. BOOSTER PP	98.27	91.14
	3: ONE REACT. RECIRC MG	101.56	85.51
	4: ONE CRD PUMP	92.65	84.47
	5: DRYWELL FAN COIL UNIT	96.0	89.31
CASE 7: STARTUP OFFSITE LINE VOLTAGE LOW (154KV) & PLANT NORMAL OPERATION WITH SUDDEN LOCA SHUTDOWN LOADS ADDED	SUBCASE 1: TWO RHR PUMPS	96.52	86.79
	2: TWO CORE SPRAY PPS	96.52	88.79
	3: ONE REACT. RECIRC MG	101.23	85.27
	4: ONE CRD PUMP	92.95	82.91
	5: DRYWELL FAN COIL UNIT	94.26	87.31
CASE 8: STARTUP OFFSITE LINE VOLTAGE HIGH (161KV) & PLANT NORMAL OPERATION	SUBCASE 1: TWO CIRC. WTR PPS	103.46	94.02
	2: ONE COND. BOOSTER PP	103.36	93.89
	3: ONE REACT. RECIRC MG	106.48	89.71
	4: ONE CRD PUMP	97.52	88.82
	5: RHR M.O.V. RH SIGA	102.13	100.00
CASE 9: STARTUP OFFSITE LINE VOLTAGE HIGH (161KV) & PLANT NORMAL OPERATION WITH SUDDEN LOCA SHUTDOWN	SUBCASE 1: TWO RHR PUMPS	101.73	93.64
	2: TWO CORE SPRAY PPS	101.73	93.64
	3: ONE REACT. RECIRC MG	105.17	89.45
	4: ONE CRD PUMP	93.93	87.46
	5: RHR M.O.V. RH SIGA	100.45	93.38

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REMARKS: VOLTAGE LEVELS UNDER ALL CASES LISTED ABOVE
 ARE ACCEPTABLE - WITHIN ±10% RUNNING & ±20% STARTING

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SUMMARY OF VOLTAGE DROP COMPUTATIONS

TABLE III - 22KV NORMAL STATION POWER

PLANT OPERATING CONDITION	MOTOR STARTING CASES FOR MAX. UNDERVOLTAGE WITH ALL OTHER LOADS RUNNING	% MOTOR TERM. VOLTAGE (NORMAL STN. STARTING TR. TAP = 0%)	
		RUN	START
CASE I0: NORMAL STATION LINE VOLTAGE HIGH (22.05 KV = +5% OVER NOMINAL 21KV) & PLANT ON HOT STANDBY	SUBCASE I1: TWO CIRC. WTR. PUMPS	106.23	96.58
	2: ONE COND. BOOSTER PP	106.17	98.52
	3: ONE REACT. RECIRING	107.15	92.95
	4: RHR M.O.V. RHEISA	109.36	107.
	5: R.B. CLD CLG WTR PPIA	109.64	107.96
	6: S.W. GLAND SEAL PPIA	109.24	105.55
CASE I1: NORMAL STATION LINE VOLTAGE LOW (21.6KV - NOMINAL) & PLANT NORMAL OPERATION	SUBCASE I1: TWO CIRC. WTR. PUMPS	100.91	91.56
	2: ONE COND. BOOSTER PP	100.79	93.39
	3: ONE REACT. RECIRING	104.47	90.62
	4: ONE CRD PUMP	95.05	86.65
	5: DRYWELL PAN COIL UNIT	98.53	91.33
	6: S.W. GLAND SEAL PPIA	99.19	95.5
	7: RHR M.O.V. RHEISA	99.52	97.45

REMARKS: VOLTAGE LEVELS UNDER ALL CASES LISTED ABOVE ARE ACCEPTABLE = ±10% OF NAME PLATE RATING FOR RUNNING
 -20% OF NAME PLATE RATING FOR STARTING.

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G. CONCLUSIONS:

THE PLANT ELECTRICAL DISTRIBUTION SYSTEM VOLTAGES ARE ADEQUATE TO START AND OPERATE ALL SAFETY RELATED LOADS UNDER ANTICIPATED MINIMUM AND MAXIMUM OFFSITE POWER GRID VOLTAGES DURING VARIOUS MODES OF PLANT OPERATION. IN THE CASE OF THE 69KV EMERGENCY OFFSITE LINE, THE COMPUTATION WAS BASED ON ONLY ONE VALUE OF THE VOLTAGE. THE DISTRICT HAS DETERMINED THAT THE 69KV EMERGENCY LINE VOLTAGE REMAINS ESSENTIALLY CONSTANT.

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GUIDELINES FOR VOLTAGE DROP CALCULATIONS

DE NRC LETTER DT. AUG. 8 1979
RE: ADEQUACY OF STATION ELECTRIC
DISTRIBUTION SYSTEMS VOLTAGES

CALC# 2-15-01, PAGE 1, SH 11
CONT. ON
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1. Separate analyses should be performed assuming the power source to safety buses is (a) the unit auxiliary transformer; (b) the startup transformer; and (c) other available connections to the offsite network one by one assuming the need for electric power is initiated by (1) an anticipated transient (e.g., unit trip) or (2) an accident, whichever presents the largest load demand situation.
2. For multi-unit stations a separate analysis should be performed for each unit assuming (1) an accident in the unit being analyzed and simultaneous shutdown of all other units at that station; or (2) an anticipated transient in the unit being analyzed (e.g., unit trip) and simultaneous shutdown of all other units at that station, whichever presents the largest load demand situation.
3. All actions the electric power system is designed to automatically initiate should be assumed to occur as designed (e.g., automatic bulk or sequential loading or automatic transfers of bulk loads from one transformer to another). Included should be consideration of starting of large non-safety loads (e.g., condensate pumps).
4. Manual load shedding should not be assumed.
5. For each event analyzed, the maximum load necessitated by the event and the mode of operation of the plant at the time of the event should be assumed in addition to all loads caused by expected automatic actions and manual actions permitted by administrative procedures.
6. The voltage at the terminals of each safety load should be calculated based on the above listed considerations and assumptions and based on the assumption that the grid voltage is at the "minimum expected value". The "minimum expected value" should be selected based on the least of the following:
 - a. The minimum steady-state voltage experienced at the connection to the offsite circuit.
 - b. The minimum voltage expected at the connection to the offsite circuit due to contingency plans which may result in reduced voltage from this grid.
 - c. The minimum predicted grid voltage from grid stability analysis. (e.g., load flow studies).

In the report to NRC on this matter the licensee should state planned actions, including any proposed "Limiting Conditions for Operation" for Technical Specifications, in response to experiencing voltage at the connection to the offsite circuit which is less than the "minimum expected value." A copy of the plant procedure in this regard should be provided.

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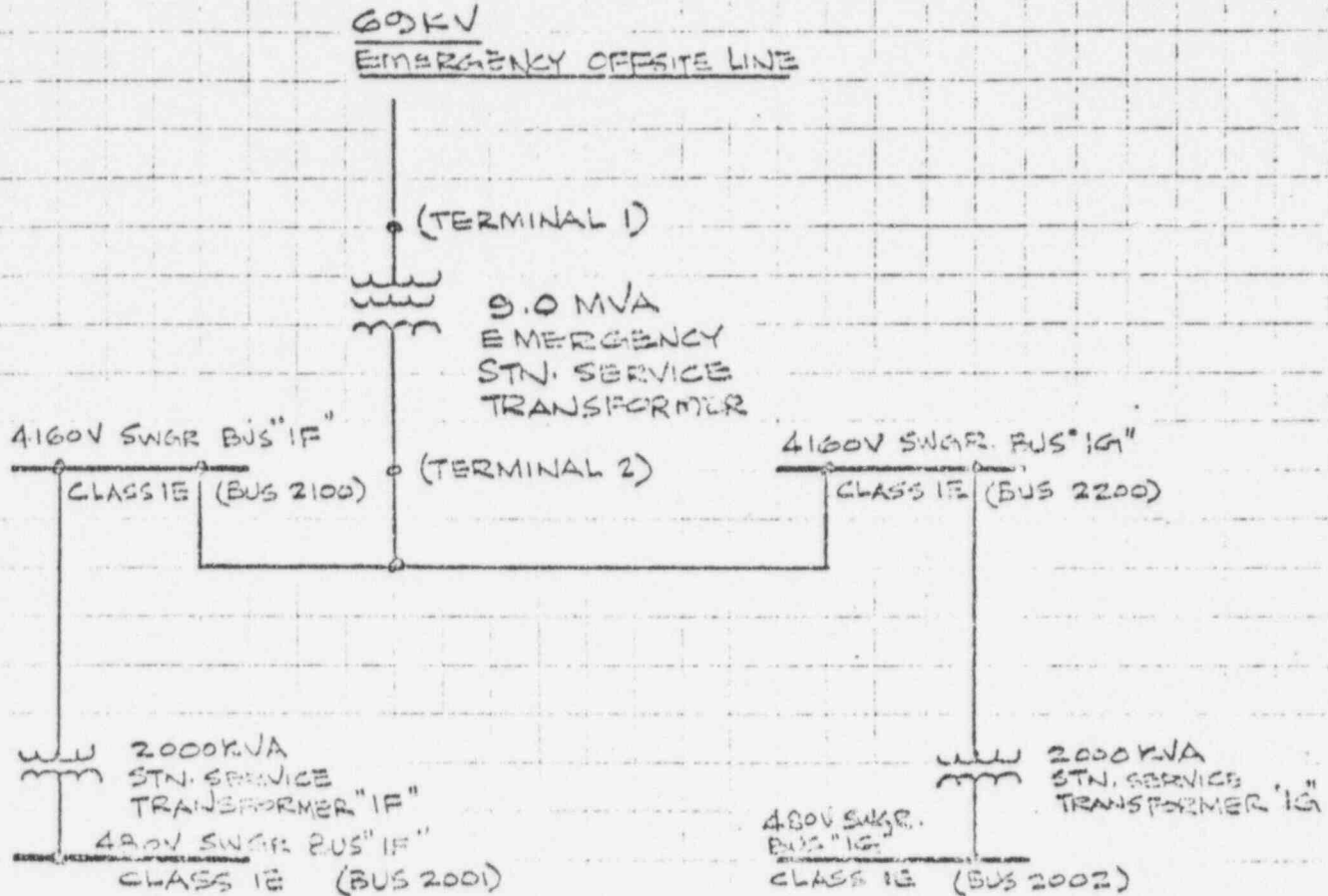
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- 7. The voltage analysis should include documentation for each condition analyzed, of the voltage at the input and output of each transformer and at each intermediate bus between the connection to the offsite circuit and the terminals of each safety load.
- 8. The analysis should document the voltage setpoint and any inherent or adjustable (with nominal setting) time delay for relays which (1) initiate or execute automatic transfer of loads from one source to another; (2) initiate or execute automatic load shedding; or (3) initiate or execute automatic load sequencing.
- 9. The calculated voltages at the terminals of each safety load should be compared with the required voltage range for normal operation and starting of that load. Any identified inadequacies of calculated voltage require immediate remedial action and notification of NRC.
- 10. For each case evaluated the calculated voltages on each safety bus should be compared with the voltage-time settings for the undervoltage relays on these safety buses. Any identified inadequacies in undervoltage relay settings require immediate remedial action and notification of NRC.
- 11. To provide assurance that actions taken to assure adequate voltage levels for safety loads do not result in excessive voltage, assuming the maximum expected value of voltage at the connection to the offsite circuit, a determination should be made of the maximum voltage expected at the terminals of each safety load and its starting circuit. If this voltage exceeds the maximum voltage rating of any item of safety equipment immediate remedial action is required and NRC shall be notified.
- 12. Voltage-time settings for undervoltage relays shall be selected so as to avoid spurious separation of safety buses from offsite power during plant startup, normal operation and shutdown due to startup and/or operation of electric loads.
- 13. Analysis documentation should include a statement of the assumptions for each case analyzed.

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VOLTAGE DROP CASE RUNS



- CASE 1 : EMERGENCY OFFSITE POWER LINE VOLTAGE LOW (69KV*)
 & LOCA SHUTDOWN LOADS
- CASE 2 : EMERGENCY OFFSITE POWER LINE VOLTAGE LOW (69KV*)
 & GOLD SHUTDOWN LOADS
- CASE 3 : EMERGENCY OFFSITE POWER LINE VOLTAGE HIGH (73.5KV)
 & LOCA SHUTDOWN LOADS
- CASE 4 : EMERGENCY OFFSITE POWER LINE VOLTAGE HIGH (73.5KV)
 & COLD SHUTDOWN LOADS.

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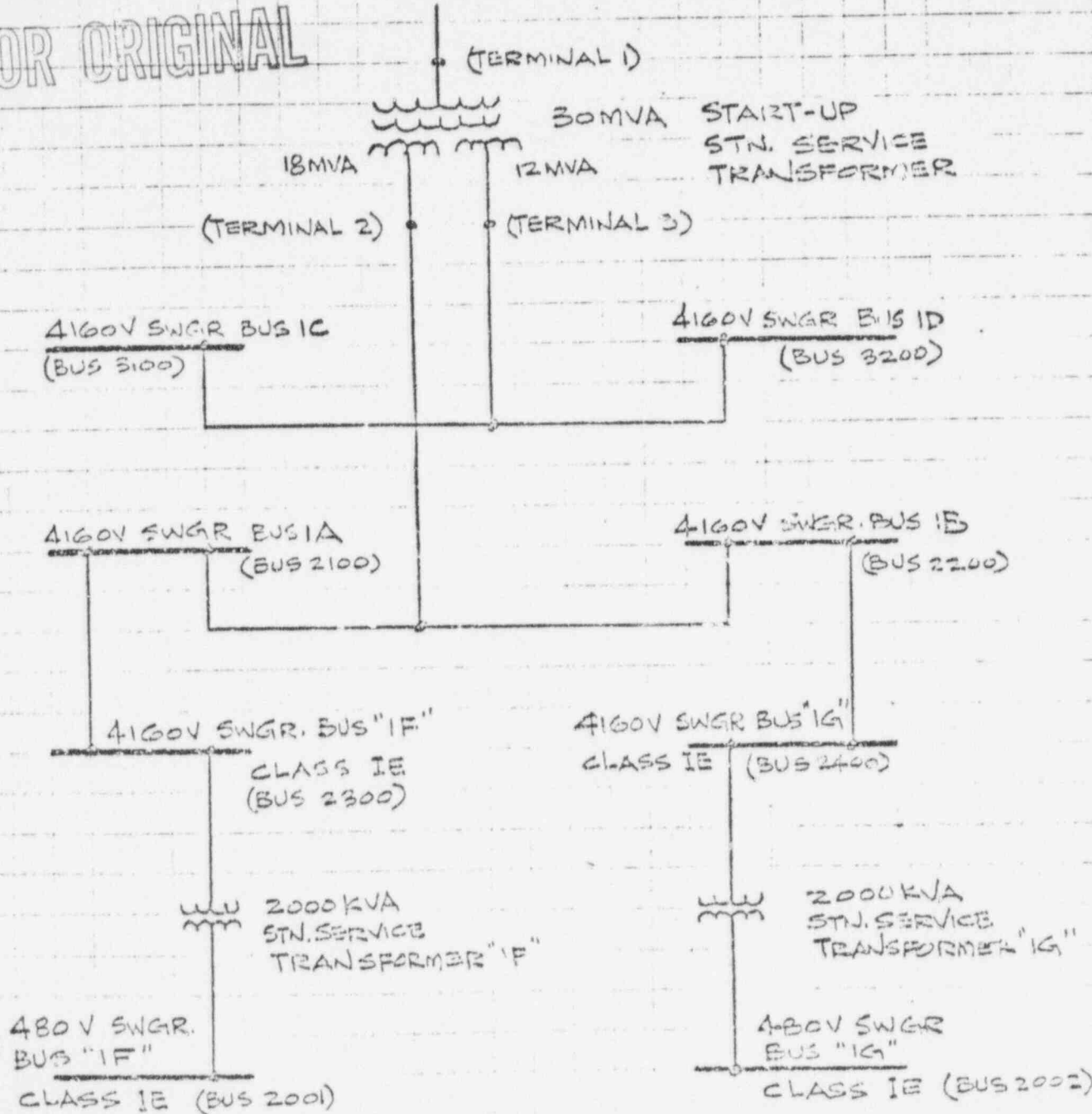
NOTE: TAG NUMBERS IN PARANTHESIS ARE FOR COMPUTER PROGRAM ELD110
 * LOWEST STEADY STATE VOLTAGE RECORDED IN NPPD LOG
 IS 70KV, BUT NOMINAL VOLTAGE IS CONSERVATIVELY TAKEN.

