Table of Contents
Job #DEMO-JOB

Customer County Co-op
User Hometown Utility
Plant

VARIABLE FREQUENCY DRIVE

CUSTOMER	County Co-op	PAGE	1 of 37
ADDRESS	7833 West Road; Midland TX	JOB #	DEMO-JOB
USER	Hometown Utility; 789 Elm Street; Bryan TX 77840		
OWNER REPRESENTATIVE	Ed Smith	TELEPHONE	
DATE	2/8/2008	TEMPERATURE	95 °F
HUMIDITY	80 %	EQPT. LOCATION	
SUBSTATION	FINFEATHER	POSITION	TECH AREA

VFD	
MFG:	Fuji General Electric AF-300 P11
EQUIPMENT ID:	
I/D:	
P/N:	
MODEL/HP:	6KP1143100X9A1 / 100HP
ENG:	
SYSTEM S/N:	9944-01081M0001
INPUT:	380V-480V 134 AMPS
OUTPUT:0-460VAC	
ORDER:	
WIRING DIAGRAM:	1

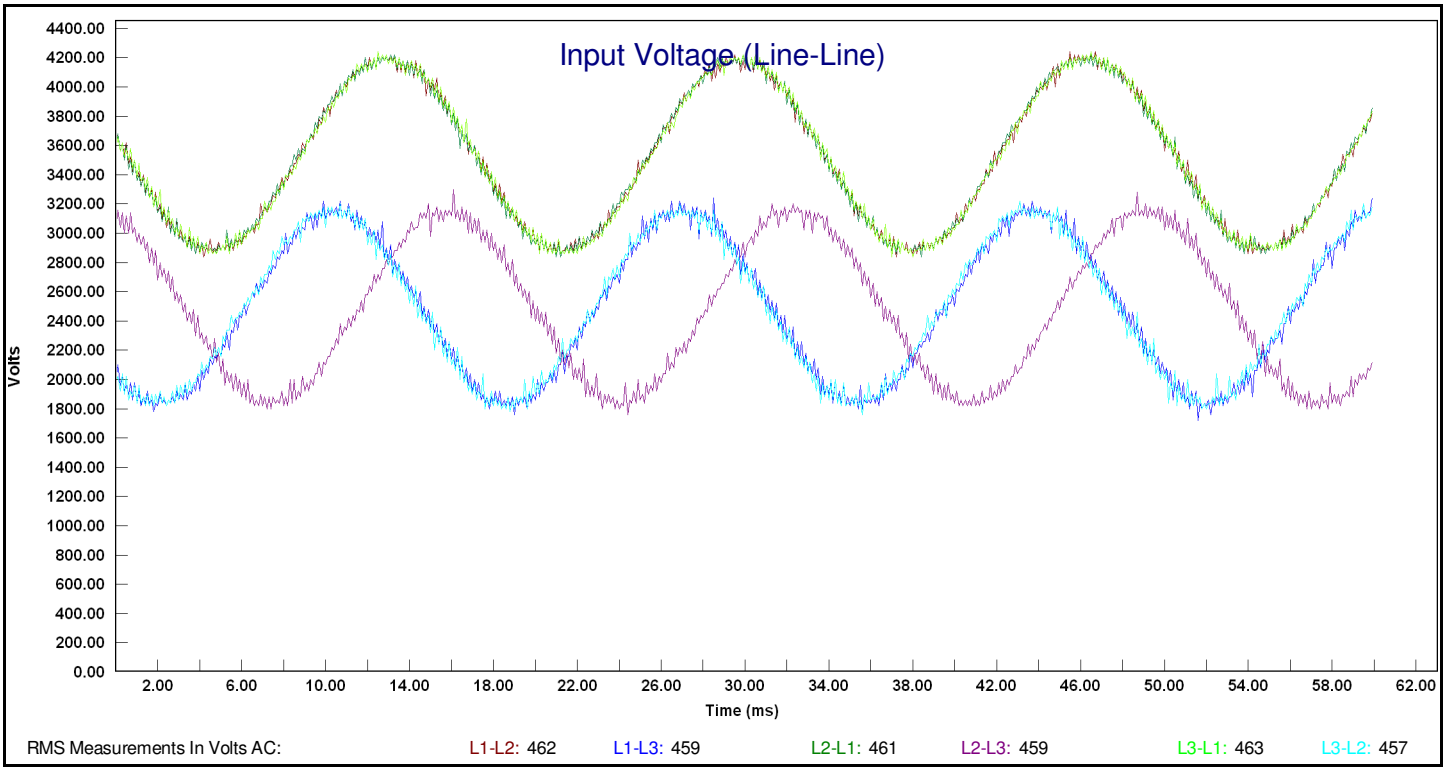
MOTOR	
MFG:	GENERAL ELECTRIC
EQUIPMENT ID:	
I/D:	
M/D:	5K82B488P205D12
HP:	25
FRAME:	284T
VOLTS:	480
AMPS:	28.8
RPM:	1775