NOTE: TAG NUMBERS IN PARANTHESIS ARE FOR COMPUTER PROGRAM ELO110

OFFSITE POWER SOURCE

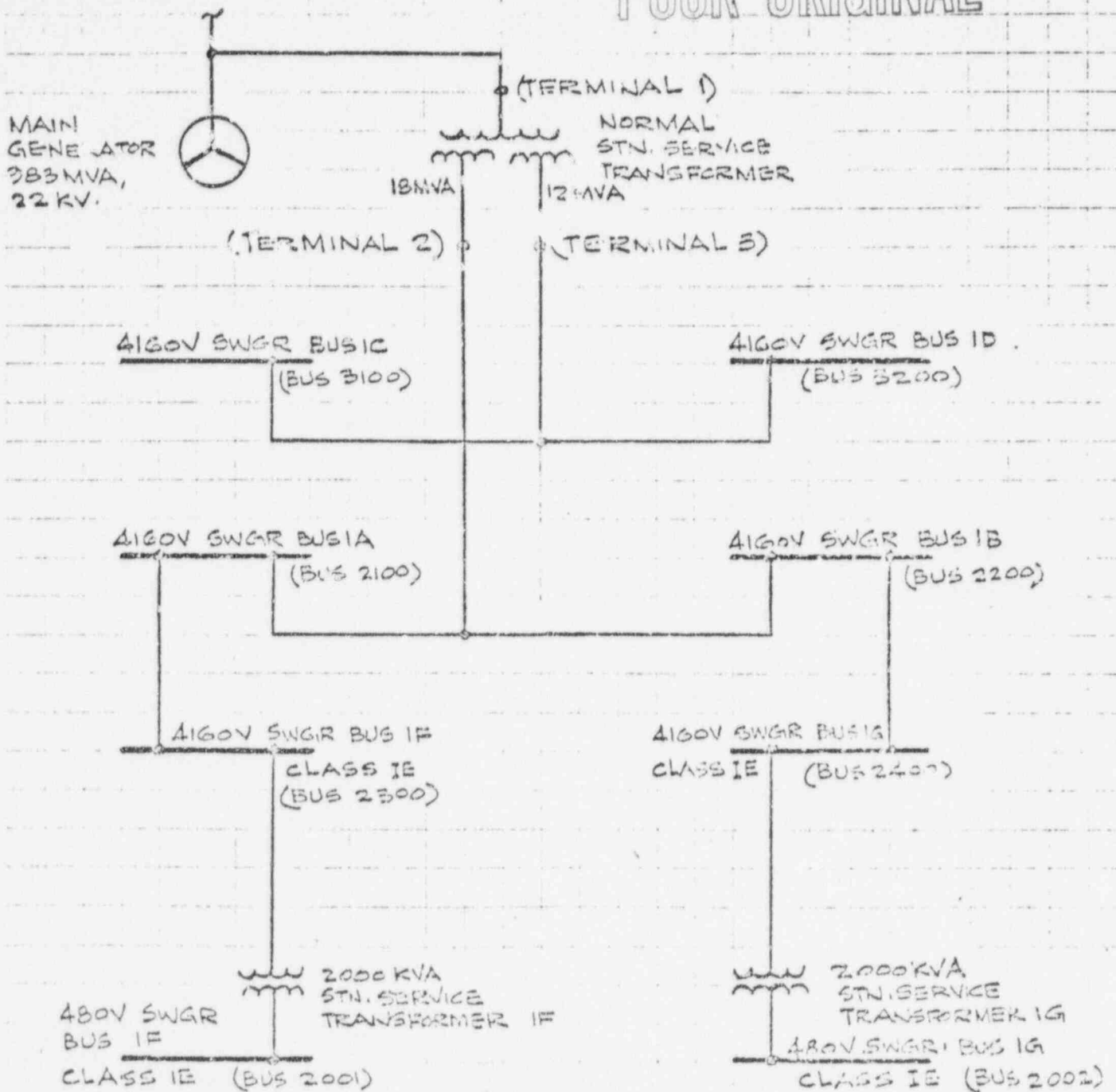
161 KV LINE

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- CASE 5: OFFSITE STARTUP POWER LINE VOLTAGE HIGH (161KV) & PLANT ON HOT STAND-BY.
- CASE 6: OFFSITE STARTUP POWER LINE VOLTAGE LOW (154KV) & PLANT NORMAL OPERATION
- CASE 7: SAME AS CASE 6, BUT WITH LOCA LOADS ADDED.
- CASE 8: OFFSITE STARTUP POWER LINE VOLT. HIGH (161KV) & PLANT NORMAL LOADS.
- CASE 9: SAME AS CASE 8, BUT WITH LOCA LOADS ADDED.

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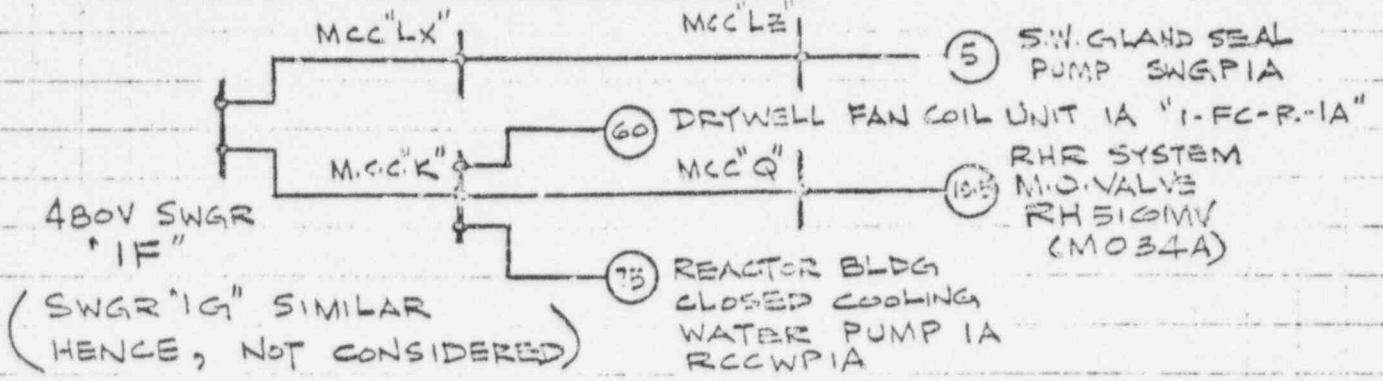


- CASE 10 : NORMAL PLANT GENERATOR OUTPUT VOLTAGE HIGH (2205KV)
 & PLANT = HOT STANDBY
 CASE 11 : NORMAL PLANT GENERATOR OUTPUT VOLTAGE LOW (210KV)
 & PLANT NORMAL OPERATION.

NOTE: TAG NUMBERS IN PARANTHESIS ARE FOR COMPUTER PROGRAM E1.0110
 Form BH 8002 2 (5/78)

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VOLTAGE DROP AT SMALLER MOTORS, LIKELY TO PRODUCE MAX. VOLTAGE DROP



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<u>CABLE</u>	<u>SIZE</u>	<u>LENGTH</u>
FEEDER TO MCC "K"	2-750MCM	70'
FEEDER TO MCC "LX"	2-500MCM	120'
FEEDER TO MCC "LE"	#4	600'
FEEDER TO MCC "Q"	#1/0	50'
MCC TO MOTOR SWGPIA (MLE1)	#12	50'
I-FC-R-IA (MKGI)	#2 & 1/0	200'
RHEIGMV (MQ191)	#8	50'
RCCWPIA (MK1)	1/0	60'

1. CABLE ARE INSTALLED IN STEEL CONDUIT
2. CABLE FOR MOTORS INSIDE DRYWELL ARE ASSUMED TO BE SAME INSIDE & OUTSIDE AIR VOLTS DROP

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 Drawing No. _____ Calc. No. 2.15.01 Sheet _____ Cont. on Sheet _____
 By PS Checked JME Approved _____
 Title NPPD/CNS - VOLTAGE DROP STUDY - COMPUTATIONS

MOTOR	CABLE	MOTOR F.L. AMP	AMP.FT	VOLTS DROP @ 80% P.F.	STARTING VOLT DROP ASSUME 6X
SWGPIA	FDR TO MCC LX" 2-500MCM, 120'	7.5	900	0.04	
	FDR TO MCC LE" #4, 600'		4500	2.17	
	FDR TO MOTOR #12, 50'		375	1.04	
	TOTAL			3.25	19.5
I-FC-R-1A	FDR TO MCC "K" 2-750MCM, 70'	75	5250	.26	
	FDR TO MOTOR #2, 235'		17625	5.68	
	TOTAL			5.94	35.64
RH 516A	FDR TO MCC K 2-750MCM, 70'	26	1820	.09	
	FDR TO MCC Q 1/0, 50'		1300	.26	
	FDR TO MOTOR #8, 50'		1300	1.47	
	TOTAL			1.82	10.92
RCCWPIA	FDR TO MCC K 2-750MCM, 70'	93	6310	.35	
	FDR TO MOTOR #1/0, 60'		5580	1.13	
	TOTAL			1.48	8.88

POOR ORIGINAL

1. THE SWGR BUS VOLTAGES FOR 480VOLT UNIT SUBSTATION "IF" (IC) ARE PROVIDED BY COMPUTER PROGRAM PER EACH CASE - STEADY STATE VOLTAGES.

2. FORMULA FOR % VOLTS DROP AT MOTOR TERM =

$$10^{-2} \times (\text{STEADY STATE SWGR BUS VOLTS} - \text{VOLTS DROP}) \div \text{MOTOR RATED VOLTS (440)}$$

POOR ORIGINAL

CASE 1 VOLTAGE DROP WITH INTERMEDIATE LOADS
APPROX 65.7KV SOURCE VOLTAGE (LOAD) = 63.65KV

LOCAL SUBSTATION LOADS

PROGRAM OBJECTIVE - ~~SYSTEM~~ VOLTAGE DROP STUDIES

INPUT DATA

BASE MVA USED FOR CALCULATIONS = 1000.00

RATED KV ON TERMINAL 1 = 63.65

RATED KV ON TERMINAL 2 = 4.16

MAIN GENERATOR

MVA = 0.0 KV = 0.0

SUBTRANSIENT REACTANCE = 0.0 PU X/R RATIO = 0.0

TRANSIENT REACTANCE = 0.0 PU RESISTANCE = 0.0 PU

STEP-UP TRANSFORMER

MVA = 0.0 X/R RATIO = 30.00

REACTANCE = 0.0 % ON 0.0 MVA BASE

UTILITY SYSTEM

MVA = 193.00 BASE MVA OF IMPEDANCE = 0.0

IMPEDANCE = .0 PU AT 0.0 DEG.

90000502

LOAD BY ELEMENT DATA

THE VALUES LISTED BELOW ARE ACTUAL LOADS AND ARE SUBJECT TO ASSUMPTIONS
 WHICH IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY
 MOTOR IDENTIFICATION = MOTOR (ID), STATIC LOAD (L) AND MOTOR (ID)

POOR ORIGINAL

LINE	BUS	BUS KV	EQUIP	NAMEPLATE HP/KVA	BRAKE HP	RATED KV	X SU	RES	EFF	R PF	S PF	LH/FLC	CAHLE LOSS	
													RES	REACT
2	1.0	4.16	1 SSW-1A	300.0	0.0	4.00			.900	.850	.200	6.00	0.1421	0.0436
2	1.0	4.16	1 SSW-1C	300.0	0.0	4.00			.900	.850	.200	6.00	0.1421	0.0436
2	1.0	4.16	1 RHR-1A*2	1250.0	1090.0	4.00			.900	.850	.200	6.50	0.0105	0.0079
2	1.0	4.16	1 CSP-1A*1	1250.0	1090.0	4.00			.900	.850	.200	6.50	0.0105	0.0079
2	2.0	4.16	1 SSW-1H	300.0	0.0	4.00			.900	.850	.200	6.00	0.1421	0.0436
2	2.0	4.16	1 SSW-1D	300.0	0.0	4.00			.900	.850	.200	6.00	0.1421	0.0436
2	2.0	4.16	1 RHR-1H*2	1250.0	1090.0	4.00			.900	.850	.200	6.50	0.0105	0.0079
2	2.0	4.16	1 CSP-1H*1	1250.0	1090.0	4.00			.900	.850	.200	6.50	0.0105	0.0079
2	0.1	0.48	1 CRDPIA*3	250.0	0.0	0.46			.900	.850	.200	5.60	0.0068	0.0085
2	0.1	0.48	1 SACPIA	125.0	0.0	0.46			.900	.850	.200	6.50	0.0112	0.0077
2	0.1	0.48	4 MCC-K	600.0		0.48				.850			0.0010	0.0015
2	0.1	0.48	4 MCC-L	475.0		0.48				.850			0.0025	0.0026
2	0.2	0.48	1 CRDPIB*4	250.0	0.0	0.46			.900	.850	.200	5.60	0.0068	0.0085
2	0.2	0.48	1 SACPIB	125.0	0.0	0.46			.900	.850	.200	6.50	0.0112	0.0077
2	0.2	0.48	4 MCC-T	100.0		0.48				.850			0.0016	0.0016
2	0.2	0.48	4 MCC-S	480.0		0.48				.650			0.0021	0.0027

90000503

POOR ORIGINAL

LINE 401 REACTOR DATA

TERM	BUS	REACTANCE (OHMS)	RESISTANCE (OHMS)
2	1 0	0.0	0.0
2	2 0	0.0	0.0

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REV. 1

LINE STATION SERVICE TRANSFORMER AND CABLE DATA

TERM	BUS	MVA	REACTANCE	X/R	TOLERANCE	CABLE VALUES (OHMS)		KV
						REACTANCE	RESISTANCE	
2	0 1	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16
2	0 2	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16

UNIT AUXILIARY TRANSFORMER TOLERANCE USED

2-WINDING	3-WINDING
7.50 %	10.00 %

UNIT AUXILIARY TRANSFORMER DATA

Wdg	TERM	MVA	% REACTANCE				BREAKER CAPABILITIES (KA)				MOM. MULT		
			XHL	XHM	XLM	X/R	INT.	LV	MV	LV	MV	LV	MV
2	2 0	9.0	7.00	0.0	0.0	25.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0

BREAKER TIME DATA

TERM	BUS	BUS KV	TRIPPING TIME (CYCLES)	CONTACT PARTING TIME (CYCLES)
2	1 0	4.16	5.0	3.0
2	2 0	4.16	5.0	3.0
2	0 1	0.48	2.0	2.0
2	0 2	0.48	2.0	2.0

90000504

TEST DATA VOLTAGE DROP RESULTS
VOLTAGE AT HV TERMINAL OF AIR INSULATOR FOR 470 = 1.000(100)

LINE	BUS	DATE	BUS KV	ACTUAL BUS VOLTAGE
2	1 0	4.16		4.2031 (KV)
2	2 0	4.16		4.2031 (KV)
2	0 1	0.48		0.4726 (KV)
2	0 2	0.48		0.4768 (KV)

POOR ORIGINAL

90000305

VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF BJK TRANSFORMER FOR V/D = 1.048 (P/D)

VOLTAGE AT BUS

FEED	BUS	KV	V/D CASE	BUS VOLTAGE		VOLTAGE AT MOTOR TERMINAL		PERCENTAGE	
				RUNNING LOAD	STARTING LOAD	RUNNING LOAD	STARTING LOAD	RUN	START
2	1 0	4.16	1	4.2479 (KV)	3.7147 (KV)	4.2445 (KV)	3.6967 (KV)	106.11	92.42
2	2 0	4.16	1	4.2479 (KV)	3.7147 (KV)	4.2445 (KV)	3.6967 (KV)	106.11	92.42
2	0 1	0.48	1	0.4777 (KV)	0.4177 (KV)				
2	0 2	0.48	1	0.4819 (KV)	0.4214 (KV)				
2	1 0	4.16	2	4.2479 (KV)	3.7147 (KV)	4.2445 (KV)	3.6967 (KV)	106.11	92.42
2	2 0	4.16	2	4.2479 (KV)	3.7147 (KV)	4.2445 (KV)	3.6967 (KV)	106.11	92.42
2	0 1	0.48	2	0.4777 (KV)	0.4177 (KV)				
2	0 2	0.48	2	0.4819 (KV)	0.4214 (KV)				
2	1 0	4.16	3	4.2084 (KV)	4.1625 (KV)				
2	2 0	4.16	3	4.2084 (KV)	4.1625 (KV)				
2	0 1	0.48	3	0.4753 (KV)	0.4530 (KV)	0.4702 (KV)	0.4261 (KV)	102.21	92.62
2	0 2	0.48	3	0.4774 (KV)	0.4722 (KV)				
2	1 0	4.16	4	4.2084 (KV)	4.1518 (KV)				
2	2 0	4.16	4	4.2084 (KV)	4.1518 (KV)				
2	0 1	0.48	4	0.4732 (KV)	0.4680 (KV)				
2	0 2	0.48	4	0.4795 (KV)	0.4569 (KV)	0.4743 (KV)	0.4297 (KV)	103.12	93.41

POOR ORIGINAL

90000506

CASE 2 VOLTAGE DROP WITH ON 14. ST. ON 4.10. UNDER COOL SUBTRANSIENT LOADS
IMPROVING 56.74V - SOURCE VOLTAGE (3.0) 4.10. 14.0 53.650V

PAGE 10 OF 23
REV. 1

PROJECT OBJECTIVE - ~~56.74V~~ VOLTAGE DROP STUDIES

INPUT DATA

BASE MVA USED FOR CALCULATIONS = 1000.00

RATED KV ON TERMINAL 1 = 63.65

RATED KV ON TERMINAL 2 = 4.16

M-14 GENERATOR

MVA = 0.0 KV = 0.0

SUBTRANSIENT REACTANCE = 0.0 PU X/R RATIO = 0.0

TRANSIENT REACTANCE = 0.0 PU RESISTANCE = 0.0 PU

STEP-UP TRANSFORMER

MVA = 0.0 X/R RATIO = 30.00

REACTANCE = 0.0 % ON 0.0 MVA BASE

UTILITY SYSTEM

MVA = 193.00 BASE MVA OF IMPEDANCE = 0.0

IMPEDANCE = .0 PU AT 0.0 DEG.

POOR ORIGINAL

90000307

10.00 BUS ELEMENT DATA

THE VALUES LISTED BELOW ARE ACTUAL (LPH) AND NECESSARY ASSUMPTIONS
 IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY
 (1) = MOTOR (2) = STATIC LOAD (3) = GENERATOR

RE

POOR ORIGINAL

ID	BUS	KV	IDENT	NAMEPLATE HP/KVA	BRAKE HP	RATED KV	X S3	RES	EFF	R PF	S PF	LR/FLO	CABLE (1)	
													RES	RE
2	1 0	4.16	1 SS4P1A	300.0	0.0	4.00			.900	.850	.200	6.00	0.1421	0.0436
2	1 0	4.16	1 RHRB1A*1	1000.0	0.0	4.00			.900	.850	.200	6.50	0.0212	0.0109
2	1 0	4.16	1 RHRB1C	1000.0	0.0	4.00			.900	.850	.200	6.50	0.0212	0.0109
2	1 0	4.16	1 RHR-1A	1250.0	1090.0	4.00			.900	.850	.200	6.50	0.0105	0.0079
2	2 0	4.16	1 SS4P1B	300.0	0.0	4.00			.900	.850	.200	6.00	0.1421	0.0436
2	2 0	4.16	1 RHRB1B*2	1000.0	0.0	4.00			.900	.850	.200	6.50	0.0212	0.0109
2	2 0	4.16	1 RHRB1D	1000.0	0.0	4.00			.900	.850	.200	6.50	0.0212	0.0109
2	2 0	4.16	1 RHR-1B	1250.0	1090.0	4.00			.900	.850	.200	6.50	0.0105	0.0079
2	0 1	0.48	1 CRDPIA*3	250.0	0.0	0.46			.900	.850	.200	5.60	0.0064	0.0045
2	0 1	0.48	1 SACPIA	125.0	0.0	0.46			.900	.850	.200	6.50	0.0112	0.0077
2	0 1	0.48	4 MCC-K	600.0		0.48				.850			0.0010	0.0015
2	0 1	0.48	4 MCC-L	475.0		0.48				.850			0.0025	0.0026
2	0 2	0.48	1 CRDPIB*4	250.0	0.0	0.46			.900	.850	.200	5.60	0.0064	0.0045
2	0 2	0.48	1 SACPIB	125.0	0.0	0.46			.900	.850	.200	6.50	0.0112	0.0077
2	0 2	0.48	4 MCC-T	100.0		0.48				.850			0.0016	0.0016
2	0 2	0.48	4 MCC-S	480.0		0.48				.850			0.0021	0.0027

90000508

INPUT BUS REACTOR DATA

TERM	BUS	REACTANCE (OHMS)	RESISTANCE (OHMS)
2	1 0	0.0	0.0
2	2 0	0.0	0.0

PAGE 12 OF 93
REV. 1

POOR ORIGINAL

INPUT STATION SERVICE TRANSFORMER AND CABLE DATA

TERM	BUS	MVA	REACTANCE	X/R	TOLERANCE	CABLE VALUES (OHMS)		KV
						REACTANCE	RESISTANCE	
2	0 1	2.00	5.75 %	6.00	7.50 %	0.00	0.00	4.16
2	0 2	2.00	5.75 %	6.00	7.50 %	0.00	0.00	4.16

INPUT AUXILIARY TRANSFORMER TOLERANCE USED

2-WINDING	3-WINDING
7.50 %	10.00 %

INPUT UNIT AUXILIARY TRANSFORMER DATA

Wdg	TERM	MVA	% REACTANCE				BREAKER CAPABILITIES (KA)				MOM MULT		
			XHL	XHS	XLM	X/R	INT.	MOV	LV	MV	LV	MV	
2	2 0	9.0	7.00	0.0	0.0	25.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0

BREAKER TIME DATA

TERM	BUS	BUS KV	TRIPPING TIME (CYCLES)	CONTACT PARTING TIME (CYCLES)
2	1 0	4.16	5.0	3.0
2	2 0	4.16	5.0	3.0
2	0 1	0.48	2.0	2.0
2	0 2	0.48	2.0	2.0

90000509

NEW YORK STATE VOLTAGE DROP RESULTS

PAGE 13 OF 23
REV. 1

VOLTAGE AT HV TERMINAL OF AJX (RAISE FOR V/D) = 1.000000

VOLTAGE AT BUS

FEED	BUS	RATED BUS KV	ACTUAL BUS VOLTAGE
2	1 0	4.16	4.1771 (KV)
2	2 0	4.16	4.1771 (KV)
2	0 1	0.48	0.4697 (KV)
2	0 2	0.48	0.4739 (KV)

POOR ORIGINAL

90000310

VOLTAJE AT HV TERMINAL OF AXK 100013F F34 V/F3 = 1.000000

VOLTAJE AT 400V

ITER	POS	KV	V/D	CASE	HVS VOLTAJE STARTING LOAD	HVS VOLTAJE STARTING LOAD	VOLTAJE AT 400V TERMINAL STARTING LOAD	VOLTAJE AT 400V START
2	1 0	4.16	1	1	4.1984 (KV)	3.9602 (KV)	4.1928 (KV)	104.82 98.02
2	2 0	4.16	1	1	4.1984 (KV)	3.9602 (KV)		
2	0 1	0.48	1	1	0.4721 (KV)	0.4462 (KV)		
2	0 2	0.48	1	1	0.4763 (KV)	0.4502 (KV)		
2	1 0	4.16	2	2	4.1984 (KV)	3.9682 (KV)		
2	2 0	4.16	2	2	4.1984 (KV)	3.9682 (KV)	4.1928 (KV)	104.82 98.02
2	0 1	0.48	2	2	0.4721 (KV)	0.4462 (KV)		
2	0 2	0.48	2	2	0.4763 (KV)	0.4502 (KV)		
2	1 0	4.16	3	3	4.1826 (KV)	4.1367 (KV)		
2	2 0	4.16	3	3	4.1826 (KV)	4.1367 (KV)		
2	0 1	0.48	3	3	0.4724 (KV)	0.4502 (KV)	0.4673 (KV)	101.58 92.05
2	0 2	0.48	3	3	0.4745 (KV)	0.4693 (KV)		
2	1 0	4.16	4	4	4.1826 (KV)	4.1300 (KV)		
2	2 0	4.16	4	4	4.1826 (KV)	4.1360 (KV)		
2	0 1	0.48	4	4	0.4703 (KV)	0.4651 (KV)		
2	0 2	0.48	4	4	0.4766 (KV)	0.4540 (KV)	0.4714 (KV)	102.49 92.83

POOR ORIGINAL

90000311

0001-1176-12 12,891

PAGES 15 THRU 44
REV. 1

THESE PAGES ARE DELETED.

POOR ORIGINAL

90000512

0001-1176-12 12,891

0001-1176-12 12,891

0001-1176-12 12,891

0001-1176-12 12,891

POOR ORIGINAL

CASE 5 VOLTAGE DROP WHILE ON STARTUP ST.SER.TR.-----PLANT-ON-HOT-STANDBY
NPPD/CNS 161KV SOURCE VOLTS(HIGH) -5.9% TAP 152.95KV

PROGRAM OBJECTIVE - SHORT CIRCUIT AND VOLTAGE DROP STUDIES

INPUT DATA

BASE MVA USED FOR CALCULATIONS = 1000.00

RATED KV ON TERMINAL 1 = 152.90

RATED KV ON TERMINAL 2 = 4.16

RATED KV ON TERMINAL 3 = 4.16

MAIN GENERATOR

MVA = 0.0 KV = 0.0

SUBTRANSIENT REACTANCE = 0.0 PU X/R RATIO = 0.0

TRANSIENT REACTANCE = 0.0 PU RESISTANCE = 0.0 PU

STEP-UP TRANSFORMER

MVA = 0.0 X/R RATIO = 30.00

REACTANCE = 0.0 % ON 0.0 MVA BASE

UTILITY SYSTEM

MVA = 10000.00 BASE MVA OF IMPEDANCE = 0.0

IMPEDANCE = .0 PU AT 0.0 DEG.

90000313

INPUT BUS ELEMENT DATA

THE VALUES LISTED BELOW ARE ACTUAL INPUT AND NECESSARY ASSUMPTIONS

* IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY

PROGRAM IDENTIFICATION - MOTOR(1), STATIC LOAD (4), GENERATOR(6)

TERM	RUS	RUS KV	IDENT	NAMEPLATE HP/KVA	BRAKE HP	RATED KV	X SUB	RES	EFF	R PF	S PF	I R/FLC	RES	REACT	CABLE (OHMS)
2	1	4.16	1	CWP-1A*1	1750.0	0.0	4.00		.900	.850	.200	5.00	0.0300	0.0334	
2	1	4.16	1	CBP-1A*2	2500.0	0.0	4.00		.900	.850	.200	5.50	0.0108	0.0149	
2	1	4.16	1	CORPIA	800.0	0.0	4.00		.900	.850	.200	5.50	0.0609	0.0187	
2	1	4.16	4	SUBS1A	1200.0		4.16		.850				0.0046	0.0051	
2	1	4.16	4	SUBS1C	300.0		4.16		.850				0.1218	0.0374	
2	1	4.16	4	BUS-1E	400.0		4.16		.850				0.0023	0.0026	
2	2	4.16	1	CWP-1C*1	1750.0	0.0	4.00		.900	.850	.200	5.00	0.0300	0.0334	
2	2	4.16	4	SUBS1B	1000.0		4.16		.850				0.0045	0.0051	
2	2	4.16	4	SUBS1D	300.0		4.16		.850				0.1218	0.0374	
2	3	4.16	1	FAKE	1.0	0.0	4.00		.900	.850	.200	6.50	0.0	0.0	
2	4	4.15	1	FAKE	1.0	0.0	4.00		.900	.850	.200	6.50	0.0	0.0	
3	1	4.16	1	RRMGST*3	7000.0	0.0	4.00		.900	.850	.200	5.50	0.0018	0.0025	
3	2	4.16	1	RRMGST*3	7000.0	0.0	4.00		.900	.850	.200	5.50	0.0018	0.0025	
2	0	0.48	4	SUBS1F	480.0		0.48		.850				0.0	0.0	
2	0	0.48	4	SUBS1G	150.0		0.48		.850				0.0	0.0	
3	0	0.48	4	FAKE	1.0		0.48		.850				0.0	0.0	

INPUT BUS REACTOR DATA

TERM	BUS	REACTANCE (OHMS)	RESISTANCE (OHMS)
2	1 0	0.0	0.0
2	2 0	0.0	0.0
2	3 0	0.005	0.004
2	4 0	0.005	0.004
3	1 0	0.0	0.0
3	2 0	0.0	0.0

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INPUT STATION SERVICE TRANSFORMER AND CABLE DATA

TERM	BUS	MVA	REACTANCE	X/R	TOLERANCE	CABLE VALUES (OHMS)		KV
						REACTANCE	RESISTANCE	
2	0 1	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16
2	0 2	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16
3	0 1	0.01	0.0 %	6.60	7.50 %	0.0	0.0	0.0

UNIT AUXILIARY TRANSFORMER TOLERANCE USED

2-WINDING	3-WINDING
7.50 %	10.00 %

INPUT UNIT AUXILIARY TRANSFORMER DATA

WDG	TERM	MVA	% REACTANCE		XLK	X/R	BREAKER CAPABILITIES (KA)				MOM MULT	
			XHL	XHM			INT.	MV	LV	MV	LV	MV
3	2 3	30.0	12.30	12.30	0.0	25.00	0.0	0.0	0.0	0.0	0.0	0.0

BREAKER TIME DATA

TERM	BUS	BUS KV	TRIPPING TIME (CYCLES)	CONTACT PARTING TIME (CYCLES)
2	1 0	4.16	5.0	3.0
2	2 0	4.16	5.0	3.0
2	3 0	4.16	5.0	3.0
2	4 0	4.16	5.0	3.0
2	0 1	0.48	2.0	2.0
2	0 2	0.48	2.0	2.0
3	1 0	4.16	5.0	3.0
3	2 0	4.16	5.0	3.0
3	0 1	0.48	2.0	2.0

90000515

STEADY STATE VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D = 1.053(PU)

VOLTAGE AT BUS

TERM	BUS	RATED BUS KV	ACTUAL BUS VOLTAGE
2	1 0	4.16	4.2418 (KV)
2	2 0	4.16	4.2418 (KV)
2	3 0	4.16	4.2418 (KV)
2	4 0	4.16	4.2418 (KV)
2	0 1	0.48	0.4852 (KV)
2	0 2	0.48	0.4881 (KV)
3	1 0	4.16	4.2133 (KV)
3	2 0	4.16	4.2133 (KV)
3	0 1	0.48	0.4862 (KV)

VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D =1.053(PU)

VOLTAGE AT BUS

TERM	BUS	KV	V/D CASE	BUS VOLTAGE		VOLTAGE AT MOTOR TERMINAL		PERCENTAGE	
				RUNNING LOAD	STARTING LOAD	RUNNING LOAD	STARTING LOAD	RUN	START
2	1 0	4.16	1	4.2788 (KV)	3.9586 (KV)	4.2507 (KV)	3.8783 (KV)	106.52	96.96
2	2 0	4.16	1	4.2788 (KV)	3.9586 (KV)	4.2507 (KV)	3.8783 (KV)	106.52	96.96
2	3 0	4.16	1	4.2788 (KV)	3.9586 (KV)				
2	4 0	4.16	1	4.2788 (KV)	3.9586 (KV)				
2	0 1	0.48	1	0.4895 (KV)	0.4528 (KV)				
2	0 2	0.48	1	0.4924 (KV)	0.4555 (KV)				
3	1 0	4.16	1	4.2209 (KV)	4.1552 (KV)				
3	2 0	4.16	1	4.2209 (KV)	4.1552 (KV)				
3	0 1	0.48	1	0.4870 (KV)	0.4794 (KV)				
2	1 0	4.16	2	4.2684 (KV)	4.0110 (KV)	4.2582 (KV)	3.9554 (KV)	106.45	98.89
2	2 0	4.16	2	4.2684 (KV)	4.0110 (KV)				
2	3 0	4.16	2	4.2684 (KV)	4.0110 (KV)				
2	4 0	4.16	2	4.2684 (KV)	4.0110 (KV)				
2	0 1	0.48	2	0.4883 (KV)	0.4588 (KV)				
2	0 2	0.48	2	0.4912 (KV)	0.4616 (KV)				
3	1 0	4.16	2	4.2187 (KV)	4.1661 (KV)				
3	2 0	4.16	2	4.2187 (KV)	4.1661 (KV)				
3	0 1	0.48	2	0.4868 (KV)	0.4807 (KV)				
2	1 0	4.16	3	4.2714 (KV)	4.0339 (KV)				
2	2 0	4.16	3	4.2714 (KV)	4.0339 (KV)				

90000317

VOLTAGE DROOP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/C = 1.053(PU)

VOLTAGE AT BUS

TFRM	BUS	KV	V/D CASE	RUNNING LOAD	BUS VOLTAGE STARTING LOAD	RUNNING LOAD	VOLTAGE AT MOTOR TERMINAL RUNNING LOAD	VOLTAGE AT MOTOR TERMINAL STARTING LOAD	PERCENTAGE RUN	PERCENTAGE START
2	3 0	4.16	3	4.2714 (KV)	4.0339 (KV)	4.0339 (KV)				
2	4 0	4.16	3	4.2714 (KV)	4.0339 (KV)	4.0339 (KV)				
2	0 1	0.48	3	0.4886 (KV)	0.4615 (KV)	0.4615 (KV)				
2	0 2	0.48	3	0.4915 (KV)	0.4642 (KV)	0.4642 (KV)				
3	1 0	4.16	3	4.3589 (KV)	3.2154 (KV)	3.2154 (KV)	4.3540 (KV)	3.1943 (KV)	108.85	79.86
3	2 0	4.16	3	4.3589 (KV)	3.2154 (KV)	3.2154 (KV)	4.3540 (KV)	3.1943 (KV)	108.85	79.86
3	0 1	0.48	3	0.5029 (KV)	0.3710 (KV)	0.3710 (KV)				

CASE 6 VOLTAGE DROP WHILE ON STARTUP ST.SER.TR.---PLANT NORMAL OPERATION
 NPPD/CNS 154KV SOURCE VOLTS(LOW) -5.0% TAP 152.95KV

PROGRAM OBJECTIVE - VOLTAGE DROP STUDY ONLY

INPUT DATA

BASE MVA USED FOR CALCULATIONS = 1000.00

RATED KV ON TERMINAL 1 = 152.90

RATED KV ON TERMINAL 2 = 4.16

RATED KV ON TERMINAL 3 = 4.16

MAIN GENERATOR

MVA = 0.0 KV = 0.0

SUBTRANSIENT REACTANCE = 0.0 PU X/R RATIO = 0.0

TRANSIENT REACTANCE = 0.0 PU RESISTANCE = 0.0 PU

STEP-UP TRANSFORMER

MVA = 0.0 X/R RATIO = 30.00

REACTANCE = 0.0 % ON 0.0 MVA BASE

UTILITY SYSTEM

MVA = 10000.00 BASE MVA OF IMPEDANCE = 0.0

IMPEDANCE = .0 PU AT 0.0 DEG.

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INPUT BUS ELEMENT DATA

THE VALUES LISTED BELOW ARE ACTUAL INPUT AND NECESSARY ASSUMPTIONS
 IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY
 PROGRAM IDENTIFICATION - MOTOR(1), STATIC LOAD (4), GENERATOR(6)

TERM	BUS	BUS KV	IDENT	NAMEPLATE HP/KVA	BRAKE HP	RATED KV	X SUB	RES	EFF	R PF	S PF	I R/F/LC	CABLE (OHMS) RES	REACT
2	1 0	4.16	1 CWF-1A*1	1750.0	0.0	4.00			.900	.850	.200	5.00	0.0300	0.0334
2	1 0	4.16	1 CWP-1R	1750.0	0.0	4.00			.900	.850	.200	5.00	0.0300	0.0334
2	1 0	4.16	1 CWP-1A*2	2500.0	0.0	4.00			.900	.850	.200	5.50	0.0108	0.0149
2	1 0	4.16	1 COMPLA	800.0	0.0	4.00			.900	.850	.200	5.50	0.0600	0.0187
2	1 0	4.16	4 SUBS1A	1200.0		4.16				.850			0.0046	
2	1 0	4.16	4 SUBS1C	300.0		4.16				.850			0.1218	
2	1 0	4.16	4 SUBS-1E	400.0		4.16				.850			0.0023	
2	2 0	4.16	1 CWP-1C*1	1750.0	0.0	4.00			.900	.850	.200	5.00	0.0300	0.0334
2	2 0	4.16	1 CWP-1D	1750.0	0.0	4.00			.900	.850	.200	5.00	0.0300	0.0334
2	2 0	4.16	1 CWP-1R	2500.0	0.0	4.00			.900	.850	.200	5.50	0.0108	0.0149
2	2 0	4.16	1 COMFLS	800.0	0.0	4.00			.900	.850	.200	5.50	0.0609	0.0187
2	2 0	4.16	4 SUBS1R	1000.0		4.16				.850			0.0016	0.0051
2	2 0	4.16	4 SUBS1D	300.0		4.16				.850			0.219	0.0374
2	3 0	4.16	1 FAKE	1.0	0.0	4.00			.900	.850	.200	6.50	0.0	0.0
2	4 0	4.16	1 FAKE	1.0	0.0	4.00			.900	.850	.200	6.50	0.0	0.0
3	1 0	4.16	1 RRMGST	7000.0	0.0	4.00			.900	.850	.200	5.50	0.0018	0.0025
3	2 0	4.16	1 RRMGST-3	7000.0	0.0	4.00			.900	.850	.200	5.50	0.0018	0.0025
2	0 1	0.48	1 CROPIA*4	250.0	0.0	0.46			.900	.850	.200	5.60	0.0068	0.0085
2	0 1	0.48	1 SACPIA	125.0	0.0	0.46			.900	.850	.200	6.50	0.0112	0.0077
2	0 1	0.48	4 MCC-K	600.0		0.48				.850			0.0010	0.0015

POOR ORIGINAL

INPUT BUS ELEMENT DATA
 THE VALUES LISTED BELOW ARE ACTUAL INPUT AND NECESSARY ASSUMPTIONS
 * IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY
 PROGRAM IDENTIFICATION - MOTOR(1), STATIC LOAD (4), GENERATOR(6)

TERM	BUS	BUS KV	IDENT	NAMEPLATE HP/KVA	BRAKE HP	RATED KV	X SUB	RES	EFF	R PF	S PF	LR/FLC	CABLE(OHMS)	
													RES	REACT
2	0 1	0.48	4 MCC-L	475.0						.850			0.0025	0.0026
2	0 1	0.48	4 MCC-M	500.0		0.48				.850			0.0025	0.0031
2	0 1	0.48	4 MCC-N	240.0		0.48				.850			0.0036	0.0045
2	0 1	0.48	4 MCC-P	430.0		0.48				.850			0.0036	0.0043
2	0 1	0.48	4 MCCOGI	235.0		0.48				.850			0.0058	0.0059
2	0 2	0.48	1 CRDP1B	250.0	0.0	0.46			.900	.850	.200	5.60	0.0069	0.0085
2	0 2	0.48	1 SACP1B	125.0	0.0	0.46			.900	.850	.200	6.50	0.0112	0.0077
2	0 2	0.48	4 MCC-T	100.0		0.48				.850			0.0016	0.0016
2	0 2	0.48	4 MCC-S	480.0		0.48				.850			0.0021	0.0027
2	0 2	0.48	4 MCC-U	400.0		0.48				.850			0.0032	0.0033
2	0 2	0.48	4 MCC-V	290.0		0.48				.850			0.0089	0.0092
2	0 2	0.48	4 MCC-W	320.0		0.48				.850			0.0046	0.0047
2	0 2	0.48	4 MCC-MR	200.0		0.48				.850			0.0090	0.0112
3	0 1	0.48	4 FAKE	1.0		0.48				.850			0.0	0.0

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JTC Corporation

POOR ORIGINAL

INPUT BUS REACTOR DATA

TERM	BUS	REACTANCE (OHMS)	RESISTANCE (OHMS)
2	1 0	0.0	0.0
2	2 0	0.0	0.0
2	3 0	0.005	0.004
2	4 0	0.005	0.004
3	1 0	0.0	0.0
3	2 0	0.0	0.0

INPUT STATION SERVICE TRANSFORMER AND CABLE DATA

TERM	BUS	MVA	REACTANCE	X/R	TOLERANCE	CABLE VALUES (OHMS)		KV
						REACTANCE	RESISTANCE	
2	0 1	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16
2	0 2	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16
3	0 1	2.00	0.01 %	6.60	7.50 %	0.0	0.0	0.0

UNIT AUXILIARY TRANSFORMER TOLERANCE USED

2-WINDING	3-WINDING
7.50 %	10.00 %

INPUT UNIT AUXILIARY TRANSFORMER DATA

BREAKER CAPABILITIES (KA)

WDG	TERM	MVA	% REACTANCE		XLM	X/R	INT.				MOM MULT	
			XHL	XHM			LV	MV	LV	MV	LV	MV
3	2 3	30.0	12.30	12.30	0.0	25.00	0.0	0.0	0.0	0.0	0.0	0.0

BREAKER TIME DATA

TERM	BUS	BUS KV	TRIPPING TIME		CONTACT PARTING TIME	
			(CYCLES)	(CYCLES)	(CYCLES)	(CYCLES)
2	1 0	4.16	5.0	3.0		
2	2 0	4.16	5.0	3.0		
2	3 0	4.16	5.0	3.0		
2	4 0	4.16	5.0	3.0		
2	0 1	0.48	2.0	2.0		
2	0 2	0.48	2.0	2.0		
3	1 0	4.16	5.0	3.0		
3	2 0	4.16	5.0	3.0		
3	0 1	0.48	2.0	2.0		

90000522

STEADY STATE VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D = 1.007(PU)

VOLTAGE AT BUS

TERM	BUS	RATED BUS KV	ACTUAL BUS VOLTAGE
2	1 0	4.16	3.9092 (KV)
2	2 0	4.16	3.9092 (KV)
2	3 0	4.16	3.9092 (KV)
2	4 0	4.16	3.9092 (KV)
2	0 1	0.48	0.4286 (KV)
2	0 2	0.48	0.4277 (KV)
3	1 0	4.16	3.9870 (KV)
3	2 0	4.16	3.9870 (KV)
3	0 1	0.48	0.4600 (KV)

POOR ORIGINAL

POOR ORIGINAL

VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D =1.007(PU)

VOLTAGE AT BUS

TERM	BUS	KV	V/D CASE	BUS VOLTAGE		VOLTAGE AT MOTOR TERMINAL		PERCENTAGE	
				RUNNING LOAD	STARTING LOAD	RUNNING LOAD	STARTING LOAD	RUN	START
2	1 0	4.16	1	3.9525 (KV)	3.6496 (KV)	3.9358 (KV)	3.5755 (KV)	98.39	89.39
2	2 0	4.16	1	3.9525 (KV)	3.6496 (KV)	3.9358 (KV)	3.5755 (KV)	98.39	89.39
2	3 0	4.16	1	3.9525 (KV)	3.6496 (KV)				
2	4 0	4.16	1	3.9525 (KV)	3.6496 (KV)				
2	0 1	0.48	1	0.4333 (KV)	0.4001 (KV)				
2	0 2	0.48	1	0.4395 (KV)	0.4058 (KV)				
3	1 0	4.16	1	3.9953 (KV)	3.9346 (KV)				
3	2 0	4.16	1	3.9953 (KV)	3.9346 (KV)				
3	0 1	0.48	1	0.4610 (KV)	0.4540 (KV)				
2	1 0	4.16	2	3.9404 (KV)	3.6968 (KV)	3.9309 (KV)	3.6455 (KV)	98.27	91.14
2	2 0	4.16	2	3.9404 (KV)	3.6968 (KV)				
2	3 0	4.16	2	3.9404 (KV)	3.6968 (KV)				
2	4 0	4.16	2	3.9404 (KV)	3.6968 (KV)				
2	0 1	0.48	2	0.4320 (KV)	0.4053 (KV)				
2	0 2	0.48	2	0.4381 (KV)	0.4111 (KV)				
3	1 0	4.16	2	3.9930 (KV)	3.9443 (KV)				
3	2 0	4.16	2	3.9930 (KV)	3.9443 (KV)				
3	0 1	0.48	2	0.4607 (KV)	0.4551 (KV)				
2	1 0	4.16	3	3.9260 (KV)	3.7933 (KV)				
2	2 0	4.16	3	3.9260 (KV)	3.7933 (KV)				

90000524

VOLTAGE_DROP_RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D =1.007(PU)

VOLTAGE AT BUS

TERM.	BUS	KV	V/D_CASE	BUS VOLTAGE		VOLTAGE AT MOTOR TERMINAL		PERCENTAGE RUN	START
				RUNNING_LOAD	STARTING_LOAD	RUNNING_LOAD	STARTING_LOAD		
2	3 0	4.16	3	3.9250 (KV)	3.7933 (KV)				
2	4 0	4.16	3	3.9260 (KV)	3.7933 (KV)				
2	0 1	0.48	3	0.4304 (KV)	0.4159 (KV)				
2	0 2	0.48	3	0.4365 (KV)	0.4218 (KV)				
3	1 0	4.16	3	4.0658 (KV)	3.4442 (KV)				
3	2 0	4.16	3	4.0668 (KV)	3.4442 (KV)	4.0622 (KV)	3.4216 (KV)	101.56	85.54
3	0 1	0.48	3	0.4692 (KV)	0.3974 (KV)				
2	1 0	4.16	4	3.9124 (KV)	3.8900 (KV)				
2	2 0	4.16	4	3.9124 (KV)	3.8900 (KV)				
2	3 0	4.16	4	3.9124 (KV)	3.8900 (KV)				
2	4 0	4.16	4	3.9124 (KV)	3.8900 (KV)				
2	0 1	0.48	4	0.4308 (KV)	0.4132 (KV)	0.4262 (KV)	0.3886 (KV)	92.65	34.87
2	0 2	0.48	4	0.4350 (KV)	0.4325 (KV)				
3	1 0	4.16	4	3.9876 (KV)	3.9832 (KV)				
3	2 0	4.16	4	3.9876 (KV)	3.9832 (KV)				
3	0 1	0.48	4	0.4601 (KV)	0.4596 (KV)				

POOR ORIGINAL

90000325

POOR ORIGINAL

CASE 7 VOLTAGE DROP WHILE ON STARTUP ST. SER. TR. ---SUDDEN LOCA SHUTDOWN
NPPD/CNS 154KV SOURCE VOLTS (LOW) -5.0% TAP 152.95KV

PROGRAM OBJECTIVE - VOLTAGE DROP STUDY ONLY

INPUT DATA

BASE MVA USED FOR CALCULATIONS = 1000.00

RATED KV ON TERMINAL 1 = 152.90

RATED KV ON TERMINAL 2 = 4.16

RATED KV ON TERMINAL 3 = 4.16

MAIN GENERATOR

MVA = 0.0 KV = 0.0

SURTRANSIENT REACTANCE = 0.0 PU X/R RATIO = 0.0

TRANSIENT REACTANCE = 0.0 PU RESISTANCE = 0.0 PU

STEP-UP TRANSFORMER

MVA = 0.0 X/R RATIO = 30.00

REACTANCE = 0.0 % ON 0.0 MVA BASE

UTILITY SYSTEM

MVA = 10000.00 BASE MVA OF IMPEDANCE = 0.0

IMPEDANCE = .0 PU AT 0.0 DEG.

90000326

INPUT BUS ELEMENT DATA

THE VALUES LISTED BELOW ARE ACTUAL INPUT AND NECESSARY ASSUMPTIONS

* IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY

PROGRAM IDENTIFICATION - MOTOR(1), STATIC LOAD (4), GENERATOR(6)

TERM	BUS	BUS	IDENT	NAMEPLATE	BRAKE	RATED	X	SUB	RES	EFF	R	PF	S	PF	LR/FLC	RES	CABLE (OHMS)
		KV		HP/KVA	HP	KV											REACT
2	1	4.16	1	CWP-1A	1750.0	0.0	4.00			.900	.850	.200	.200	5.00	0.0300	0.0334	
2	1	4.16	1	CWP-1B	1750.0	0.0	4.00			.900	.850	.200	.200	5.00	0.0300	0.0334	
2	1	4.16	1	CWP-1A	2500.0	0.0	4.00			.900	.850	.200	.200	5.50	0.0108	0.0149	
2	1	4.16	1	CONP1A	800.0	0.0	4.00			.900	.850	.200	.200	5.50	0.0609	0.0187	
2	1	4.16	4	SUBS1A	1200.0		4.16				.850				0.0046	0.0051	
2	1	4.16	4	SUBS1C	300.0		4.16				.850				0.1210	0.0374	
2	1	4.16	4	RUS-1E	400.0		4.16				.850				0.0023	0.0026	
2	2	4.16	1	CWP-1C	1750.0	0.0	4.00			.900	.850	.200	.200	5.00	0.0300	0.0334	
2	2	4.16	1	CWP-1D	1750.0	0.0	4.00			.900	.850	.200	.200	5.00	0.0300	0.0334	
2	2	4.16	1	CWP-1A	2500.0	0.0	4.00			.900	.850	.200	.200	5.50	0.0108	0.0149	
2	2	4.16	1	CONP1A	800.0	0.0	4.00			.900	.850	.200	.200	5.50	0.0609	0.0187	
2	2	4.16	4	SUBS1H	1000.0		4.16				.850				0.0046	0.0051	
2	2	4.16	4	SUBS1D	300.0		4.16				.850				0.1218	0.0374	
2	3	4.16	1	SSW-1A	300.0	0.0	4.00			.900	.850	.200	.200	6.00	0.1421	0.0436	
2	3	4.16	1	SSW-1C	300.0	0.0	4.00			.900	.850	.200	.200	6.00	0.1421	0.0436	
2	3	4.16	1	RHR-1A*1	1250.0	1090.0	4.00			.900	.850	.200	.200	6.50	0.0105	0.0079	
2	3	4.16	1	CSP-1A*2	1250.0	1090.0	4.00			.900	.850	.200	.200	6.50	0.0105	0.0079	
2	4	4.16	1	SSW-1B	300.0	0.0	4.00			.900	.850	.200	.200	6.00	0.1421	0.0436	
2	4	4.16	1	SSW-1D	300.0	0.0	4.00			.900	.850	.200	.200	6.00	0.1421	0.0436	
2	4	4.16	1	RHR-1B*1	1250.0	1090.0	4.00			.900	.850	.200	.200	6.50	0.0105	0.0079	

INPUT BUS ELEMENT DATA

THE VALUES LISTED BELOW ARE ACTUAL INPUT AND NECESSARY ASSUMPTIONS

* IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY

PROGRAM IDENTIFICATION - MOTOR(1), STATIC LOAD (4), GENERATOR(6)

TRM	BUS	BUS KV	IDENT	NAMEPLATE HP/KVA	BRAKE HP	RATED KV	X SUB	RES	EFF	R PF	S PF	LR/FLC	CABLE(OHMS)	
													RES	REACT
2	4 0	4.16	1 CSP-1802	1250.0	1090.0	4.00			.900	.850	.200	6.50	0.0105	0.0079
3	1 0	4.16	1 RRNGST	7000.0	0.0	4.00			.900	.850	.200	5.50	0.0018	0.0025
3	2 0	4.16	1 RRNGSY*3	7000.0	0.0	4.00			.900	.850	.200	5.50	0.0018	0.0025
2	0 1	0.48	1 CRDPIA*4	250.0	0.0	0.46			.900	.850	.200	5.60	0.0068	0.0085
2	0 1	0.48	1 SACPIA	125.0	0.0	0.46			.900	.850	.200	6.50	0.0112	0.0077
2	0 1	0.48	4 MCC-K	600.0		0.48				.850			0.0010	0.0015
2	0 1	0.48	4 MCC-L	475.0		0.48				.850			0.0025	0.0026
2	0 1	0.48	4 MCC-M	500.0		0.48				.850			0.0025	0.0031
2	0 1	0.48	4 MCC-N	240.0		0.48				.850			0.0036	0.0045
2	0 1	0.48	4 MCC-P	430.0		0.48				.850			0.0036	0.0045
2	0 1	0.48	4 MCCQBI	235.0		0.48				.850			0.0058	0.0059
2	0 2	0.48	1 CRDPIH	250.0	0.0	0.46			.900	.850	.200	5.60	0.0048	0.0085
2	0 2	0.48	1 SACPIB	125.0	0.0	0.46			.900	.850	.200	6.50	0.0112	0.0077
2	0 2	0.48	4 MCC-T	100.0		0.48				.850			0.0016	0.0016
2	0 2	0.48	4 MCC-S	400.0		0.48				.850			0.0021	0.0027
2	0 2	0.48	4 MCC-U	400.0		0.48				.850			0.0032	0.0033
2	0 2	0.48	4 MCC-V	200.0		0.48				.850			0.0049	0.0092
2	0 2	0.48	4 MCC-W	320.0		0.48				.850			0.0046	0.0047
2	0 2	0.48	4 MCC-MR	200.0		0.48				.850			0.0090	0.0112
3	0 1	0.48	4 FAKE	1.0		0.48				.850			0.0	0.0

POOR ORIGINAL

9000028

INPUT BUS REACTOR DATA

TRM	BUS	REACTANCE (OHMS)	RESISTANCE (OHMS)
2	1 0	0.0	0.0
2	2 0	0.0	0.0
2	3 0	0.005	0.004
2	4 0	0.005	0.004
3	1 0	0.0	0.0
3	2 0	0.0	0.0

INPUT STATION SERVICE TRANSFORMER AND CABLE DATA

TRM	BUS	MVA	REACTANCE	X/R	TOLERANCE	REACTANCE	RESISTANCE	KV
2	0 1	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16
2	0 2	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16
3	0 1	2.00	0.01 %	6.60	7.50 %	0.0	0.0	0.0

UNIT AUXILIARY TRANSFORMER TOLERANCE USED

2-WINDING	3-WINDING
7.50 %	10.00 %

INPUT UNIT AUXILIARY TRANSFORMER DATA

Wdg	TRM	MVA	XHL	% REACTANCE	XHM	ALM	X/R	LV	MV	LV	MV	MOM MULT
3	2 3	30.0	12.30	12.30	0.0	0.0	25.00	0.0	0.0	0.0	0.0	0.0

BREAKER TIME DATA

TRM	BUS	BUS KV	TRIPPING TIME (CYCLES)	CONTACT PARTING TIME (CYCLES)
2	1 0	4.16	5.0	3.0
2	2 0	4.16	5.0	3.0
2	3 0	4.16	5.0	3.0
2	4 0	4.16	5.0	3.0
2	0 1	0.48	2.0	2.0
2	0 2	0.48	2.0	2.0
3	1 0	4.16	5.0	3.0
3	2 0	4.16	5.0	3.0
3	0 1	0.48	2.0	2.0

STEADY STATE VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D = 1.007(PU)

VOLTAGE AT BUS

TERM	BUS	RATED BUS KV	ACTUAL BUS VOLTAGE
2	1 0	4.16	3.8371 (KV)
2	2 0	4.16	3.837 (KV)
2	3 0	4.16	3.8337 (KV)
2	4 0	4.16	3.8337 (KV)
2	0 1	0.48	0.4207 (KV)
2	0 2	0.48	0.4267 (KV)
3	1 0	4.16	3.9735 (KV)
3	2 0	4.16	3.9735 (KV)
3	0 1	0.48	0.4585 (KV)

90000 30

VOLTAGE DROP RESULTS

VOLTAGE AT MV TERMINAL OF AUX TRANSF FOR V/D = 1.007(PU)

VOLTAGE AT BUS

TERM	BUS	KV	V/D CASE	BUS VOLTAGE		VOLTAGE AT MOTOR TERMINAL		PERCENTAGE RUN	PERCENTAGE START
				RUNNING LOAD	STARTING LOAD	RUNNING LOAD	STARTING LOAD		
2	1 0	4.16	1	3.8659 (KV)	3.5806 (KV)	3.8607 (KV)	3.5514 (KV)	96.52	88.79
2	2 0	4.16	1	3.8659 (KV)	3.5806 (KV)	3.8607 (KV)	3.5514 (KV)	96.52	88.79
2	3 0	4.16	1	3.8638 (KV)	3.5688 (KV)	3.8607 (KV)	3.5514 (KV)	96.52	88.79
2	4 0	4.16	1	3.8637 (KV)	3.5688 (KV)	3.8607 (KV)	3.5514 (KV)	96.52	88.79
2	0 1	0.48	1	0.4239 (KV)	0.3926 (KV)	0.4239 (KV)	0.3926 (KV)		
2	0 2	0.48	1	0.4299 (KV)	0.3981 (KV)	0.4299 (KV)	0.3981 (KV)		
3	1 0	4.16	1	3.9788 (KV)	3.9228 (KV)	3.9788 (KV)	3.9228 (KV)		
3	2 0	4.16	1	3.9788 (KV)	3.9228 (KV)	3.9788 (KV)	3.9228 (KV)		
3	0 1	0.48	1	0.4591 (KV)	0.4526 (KV)	0.4591 (KV)	0.4526 (KV)		
2	1 0	4.16	2	3.8659 (KV)	3.5806 (KV)	3.8607 (KV)	3.5514 (KV)	96.52	88.79
2	2 0	4.16	2	3.8659 (KV)	3.5806 (KV)	3.8607 (KV)	3.5514 (KV)	96.52	88.79
2	3 0	4.16	2	3.8634 (KV)	3.5688 (KV)	3.8607 (KV)	3.5514 (KV)	96.52	88.79
2	4 0	4.16	2	3.8638 (KV)	3.5688 (KV)	3.8607 (KV)	3.5514 (KV)	96.52	88.79
2	0 1	0.48	2	0.4239 (KV)	0.3926 (KV)	0.4239 (KV)	0.3926 (KV)		
2	0 2	0.48	2	0.4299 (KV)	0.3981 (KV)	0.4299 (KV)	0.3981 (KV)		
3	1 0	4.16	2	3.9788 (KV)	3.9228 (KV)	3.9788 (KV)	3.9228 (KV)		
3	2 0	4.16	2	3.9788 (KV)	3.9228 (KV)	3.9788 (KV)	3.9228 (KV)		
3	0 1	0.48	2	0.4591 (KV)	0.4526 (KV)	0.4591 (KV)	0.4526 (KV)		
2	1 0	4.16	3	3.8544 (KV)	3.7189 (KV)	3.8544 (KV)	3.7189 (KV)		
2	2 0	4.16	3	3.8544 (KV)	3.7189 (KV)	3.8544 (KV)	3.7189 (KV)		

POOR ORIGINAL

90000331

VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D = 1.007(1PU)

VOLTAGE AT BUS

TERM	BUS	KV	V/D CASE	BUS VOLTAGE		VOLTAGE AT MOTOR TERMINAL		PERCENTAGE RUN START
				RUNNING LOAD	STARTING LOAD	RUNNING LOAD	STARTING LOAD	
2	3 0	4.16	3	3.8510 (KV)	3.7156 (KV)			
2	4 0	4.16	3	3.0510 (KV)	3.7156 (KV)			
2	0 1	0.48	3	0.4226 (KV)	0.4077 (KV)			
2	0 2	0.48	3	0.4285 (KV)	0.4135 (KV)			
3	1 0	4.16	3	4.0537 (KV)	3.4332 (KV)			
3	2 0	4.16	3	4.0537 (KV)	3.4332 (KV)	4.0492 (KV)	3.4107 (KV)	101.23 85.27
3	0 1	0.48	3	0.4677 (KV)	0.3961 (KV)			
2	1 0	4.16	4	3.8405 (KV)	3.8181 (KV)			
2	2 0	4.16	4	3.8405 (KV)	3.8181 (KV)			
2	3 0	4.16	4	3.8371 (KV)	3.8147 (KV)			
2	4 0	4.16	4	3.8371 (KV)	3.8147 (KV)			
2	0 1	0.48	4	0.4229 (KV)	0.4055 (KV)	0.4184 (KV)	0.3814 (KV)	90.95 82.91
2	0 2	0.48	4	0.4270 (KV)	0.4245 (KV)			
3	1 0	4.16	4	3.9741 (KV)	3.9698 (KV)			
3	2 0	4.16	4	3.9741 (KV)	3.9698 (KV)			
3	0 1	0.48	4	0.4585 (KV)	0.4581 (KV)			

POOR ORIGINAL

90000332

CASE A VOLTAGE DROP WHILE ON STARTUP ST. SER. YR. --- PLANT NORMAL OPERATION
NPPD/CNS 161KV SOURCE VOLTS(HIGH) -5.0% TAP 152.95KV

PROGRAM OBJECTIVE - VOLTAGE DROP STUDY ONLY

INPUT DATA

BASE MVA USED FOR CALCULATIONS = 1000.00

RATED KV ON TERMINAL 1 = 152.90

RATED KV ON TERMINAL 2 = 4.16

RATED KV ON TERMINAL 3 = 4.16

MAIN GENERATOR

MVA = 0.0 KV = 0.0

SUBTRANSIENT REACTANCE = 0.0 PU X/R RATIO = 0.0

TRANSIENT REACTANCE = 0.0 PU RESISTANCE = 0.0 PU

STEP-UP TRANSFORMER

MVA = 0.0 X/R RATIO = 30.00

REACTANCE = 0.0 % ON 0.0 MVA BASE

UTILITY SYSTEM

MVA = 10000.00 BASE MVA OF IMPEDANCE = 0.0

IMPEDANCE = .0 PU AT 0.0 DEG.

INPUT BUS ELEMENT DATA
 THE VALUES LISTED BELOW ARE ACTUAL INPUT AND NECESSARY ASSUMPTIONS
 * IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY
 PROGRAM IDENTIFICATION = MOTOR(1), STATIC LOAD (4), GENERATOR(6)

TERM	BUS	RUS	KV	IDENT	NAMEPLATE HP/KVA	BRAKE HP	RATED KV	X	SUB	RES	EFF	R	PF	S	PF	LR/FLC	CABLE(OHMS) RES	REACT
2	1	0	4.16	1	CMP-1A*1	1750.0	0.0	4.0			.900	.850	.200	5.00	0.0300	0.0334		
2	1	0	4.16	1	CAP-1B	1750.0	0.0	4.00			.900	.850	.200	5.00	0.0300	0.0334		
2	1	0	4.16	1	CAP-1A*2	2500.0	0.0	4.00			.900	.850	.200	5.50	0.0108	0.0149		
2	1	0	4.16	1	COMPLA	800.0	0.0	4.00			.900	.850	.200	5.50	0.0609	0.0187		
2	1	0	4.16	4	SUBS1A	1200.0		4.16			.850				0.0046	0.0051		
2	1	0	4.16	4	SUBS1C	300.0		4.16			.850				0.1218	0.0374		
2	1	0	4.16	4	BUS-1E	400.0		4.16			.850				0.0023	0.0026		
2	2	0	4.16	1	CMP-1C*1	1750.0	0.0	4.00			.900	.850	.200	5.00	0.0300	0.0334		
2	2	0	4.16	1	CAP-1D	1750.0	0.0	4.00			.900	.850	.200	5.00	0.0300	0.0334		
2	2	0	4.16	1	CMP-1H	2500.0	0.0	4.00			.900	.850	.200	5.50	0.0108	0.0149		
2	2	0	4.16	1	COMPIB	800.0	0.0	4.00			.900	.850	.200	5.50	0.0609	0.0187		
2	2	0	4.16	4	SUBS1B	1000.0		4.16			.850				0.0046	0.0051		
2	2	0	4.16	4	SUBS1D	300.0		4.16			.850				0.1218	0.0374		
2	3	0	4.16	1	FAKE	1.0	0.0	4.00			.900	.850	.200	6.50	0.0	0.0		
2	4	0	4.16	1	FAKE	1.0	0.0	4.00			.900	.850	.200	6.50	0.0	0.0		
3	1	0	4.16	1	RRMGST	7000.0	0.0	4.00			.900	.850	.200	5.50	0.0018	0.0025		
3	2	0	4.16	1	RRMGST*3	7000.0	0.0	4.00			.900	.850	.200	5.50	0.0018	0.0025		
2	0	1	0.48	1	CROPIA*4	250.0	0.0	0.46			.900	.850	.200	5.60	0.0068	0.0085		
2	0	1	0.48	1	SACPIA	125.0	0.0	0.46			.900	.850	.200	6.50	0.0112	0.0077		
2	0	1	0.48	4	HCC-K	600.0		0.48			.850				0.0010	0.0015		

POOR ORIGINAL

90000334

POOR ORIGINAL

INPUT BUS ELEMENT DATA

THE VALUES LISTED BELOW ARE ACTUAL INPUT AND NECESSARY ASSUMPTIONS

* IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY

PROGRAM IDENTIFICATION - MOTOR(1), STATIC LOAD (4), GENERATOR(6)

TERM	BUS	BUS KV	IDENT	NAMEPLATE HP/KVA	BRAKE HP	RATED KV	X SUB	RES	EFF	R PF	S PF	LR/FLC	CABLE(OHMS)	
													RES	REACT
2	0 1	0.48	4 MCC-L	475.0		0.48				.850			0.0025	0.0026
2	0 1	0.48	4 MCC-M	500.0		0.48				.850			0.0025	0.0031
2	0 1	0.48	4 MCC-N	240.0		0.48				.850			0.0036	0.0045
2	0 1	0.48	4 MCC-P	430.0		0.48				.850			0.0036	0.0045
2	0 1	0.48	4 MCCOGI	235.0		0.48				.850			0.0058	0.0059
2	0 2	0.48	1 CRDP1B	250.0	0.0	0.46			.900	.850	.200	5.50	0.0066	0.0085
2	0 2	0.48	1 SACP1B	125.0	0.0	0.46			.900	.850	.200	6.50	0.0112	0.0077
2	0 2	0.48	4 MCC-T	100.0		0.48				.850			0.0016	0.0016
2	0 2	0.48	4 MCC-S	480.0		0.48				.850			0.0021	0.0027
2	0 2	0.48	4 MCC-U	400.0		0.48				.850			0.0032	0.0033
2	0 2	0.48	4 MCC-V	200.0		0.48				.850			0.0089	0.0092
2	0 2	0.48	4 MCC-W	320.0		0.48				.850			0.0046	0.0047
2	0 2	0.48	4 MCC-MR	200.0		0.48				.850			0.0090	0.0112
3	0 1	0.48	4 FAKE	1.0		0.48				.850			0.0	0.0

90000335

INPUT BUS REACTOR DATA

TERM	RUS	REACTANCE (OHMS)	RESISTANCE (OHMS)
2	1 0	0.0	0.0
2	2 0	0.0	0.0
2	3 0	0.005	0.004
2	4 0	0.005	0.004
3	1 0	0.0	0.0
3	2 0	0.0	0.0

INPUT STATION SERVICE TRANSFORMER AND CABLE DATA

TERM	RUS	MVA	REACTANCE	X/R	TOLERANCE	CABLE VALUES (OHMS)		KV
						REACTANCE	RESISTANCE	
2	0 1	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16
2	0 2	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16
3	0 1	2.00	0.01 %	6.60	7.50 %	0.0	0.0	0.0

UNIT AUXILIARY TRANSFORMER TOLERANCE USED

2-WINDING	3-WINDING
7.50 %	10.00 %

INPUT UNIT AUXILIARY TRANSFORMER DATA

WDG	TERM	MVA	% REACTANCE				BREAKER CAPABILITIES (KA)				MOM MULT	
			XHL	XHM	XLM	X/R	INT.	40M.	LV	MV	LV	MV
3	2 3	30.0	12.30	12.30	0.0	25.00	0.0	0.0	5.0	0.0	0.0	0.0

BREAKER TIME DATA

TERM	RUS	RUS KV	TRIPPING TIME (CYCLES)	CONTACT PARTING TIME (CYCLES)
2	1 0	4.16	5.0	5.0
2	2 0	4.16	5.0	3.0
2	3 0	4.16	5.0	3.0
2	4 0	4.16	5.0	3.0
2	0 1	0.48	2.0	2.0
2	0 2	0.48	2.0	2.0
3	1 0	4.16	5.0	3.0
3	2 0	4.16	5.0	3.0
3	0 1	0.48	2.0	2.0

90000536

STEADY STATE VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D = 1.053(PU)

VOLTAGE AT BUS

TERM	BUS	RATED BUS KV	ACTUAL BUS VOLTAGE
2	1 0	4.16	4.1151 (KV)
2	2 0	4.16	4.1151 (KV)
2	3 0	4.16	4.1151 (KV)
2	4 0	4.16	4.1151 (KV)
2	0 1	0.48	0.4512 (KV)
2	0 2	0.48	0.4576 (KV)
3	1 0	4.16	4.1883 (KV)
3	2 0	4.16	4.1883 (KV)
3	0 1	0.48	0.4633 (KV)

POOR ORIGINAL

96000337

VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANS FOR V/D = 1.053(PU)

VOLTAGE AT BUS

TERM	BUS	KV	V/D CASE	BUS VOLTAGE		VOLTAGE AT MOTOR TERMINAL		PERCENTAGE	
				RUNNING LOAD	STARTING LOAD	RUNNING LOAD	STARTING LOAD	RUN	START
2	1 0	4.16	1	4.1558 (KV)	3.8389 (KV)	4.1382 (KV)	3.7608 (KV)	103.46	94.02
2	2 0	4.16	1	4.1558 (KV)	3.8388 (KV)	4.1382 (KV)	3.7608 (KV)	103.46	94.02
2	3 0	4.16	1	4.1558 (KV)	3.8388 (KV)	4.1382 (KV)	3.7608 (KV)	103.46	94.02
2	4 0	4.16	1	4.1558 (KV)	3.8388 (KV)	4.1382 (KV)	3.7608 (KV)	103.46	94.02
2	0 1	3.48	1	0.4556 (KV)	0.4209 (KV)	0.4268 (KV)	0.4268 (KV)		
2	0 2	0.48	1	0.4621 (KV)	0.4268 (KV)	0.4268 (KV)	0.4268 (KV)		
3	1 0	4.16	1	4.1962 (KV)	4.1329 (KV)	4.1329 (KV)	4.1329 (KV)		
3	2 0	4.16	1	4.1962 (KV)	4.1329 (KV)	4.1329 (KV)	4.1329 (KV)		
3	0 1	0.48	1	0.4842 (KV)	0.4769 (KV)	0.4769 (KV)	0.4769 (KV)		
2	1 0	4.16	2	4.1444 (KV)	3.8895 (KV)	4.1345 (KV)	3.8355 (KV)	103.36	95.89
2	2 0	4.16	2	4.1444 (KV)	3.8895 (KV)	4.1345 (KV)	3.8355 (KV)	103.36	95.89
2	3 0	4.16	2	4.1444 (KV)	3.8895 (KV)	4.1345 (KV)	3.8355 (KV)	103.36	95.89
2	4 0	4.16	2	4.1444 (KV)	3.8895 (KV)	4.1345 (KV)	3.8355 (KV)	103.36	95.89
2	0 1	0.48	2	0.4544 (KV)	0.264 (KV)	0.264 (KV)	0.264 (KV)		
2	0 2	0.48	2	0.4608 (KV)	0.4325 (KV)	0.4325 (KV)	0.4325 (KV)		
3	1 0	4.16	2	4.1939 (KV)	4.1433 (KV)	4.1433 (KV)	4.1433 (KV)		
3	2 0	4.16	2	4.1939 (KV)	4.1433 (KV)	4.1433 (KV)	4.1433 (KV)		
3	0 1	0.48	2	0.4839 (KV)	0.4781 (KV)	0.4781 (KV)	0.4781 (KV)		
2	1 0	4.16	3	4.1310 (KV)	3.9931 (KV)	3.9931 (KV)	3.9931 (KV)		
2	2 0	4.16	3	4.1310 (KV)	3.9931 (KV)	3.9931 (KV)	3.9931 (KV)		

VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D = 1.053 (PU)

VOLTAGE AT BUS

TERM	BUS	KV	V/D CASE	BUS VOLTAGE		VOLTAGE AT MOTOR TERMINAL		PERCENTAGE
				RUNNING LOAD	STARTING LOAD	RUNNING LOAD	STARTING LOAD	
2	3 0	4.16	3	4.1310 (KV)	3.9931 (KV)			
2	4 0	4.16	3	4.1310 (KV)	3.9931 (KV)			
2	0 1	0.48	3	0.4529 (KV)	0.4378 (KV)			
2	0 2	0.48	3	0.4593 (KV)	0.4440 (KV)			
3	1 0	4.16	3	4.2639 (KV)	3.6119 (KV)			
3	2 0	4.16	3	4.2639 (KV)	3.6119 (KV)	3.5862 (KV)	106.48	89.71
3	0 1	0.48	3	0.4920 (KV)	0.4168 (KV)			
2	1 0	4.16	4	4.1182 (KV)	4.0947 (KV)			
2	2 0	4.16	4	4.1182 (KV)	4.0947 (KV)			
2	3 0	4.16	4	4.1182 (KV)	4.0947 (KV)			
2	4 0	4.16	4	4.1182 (KV)	4.0947 (KV)			
2	0 1	0.48	4	0.4535 (KV)	0.4349 (KV)	0.4486 (KV)	0.4090 (KV)	97.52 88.92
2	0 2	0.48	4	0.4579 (KV)	0.4553 (KV)			
3	1 0	4.16	5	4.1886 (KV)	4.1843 (KV)			
3	2 0	4.16	4	4.1886 (KV)	4.1843 (KV)			
3	0 1	0.48	4	0.4633 (KV)	0.4628 (KV)			

CASE 9 VOLTAGE DROP WHILE ON STARTUP ST. SER. TR. ---SUDDEN LOCA SHUTDOWN
NPPD/CNS 151KV SOURCE VOLTS(HIGH) -5.0% TAP 152.95KV

PROGRAM OBJECTIVE = VOLTAGE DROP STUDY ONLY

INPUT DATA

BASE MVA USED FOR CALCULATIONS = 1000.00

RATED KV ON TERMINAL 1 = 152.90

RATED KV ON TERMINAL 2 = 4.16

RATED KV ON TERMINAL 3 = 4.16

MAIN GENERATOR

MVA = 0.0 KV = 0.0

SUBTRANSIENT REACTANCE = 0.0 PU X/R RATIO = 0.0

TRANSIENT REACTANCE = 0.0 PU RESISTANCE = 0.0 PU

STEP-UP TRANSFORMER

MVA = 0.0 X/R RATIO = 30.00

REACTANCE = 0.0 % ON 0.0 MVA BASE

UTILITY SYSTEM

MVA = 10000.00 BASE MVA OF IMPEDANCE = 0.0

IMPEDANCE = .0 PU AT 0.0 DEG.

INPUT BUS ELEMENT DATA
 THE VALUES LISTED BELOW ARE ACTUAL INPUT AND NECESSARY ASSUMPTIONS
 * IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY
 PROGRAM IDENTIFICATION - MOTOR(1)-STATIC LOAD (4)-GENERATOR(6)

TERM	BUS	RVS	KV	IDENT	NAMEPLATE HP/KVA	BRAKE HP	RATED KV	X SUB	RES	EFF	R PF	S PF	LR/FLC	CABLE(OHMS) RES	REACT
2	1 0	4.16	1	CWP-1A	1750.0	0.0	4.00			.900	.850	.200	5.00	0.0300	0.0334
2	1 0	4.16	1	CWP-1B	1750.0	0.0	4.00			.900	.850	.200	5.00	0.0300	0.0334
2	1 0	4.16	1	CWP-1A	2500.0	0.0	4.00			.900	.850	.200	5.50	0.0109	0.0149
2	1 0	4.16	1	COMP1A	800.0	0.0	4.00			.900	.850	.200	5.50	0.0609	0.0187
2	1 0	4.16	4	SUR51A	1200.0		4.16			.850				0.0046	0.0051
2	1 0	4.16	4	SUR51C	300.0		4.16			.850				0.1218	0.0374
2	1 0	4.16	4	RUS-1E	400.0		4.16			.850				0.0023	0.0026
2	2 0	4.16	1	CWP-1C	1750.0	0.0	4.00			.900	.850	.200	5.00	0.0300	0.0334
2	2 0	4.16	1	CWP-1D	1750.0	0.0	4.00			.900	.850	.200	5.00	0.0300	0.0334
2	2 0	4.16	1	CWP-1B	2500.0	0.0	4.00			.900	.850	.200	5.50	0.0108	0.0149
2	2 0	4.16	1	COMP1B	800.0	0.0	4.00			.900	.850	.200	5.50	0.0609	0.0187
2	2 0	4.16	4	SUR51H	1000.0		4.16			.850				0.0046	0.0051
2	2 0	4.16	4	SUR51D	300.0		4.16			.850				0.1218	0.0374
2	3 0	4.16	1	SSW-1A	300.0	0.0	4.00			.900	.850	.200	6.00	0.1421	0.0436
2	3 0	4.16	1	SSW-1C	300.0	0.0	4.00			.900	.850	.200	6.00	0.1421	0.0436
2	3 0	4.16	1	RHR-1A*1	1250.0	1090.0	4.00			.900	.850	.200	6.50	0.0105	0.0079
2	3 0	4.16	1	CSP-1A*2	1250.0	1090.0	4.00			.900	.850	.200	6.50	0.0105	0.0079
2	4 0	4.16	1	SSW-1D	300.0	0.0	4.00			.900	.350	.200	6.00	0.1421	0.0436
2	4 0	4.16	1	SSW-1D	300.0	0.0	4.00			.900	.850	.200	6.00	0.1421	0.0436
2	4 0	4.16	1	RHR-1R*1	1250.0	1090.0	4.00			.900	.850	.200	6.50	0.0105	0.0079

POOR ORIGINAL

INPUT BUS ELEMENT DATA
 THE VALUES LISTED BELOW ARE ACTUAL INPUT AND NECESSARY ASSUMPTIONS
 * IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY
 PROGRAM IDENTIFICATION - MOTOR(1), STATIC LOAD (4), GENERATOR(6)

TERM	BUS	BUS KV	IDENT	NAMEPLATE HP/KVA	BRAKE HP	RATED KV	X SUB	RES	EFF	R PF	S PF	LR/FLC	CABLE (OHMS)	
													RES	REACT
2	4 0	4.16	1 CSP-19*2	1250.0	1090.0	4.00			.900	.850	.200	6.50	0.0105	0.0079
3	1 0	4.16	1 BRMGST	7000.0	0.0	4.00			.900	.850	.200	5.50	0.0018	0.0025
3	2 0	4.16	1 BRMGST*3	7000.0	0.0	4.00			.900	.850	.200	5.50	0.0018	0.0025
2	0 1	0.48	1 CRDP1A*4	250.0	0.0	0.46			.900	.850	.200	5.60	0.0068	0.0085
2	0 1	0.48	1 SACP1A	125.0	0.0	0.46			.900	.850	.200	6.00	0.0112	0.0077
2	0 1	0.48	4 MCC-K	600.0		0.48				.850			0.0010	0.0015
2	0 1	0.48	4 MCC-L	475.0		0.48				.850			0.0025	0.0026
2	0 1	0.48	4 MCC-M	500.0		0.48				.850			0.0025	0.0031
2	0 1	0.48	4 MCC-N	240.0		0.48				.850			0.0036	0.0045
2	0 1	0.48	4 MCC-P	430.0		0.48				.850			0.0036	0.0045
2	0 1	0.48	4 MCCOGI	235.0		0.48				.850			0.0058	0.0059
2	0 2	0.48	1 CRDP1B	250.0	0.0	0.46			.900	.850	.200	5.60	0.0068	0.0085
2	0 2	0.48	1 SACP1B	125.0	0.0	0.46			.900	.850	.200	6.50	0.0112	0.0077
2	0 2	0.48	4 MCC-T	100.0		0.48				.850			0.0016	0.0016
2	0 2	0.48	4 MCC-S	480.0		0.48				.850			0.0021	0.0027
2	0 2	0.48	4 MCC-U	400.0		0.48				.850			0.0032	0.0033
2	0 2	0.48	4 MCC-V	200.0		0.48				.850			0.0089	0.0092
2	0 2	0.48	4 MCC-W	320.0		0.48				.850			0.0046	0.0047
2	0 2	0.48	4 MCC-MR	200.0		0.48				.850			0.0090	0.0112
3	0 1	0.48	4 FAKE	1.0		0.48				.850			0.0	0.0

90000342

POOR ORIGINAL

INPUT BUS REACTOR DATA

TERM	BUS	REACTANCE (OHMS)	RESISTANCE (OHMS)
2	1 0	0.0	0.0
2	2 0	0.0	0.0
2	3 0	0.005	0.004
2	4 0	0.005	0.004
3	1 0	0.0	0.0
3	2 0	0.0	0.0

INPUT STATION SERVICE TRANSFORMER AND CABLE DATA

TERM	BUS	MVA	REACTANCE	X/R	TOLERANCE	CABLE VALUES (OHMS)		KV
						REACTANCE	RESISTANCE	
2	0 1	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16
2	0 2	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16
3	0 1	2.00	0.01 %	6.60	7.50 %	0.0	0.0	0.0

UNIT AUXILIARY TRANSFORMER TOLERANCE USED

2-WINDING	3-WINDING
7.50 %	10.00 %

INPUT UNIT AUXILIARY TRANSFORMER DATA

BREAKER CAPABILITIES (KA)

Wdg	TERM	MVA	% REACTANCE		X/R	INT.				MOM. MULT		
			XHL	XHM		LV	MV	LV	MV	LV	MV	
3	2 3	30.0	12.30	12.30	0.0	25.00	0.0	0.0	0.0	0.0	0.0	0.0

BREAKER TIME DATA

TERM	BUS	BUS KV	TRIPPING TIME (CYCLES)	CONTACT PARTING TIME (CYCLES)
2	1 0	4.16	5.0	3.0
2	2 0	4.16	5.0	3.0
2	3 0	4.16	5.0	3.0
2	4 0	4.16	5.0	3.0
2	0 1	0.48	2.0	2.0
2	0 2	0.48	2.0	2.0
3	1 0	4.16	5.0	3.0
3	2 0	4.16	5.0	3.0
3	0 1	0.48	2.0	2.0

90000,43

STEADY STATE VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D = 1.053(PU)

VOLTAGE AT BUS

TRF#	BUS	RATED BUS KV	ACTUAL BUS VOLTAGE
2	1 0	4.16	4.0477 (KV)
2	2 0	4.16	4.0477 (KV)
2	3 0	4.16	4.0441 (KV)
2	4 0	4.16	4.0441 (KV)
2	0 1	0.48	0.4439 (KV)
2	0 2	0.48	0.4501 (KV)
3	1 0	4.16	4.1755 (KV)
3	2 0	4.16	4.1755 (KV)
3	0 1	0.48	0.4818 (KV)

POOR ORIGINAL

90000 344

VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D =1.053(PU)

VOLTAGE AT BUS

TER#	BUS	KV	V/D CASE	BUS VOLTAGE		VOLTAGE AT MOTOR TERMINAL		PERCENTAGE	
				RUNNING LOAD	STARTING LOAD	RUNNING LOAD	STARTING LOAD	RUN	START
2	1 0	4.16	1	4.0746 (KV)	3.7762 (KV)				
2	2 0	4.16	1	4.0746 (KV)	3.7762 (KV)				
2	3 0	4.16	1	4.0724 (KV)	3.7637 (KV)	3.7454 (KV)	101.73	93.65	
2	4 0	4.16	1	4.0724 (KV)	3.7637 (KV)	3.7454 (KV)	101.73	93.64	
2	0 1	0.48	1	0.4467 (KV)	0.4140 (KV)				
2	0 2	0.48	1	0.4531 (KV)	0.4199 (KV)				
3	1 0	4.16	1	4.1805 (KV)	4.1222 (KV)				
3	2 0	4.16	1	4.1805 (KV)	4.1222 (KV)				
3	0 1	0.48	1	0.4824 (KV)	0.4756 (KV)				
2	1 0	4.16	2	4.0746 (KV)	3.7762 (KV)				
2	2 0	4.16	2	4.0746 (KV)	3.7762 (KV)				
2	3 0	4.16	2	4.0724 (KV)	3.7637 (KV)	3.7454 (KV)	101.73	93.64	
2	4 0	4.16	2	4.0724 (KV)	3.7637 (KV)	3.7454 (KV)	101.73	93.64	
2	0 1	0.48	2	0.4467 (KV)	0.4140 (KV)				
2	0 2	0.48	2	0.4531 (KV)	0.4199 (KV)				
3	1 0	4.16	2	4.1805 (KV)	4.1222 (KV)				
3	2 0	4.16	2	4.1805 (KV)	4.1222 (KV)				
3	0 1	0.48	2	0.4824 (KV)	0.4756 (KV)				
2	1 0	4.16	3	4.0640 (KV)	3.9236 (KV)				
2	2 0	4.16	3	4.0640 (KV)	3.9236 (KV)				

VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D = 1.053(PU)

VOLTAGE AT BUS			BUS VOLTAGE		VOLTAGE AT MOTOR TERMINAL		PERCENTAGE		
TRF#	BUS	KV	V/D CASE	RUNNING LOAD	STARTING LOAD	RUNNING LOAD	STARTING LOAD	RUN	START
2	3 0	4.16	3	4.0604 (KV)	3.9201 (KV)				
2	4 0	4.16	3	4.0604 (KV)	3.9201 (KV)				
2	0 1	0.48	3	0.4456 (KV)	0.4302 (KV)				
2	0 2	0.48	3	0.4519 (KV)	0.4363 (KV)				
3	1 0	4.16	3	4.2514 (KV)	3.6015 (KV)				
3	2 0	4.16	3	4.2514 (KV)	3.6015 (KV)	4.2467 (KV)	3.5779 (KV)	106.17	89.45
3	0 1	0.48	3	0.4905 (KV)	0.4156 (KV)				
2	1 0	4.16	4	4.0509 (KV)	4.0275 (KV)				
2	2 0	4.16	4	4.0509 (KV)	4.0275 (KV)				
2	3 0	4.16	4	4.0473 (KV)	4.0239 (KV)				
2	4 0	4.16	4	4.0473 (KV)	4.0239 (KV)				
2	0 1	0.48	4	0.4461 (KV)	0.4278 (KV)	0.4413 (KV)	0.4023 (KV)	95.93	87.46
2	0 2	0.48	4	0.4504 (KV)	0.4478 (KV)				
3	1 0	4.16	4	4.1761 (KV)	4.1716 (KV)				
3	2 0	4.16	4	4.1761 (KV)	4.1716 (KV)				
3	0 1	0.48	4	0.4819 (KV)	0.4813 (KV)				

CASE 10 VOLTAGE DROP WHILE ON MAIN GENERATOR---PLANT ON HOT STANDBY
 NPPD/CNS 22.05KV SOURCE VOLTS(HIGH) 03 TAP 21KV

PROGRAM OBJECTIVE - VOLTAGE DROP STUDY ONLY

INPUT DATA

BASE MVA USED FOR CALCULATIONS = 1000.00

RATED KV ON TERMINAL 1 = 210.00

RATED KV ON TERMINAL 2 = 4.16

RATED KV ON TERMINAL 3 = 4.16

MAIN GENERATOR

MVA = 983.00 KV = 22.0

SUBTRANSIENT REACTANCE = 0.27100 PU X/R RATIO = 4.05

TRANSIENT REACTANCE = 0.40700 PU RESISTANCE = 0.05580 PU

STEP-UP TRANSFORMER

MVA = 900.00 X/R RATIO = 45.20

REACTANCE = 11.55 % ON 900.00 MVA BASE

UTILITY SYSTEM

MVA = 10000.00 BASE MVA OF IMPEDANCE = 0.0

IMPEDANCE = .0 PU AT 0.0 DEG.

POOR ORIGINAL

90000.47

INPUT BUS ELEMENT DATA
 THE VALUES LISTED BELOW ARE ACTUAL INPUT AND NECESSARY ASSUMPTIONS
 * IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY
 PROGRAM IDENTIFICATION - MOTOR (1), STATIC LOAD (4), GENERATOR (6)

TERM	BUS	BUS	NAMEPLATE	BRAKE	RATED	A. SUB	RES	EFF	R. PF	S. PF	LR/ELC	RES	REACT	CABLE (OHMS)
		KV	HP/KVA	HP	KV									
2	1	4.16	1 CWP-1A*1	1750.0	0.0	4.00		.900	.850	.200	5.00	0.0300	0.0334	
2	1	4.16	1 CWP-1A*2	2500.0	0.0	4.00		.900	.850	.200	5.50	0.0108	0.0149	
2	1	4.16	1 CONPIA	800.0	0.0	4.00		.900	.850	.200	5.50	0.0009	0.0187	
2	1	4.16	5L 31A	1200.0		4.16		.850				0.0046	0.0051	
2	1	4.16	4 SUBS1C	300.0		4.16		.850				0.1218	0.0374	
2	1	4.16	4 BUS-1E	400.0		4.16		.850				0.0025	0.0026	
2	2	4.16	1 CWP-1C*1	1750.0	0.0	4.00		.900	.850	.200	5.00	0.0300	0.0334	
2	2	4.16	4 SUBS1B	1000.0		4.16		.850				0.0046	0.0051	
2	2	4.16	4 SUBS1D	300.0		4.16		.850				0.1218	0.0374	
2	3	4.16	1 FAKE	1.0	0.0	4.00		.900	.850	.200	6.50	0.0	0.0	
2	4	4.16	1 FAKE	1.0	0.0	4.00		.900	.850	.200	6.50	0.0	0.0	
3	1	4.16	1 BRMGST*3	7000.0	0.0	4.00		.900	.850	.200	5.50	0.0018	0.0025	
3	2	4.16	1 BRMGST	7000.0	0.0	4.00		.900	.850	.200	5.50	0.0018	0.0025	
2	0	1	4.48	4 SUBS1F	480.0		0.48	.850				0.0	0.0	
2	0	2	0.48	4 SUBS1G	150.0		0.48	.850				0.0	0.0	
3	0	1	0.48	4 FAKE	1.0		0.48	.850				0.0	0.0	

POOR ORIGINAL

INPUT BUS REACTOR DATA

TERM	BUS	REACTANCE (OHMS)	RESISTANCE (OHMS)
2	1 0	0.0	0.0
2	2 0	0.0	0.0
2	3 0	0.005	0.004
2	4 0	0.005	0.004
3	1 0	0.0	0.0
3	2 0	0.0	0.0

INPUT STATION SERVICE TRANSFORMER AND CABLE DATA

CABLE VALUES (OHMS)

TERM	BUS	MVA	REACTANCE	X/R	TOLERANCE	REACTANCE	RESISTANCE	KV
2	0 1	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16
2	0 2	2.00	5.75 %	6.60	7.50 %	0.00	0.00	4.16
3	0 1	0.01	0.0 %	6.60	7.50 %	0.0	0.0	0.0

UNIT AUXILIARY TRANSFORMER TOLERANCE USED

2-WINDING	3-WINDING
7.50 %	10.00 %

INPUT UNIT AUXILIARY TRANSFORMER DATA

BREAKER CAPABILITIES (KA)

WDG	TERM	MVA	% REACTANCE		XLM	X/R	INT. MOM.				MOM MULT		
			XHL	XHM			LV	MV	LV	MV	LV	MV	
3	2 3	30.0	12.50	10.00	0.0	25.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0

BREAKER TIME DATA

TERM	BUS	BUS KV	TRIPPING TIME (CYCLES)	CONTACT PARTING TIME (CYCLES)
2	1 0	4.16	5.0	3.0
2	2 0	4.16	5.0	3.0
2	3 0	4.16	5.0	3.0
2	4 0	4.16	5.0	3.0
2	0 1	0.48	2.0	2.0
2	0 2	0.48	2.0	2.0
3	1 0	4.16	5.0	3.0
3	2 0	4.16	5.0	3.0
3	0 1	0.48	2.0	2.0

90000349

STEADY STATE VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D = 1.050(PU)

VOLTAGE AT BUS

TERM	BUS	RATED BUS KV	ACTUAL BUS VOLTAGE
2	1 0	4.16	4.2297 (KV)
2	2 0	4.16	4.2297 (KV)
2	3 0	4.16	4.2297 (KV)
2	4 0	4.16	4.2297 (KV)
2	0 1	0.48	0.4839 (KV)
2	0 2	0.48	0.4867 (KV)
3	1 0	4.16	4.2309 (KV)
3	2 0	4.16	4.2309 (KV)
3	0 1	0.48	0.4882 (KV)

VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D =1.050(PU)

VOLTAGE AT BUS

TERM	BUS	KV	V/D CASE	BUS VOLTAGE		VOLTAGE AT MOTOR TERMINAL		PERCENTAGE	
				RUNNING LOAD	STARTING LOAD	RUNNING LOAD	STARTING LOAD	RUN	START
2	1 0	4.16	1	4.2575 (KV)	3.9432 (KV)	4.2494 (KV)	3.8531 (KV)	106.23	96.58
2	2 0	4.16	1	4.2675 (KV)	3.9432 (KV)	4.2494 (KV)	3.8531 (KV)	106.23	96.58
2	3 0	4.16	1	4.2675 (KV)	3.9432 (KV)				
2	4 0	4.16	1	4.2675 (KV)	3.9432 (KV)				
2	0 1	0.48	1	0.4882 (KV)	0.4511 (KV)				
2	0 2	0.48	1	0.4911 (KV)	0.4538 (KV)				
3	1 0	4.16	1	4.2378 (KV)	4.1784 (KV)				
3	2 0	4.16	1	4.2378 (KV)	4.1784 (KV)				
3	0 1	0.48	1	0.4890 (KV)	0.4821 (KV)				
2	1 0	4.16	2	4.2568 (KV)	3.9961 (KV)	4.2466 (KV)	3.9407 (KV)	106.17	98.52
2	2 0	4.16	2	4.2568 (KV)	3.9961 (KV)				
2	3 0	4.16	2	4.2568 (KV)	3.9901 (KV)				
2	4 0	4.16	2	4.2568 (KV)	3.9961 (KV)				
2	0 1	0.48	2	0.4870 (KV)	0.4571 (KV)				
2	0 2	0.48	2	0.4899 (KV)	0.4599 (KV)				
3	1 0	4.16	2	4.2358 (KV)	4.1883 (KV)				
3	2 0	4.16	2	4.2358 (KV)	4.1883 (KV)				
3	0 1	0.48	2	0.4888 (KV)	0.4833 (KV)				
2	1 0	4.16	3	4.2434 (KV)	4.1172 (KV)				
2	2 0	4.16	3	4.2434 (KV)	4.1172 (KV)				

VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D = 1.050 (PU)

VOLTAGE AT BUS

TERM	BUS	KV	V/D CASE	RUNNING LOAD	BUS VOLTAGE	STARTING LOAD	VOLTAGE AT MOTOR TERMINAL	PERCENTAGE
							RUNNING LOAD	START
2	3 0	4.16	3	4.2434 (KV)	4.1172 (KV)	4.1172 (KV)	4.2861 (KV)	107.15
2	4 0	4.16	3	4.2434 (KV)	4.1172 (KV)	4.1172 (KV)	3.7179 (KV)	92.95
2	0 1	0.48	3	0.4854 (KV)	0.4710 (KV)	0.4710 (KV)		
2	0 2	0.48	3	0.4883 (KV)	0.4738 (KV)	0.4738 (KV)		
3	1 0	4.15	3	4.2909 (KV)	3.7424 (KV)	3.7424 (KV)		
3	2 0	4.16	3	4.2909 (KV)	3.7424 (KV)	3.7424 (KV)		
3	0 1	0.48	3	0.4951 (KV)	0.4318 (KV)	0.4318 (KV)		

POOR ORIGINAL

90000352

CASE 11 VOLTAGE DROP WHILE ON MAIN GENERATOR---PLANT NORMAL OPERATION
 MPPD/CNS 21.6KV SOURCE VOLTS(LOW) 0% TAP 21KV

PROGRAM OBJECTIVE - VOLTAGE DROP STUDY ONLY

INPUT DATA

BASE MVA USED FOR CALCULATIONS = 1000.00

RATED KV ON TERMINAL 1 = 210.00

RATED KV ON TERMINAL 2 = 4.16

RATED KV ON TERMINAL 3 = 4.16

MAIN GENERATOR

MVA = 943.00 KV = 22.0

SURTRANSIENT REACTANCE = 0.27100 PU X/R RATIO = 4.05

TRANSIENT REACTANCE = 0.40700 PU RESISTANCE = 0.05580 PU

STEP-UP TRANSFORMER

MVA = 900.00 X/R RATIO = 46.20

REACTANCE = 11.55 % ON 900.00 MVA BASE

UTILITY SYSTEM

MVA = 10000.00 BASE MVA OF IMPEDANCE = 0.0

IMPEDANCE = .0 PU AT 0.0 DEG.

POOR ORIGINAL

90000 53

INPUT BUS ELEMENT DATA
 THE VALUES LISTED BELOW ARE ACTUAL INPUT AND NECESSARY ASSUMPTIONS
 * IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY
 PROGRAM IDENTIFICATION - MOTOR(1); STATIC LOAD (4); GENERATOR(6)

TRM	BUS	RUS	KV	IDENT	NAMEPLATE HP/KVA	BRANE HP	RATED KV	X SUR	RES	EFF	R PF	S PF	LR/FLC	RES	REACT	CABLE(OHMS)
2	1	0	4.16	1	CWP-1A*1	0.0	4.00			.900	.850	.200	5.00	0.0300	0.0334	
2	1	0	4.16	1	CWP-1B	0.0	4.00			.900	.850	.200	5.00	0.0300	0.0334	
2	1	0	4.16	1	CWP-1A*2	0.0	4.00			.900	.850	.200	5.50	0.0108	0.0149	
2	1	0	4.16	1	COMP1A	0.0	4.00			.900	.850	.200	5.50	0.0609	0.0187	
2	1	0	4.16	4	SUR51A	1200.0	4.16			.850				0.0045	0.0051	
2	1	0	4.16	4	SUR51C	300.0	4.16			.850				0.1218	0.0374	
2	1	0	4.16	4	BUS-1E	400.0	4.16			.850				0.0023	0.0026	
2	2	0	4.16	1	CWP-1C*1	1750.0	4.00			.900	.850	.200	5.00	0.0300	0.0334	
2	2	0	4.16	1	CWP-1D	1750.0	4.00			.900	.850	.200	5.00	0.0300	0.0334	
2	2	0	4.16	1	CWP-1H	2500.0	4.00			.900	.850	.200	5.50	0.0108	0.0149	
2	2	0	4.16	1	COMP1B	800.0	4.00			.900	.850	.200	5.50	0.0609	0.0187	
2	2	0	4.16	4	SUR51B	1000.0	4.16			.850				0.0045	0.0051	
2	2	0	4.16	4	SUR51D	300.0	4.16			.850				0.1218	0.0374	
2	3	0	4.16	1	FAKE	1.0	4.00			.900	.850	.200	0.50	0.0	0.0	
2	4	0	4.16	1	FAKE	1.0	4.00			.900	.850	.200	6.50	0.0	0.0	
3	1	0	4.16	1	RR40ST	7000.0	4.00			.900	.850	.200	5.50	0.0018	0.0025	
3	2	0	4.16	1	RR40ST*3	7000.0	4.00			.900	.850	.200	5.50	0.0018	0.0025	
2	0	1	0.48	1	CROPIA*4	250.0	0.46			.900	.850	.200	5.60	0.0068	0.0085	
2	0	1	0.44	1	SACPIA	125.0	0.46			.900	.850	.200	6.50	0.0112	0.0077	
2	0	1	0.48	4	MCC-K	600.0	0.48			.850				0.0010	0.0015	

POOR ORIGINAL

INPUT BUS ELEMENT DATA

THE VALUES LISTED BELOW ARE ACTUAL INPUT AND NECESSARY ASSUMPTIONS

* IDENTIFIES THE STARTING MOTOR FOR VOLTAGE DROP STUDY

PROGRAM IDENTIFICATION - MOTOR(1), STATIC LOAD (4), GENERATOR(6)

TERM	BUS	BUS KV	IDENT	NAME-PLATE HP/KVA	BRAKE HP	RATED KV	X S/A	RES	EFF	R PF	S PF	LR/FLC	CABLE (OHMS)	
													RES	REACT
2	0 1	0.48	4 MCC-L	475.0		0.48				.850			0.0025	0.0026
2	0 1	0.48	4 MCC-M	500.0		0.48				.850			0.0025	0.0031
2	0 1	0.48	4 MCC-N	240.0		0.48				.850			0.0036	0.0045
2	0 1	0.48	4 MCC-P	430.0		0.48				.850			0.0036	0.0045
2	0 1	0.48	4 MCCQSI	235.0		0.48				.850			0.0058	0.0059
2	0 2	0.48	1 CPDP1B	250.0	0.0	0.46			.900	.850	.200	5.00	0.0068	0.0085
2	0 2	0.48	1 SACPIH	125.0	0.0	0.46			.900	.850	.200	6.50	0.0112	0.0077
2	0 2	0.48	4 MCC-T	100.0		0.48				.850			0.0016	0.0016
2	0 2	0.48	4 MCC-S	480.0		0.48				.850			0.0021	0.0027
2	0 2	0.48	4 MCC-U	400.0		0.48				.850			0.0032	0.0033
2	0 2	0.48	4 MCC-V	200.0		0.48				.850			0.0089	0.0092
2	0 2	0.48	4 MCC-W	320.0		0.48				.850			0.0046	0.0047
2	0 2	0.48	4 MCC-MP	200.0		0.48				.850			0.0090	0.0112
3	0 1	0.48	4 FAKE	1.0		0.48				.0			0.0	0.0

90000355

INPUT BUS REACTOR DATA

TERM	BUS	REACTANCE (OHMS)	RESISTANCE (OHMS)
2	1 0	0.0	0.0
2	2 0	0.0	0.0
2	3 0	0.005	0.004
2	4 0	0.005	0.004
3	1 0	0.0	0.0
3	2 0	0.0	0.0

INPUT STATION SERVICE TRANSFORMER AND CABLE DATA

TERM	BUS	MVA	CABLE VALUES (OHMS)			KV
			REACTANCE	X/R	TOLERANCE	
2	0 1	2.00	5.75 %	6.60	7.50 %	4.16
2	0 2	2.00	5.75 %	6.60	7.50 %	4.16
3	0 1	2.00	0.01 %	6.60	7.50 %	0.0

UNIT AUXILIARY TRANSFORMER TOLERANCE USED

2-WINDING	3-WINDING
7.50 %	10.00 %

INPUT UNIT AUXILIARY TRANSFORMER DATA

Wdg	TERM	MVA	% REACTANCE				BREAKER CAPABILITIES (KA)				MOM MJLT	
			XHL	XHM	XLM	X/R	INT.	40M.	LV	MV	LV	MV
3	2 3	30.0	12.50	10.00	0.0	25.00	0.0	0.0	0.0	0.0	0.0	0.0

BREAKER TIME DATA

TERM	BUS	BUS KV	TRIPPING TIME (CYCLES)		CONTACT PARTING TIME (CYCLES)	
			TRIP	LOCK	TRIP	LOCK
2	1 0	4.16	5.0		3.0	
2	2 0	4.16	5.0		3.0	
2	3 0	4.16	5.0		3.0	
2	4 0	4.16	5.0		3.0	
2	0 1	0.40	2.0		2.0	
2	0 2	0.40	2.0		2.0	
3	1 0	4.16	5.0		3.0	
3	2 0	4.16	5.0		3.0	
3	0 1	0.40	2.0		2.0	

POOR ORIGINAL

90000756

STEADY STATE VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D = 1.030(PU)

VOLTAGE AT BUS

TRM BUS RATED BUS KV ACTUAL BUS VOLTAGE

2	1 0	4.16	4.0106 (KV)
2	2 0	4.16	4.0106 (KV)
2	3 0	4.16	4.0106 (KV)
2	4 0	4.16	4.0106 (KV)
2	0 1	0.48	0.4397 (KV)
2	0 2	0.48	0.4450 (KV)
3	1 0	4.16	4.1215 (KV)
3	2 0	4.16	4.1215 (KV)
3	0 1	0.48	0.4756 (KV)

POOR ORIGINAL

VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D #1, 030(PU)

VOLTAGE AT BUS

TRM	BUS	KV	V/D CASE	BUS VOLTAGE RUNNING LOAD	BUS VOLTAGE STARTING LOAD	VOLTAGE AT MOTOR TERMINAL RUNNING LOAD	VOLTAGE AT MOTOR TERMINAL STARTING LOAD	PERCENTAGE RUN	PERCENTAGE START
2	1 0	4.16	1	4.0534 (KV)	3.7384 (KV)	4.0363 (KV)	3.6625 (KV)	100.91	91.56
2	2 0	4.16	1	4.0534 (KV)	3.7384 (KV)	4.0363 (KV)	3.6625 (KV)	100.91	91.56
2	3 0	4.16	1	4.0534 (KV)	3.7384 (KV)	4.0363 (KV)	3.6625 (KV)	100.91	91.56
2	4 0	4.16	1	4.0534 (KV)	3.7384 (KV)	4.0363 (KV)	3.6625 (KV)	100.91	91.56
2	0 1	0.48	1	0.4444 (KV)	0.4099 (KV)	0.4444 (KV)	0.4099 (KV)		
2	0 2	0.48	1	0.4507 (KV)	0.4157 (KV)	0.4507 (KV)	0.4157 (KV)		
3	1 0	4.16	1	4.1289 (KV)	4.0728 (KV)	4.1289 (KV)	4.0728 (KV)		
3	2 0	4.16	1	4.1289 (KV)	4.0728 (KV)	4.1289 (KV)	4.0728 (KV)		
3	0 1	0.48	1	0.4764 (KV)	0.4699 (KV)	0.4764 (KV)	0.4699 (KV)		
2	1 0	4.15	2	4.0414 (KV)	3.7881 (KV)	4.0317 (KV)	3.7355 (KV)	100.79	93.39
2	2 0	4.16	2	4.0414 (KV)	3.7881 (KV)	4.0317 (KV)	3.7355 (KV)	100.79	93.39
2	3 0	4.16	2	4.0414 (KV)	3.7881 (KV)	4.0317 (KV)	3.7355 (KV)	100.79	93.39
2	4 0	4.16	2	4.0414 (KV)	3.7881 (KV)	4.0317 (KV)	3.7355 (KV)	100.79	93.39
2	0 1	0.48	2	0.4431 (KV)	0.4153 (KV)	0.4431 (KV)	0.4153 (KV)		
2	0 2	0.48	2	0.4494 (KV)	0.4212 (KV)	0.4494 (KV)	0.4212 (KV)		
3	1 0	4.15	2	4.1268 (KV)	4.0819 (KV)	4.1268 (KV)	4.0819 (KV)		
3	2 0	4.16	2	4.1268 (KV)	4.0819 (KV)	4.1268 (KV)	4.0819 (KV)		
3	0 1	0.48	2	0.4762 (KV)	0.4710 (KV)	0.4762 (KV)	0.4710 (KV)		
2	1 0	4.16	3	4.0254 (KV)	3.8972 (KV)	4.0254 (KV)	3.8972 (KV)		
2	2 0	4.16	3	4.0254 (KV)	3.8972 (KV)	4.0254 (KV)	3.8972 (KV)		

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 (FOR CONTINUITY, Pgs 92, 93 Follow Pgs 94)

VOLTAGE DROP RESULTS

VOLTAGE AT HV TERMINAL OF AUX TRANSF FOR V/D = 1.039(IPU)

VOLTAGE AT BUS

TRM	BUS	KV	V/O CASE	BUS VOLTAGE		VOLTAGE AT MOTOR TERMINAL		PERCENTAGE
				RUNNING LOAD	STARTING LOAD	RUNNING LOAD	STARTING LOAD	
2	3 0	4.16	3	5.0254 (KV)	3.0972 (KV)			
2	4 0	4.16	3	4.0254 (KV)	3.8972 (KV)			
2	0 1	0.48	3	0.4413 (KV)	0.4273 (KV)			
2	0 2	0.48	3	0.4476 (KV)	0.4333 (KV)			
3	1 0	4.16	3	4.1834 (KV)	3.6486 (KV)			
3	2 0	4.16	3	4.1834 (KV)	3.6486 (KV)	4.1797 (KV)	3.6247 (KV)	104.47 90.62
3	0 1	0.48	3	0.4027 (KV)	0.4210 (KV)			
2	1 0	4.16	4	4.0138 (KV)	3.9904 (KV)			
2	2 0	4.16	4	4.0138 (KV)	3.9904 (KV)			
2	3 0	4.16	4	4.0138 (KV)	3.9904 (KV)			
2	4 0	4.16	4	4.0133 (KV)	3.9904 (KV)			
2	0 1	0.48	4	0.4420 (KV)	0.4238 (KV)	0.4372 (KV)	0.3986 (KV)	95.05 86.65
2	0 2	0.48	4	0.4463 (KV)	0.4437 (KV)			
3	1 0	4.16	4	4.1221 (KV)	4.1180 (KV)			
3	2 0	4.16	4	4.1221 (KV)	4.1180 (KV)			
3	0 1	0.48	4	0.4756 (KV)	0.4752 (KV)			

-- END --

POOR ORIGINAL

90000359