COOLING FANS:	
Fan Manufacturer	
Fan Model Number	
Number of Fans	
Number of Fans Not Operating	
Number of Fans Replaced	

TEST LOCATION:		
L1 Channel 1	*Red Probe*	
L2 Channel 2	*Black Probe*	
Reference to Ground	Ground lead of scope	

DLRO READINGS (micro-ohms)

LABEL:	AS FOUND:	AS LEFT:	LABEL:	AS FOUND:	AS LEFT:
L1					
L2					
L3					
T1					
T2					
T3					

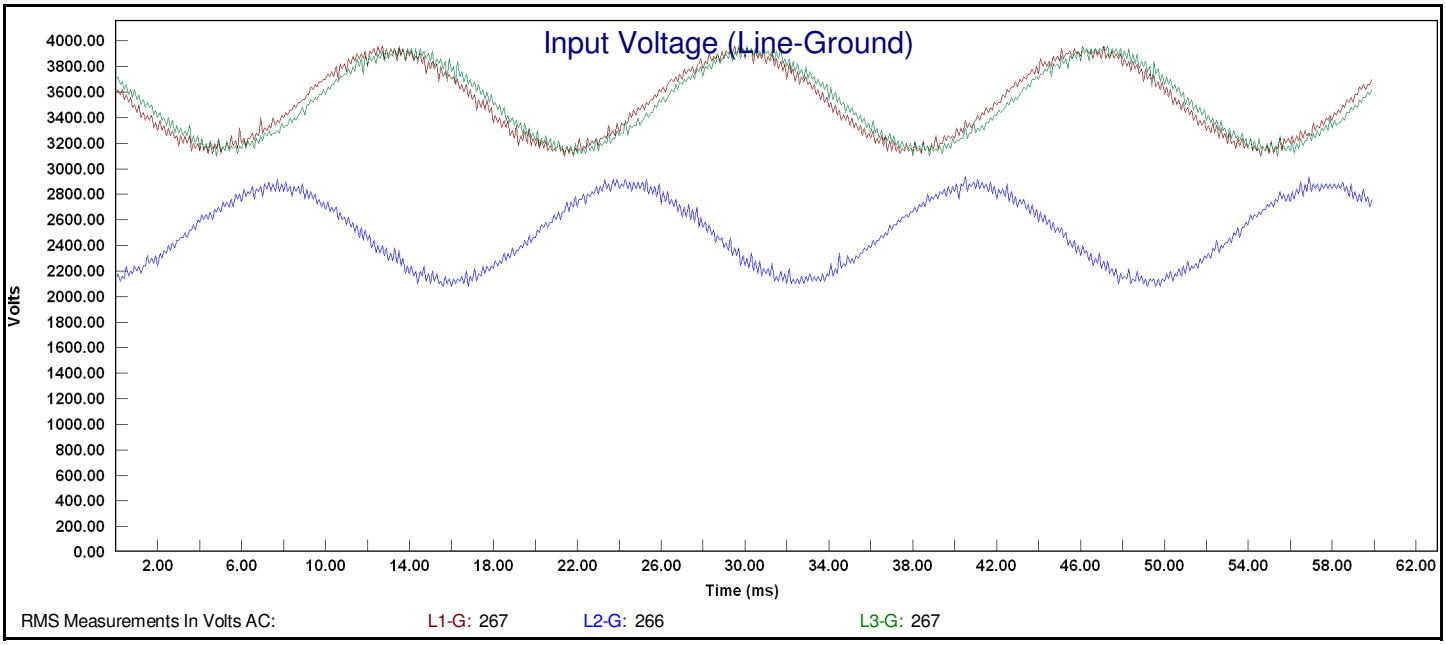


RMS Measurements In Volts AC: L1-L2: 462 L1-L3: 459 L2-L1: 461 L2-L3: 459 L3-L1: 463 L3-L2: 457

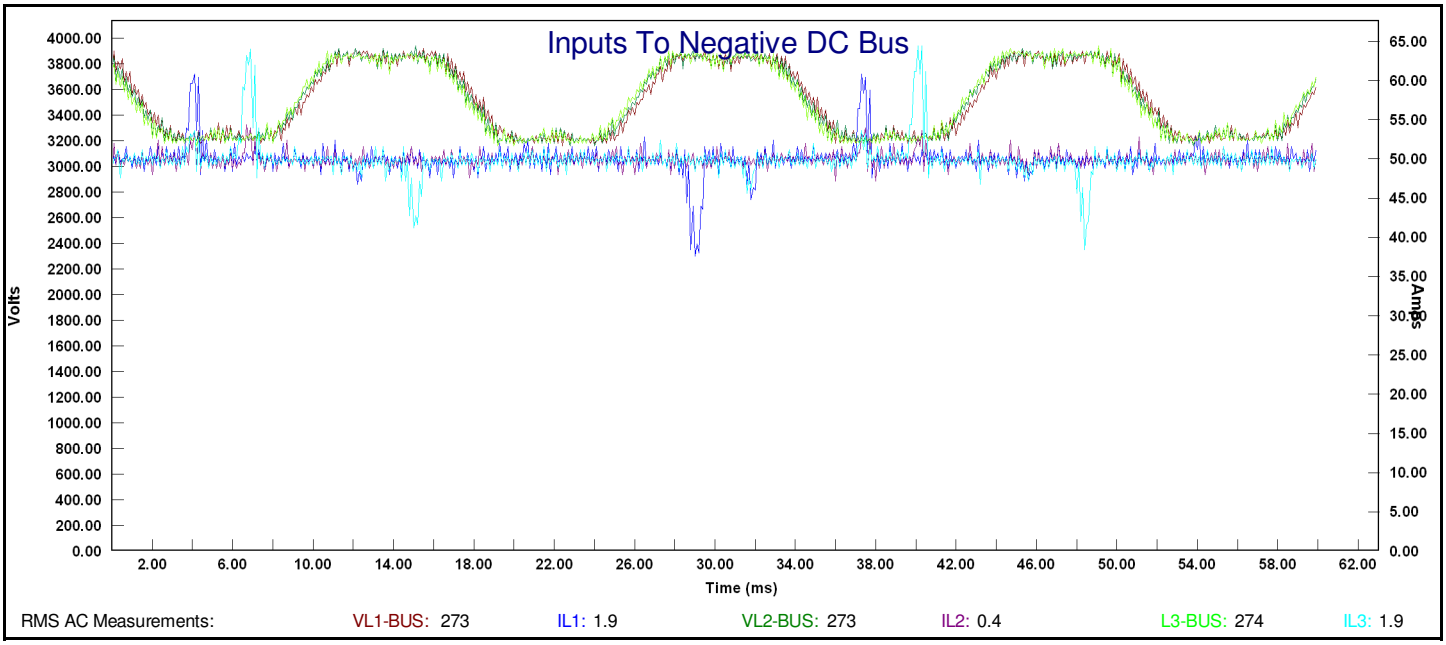
COMMENTS:

DEFICIENCIES:

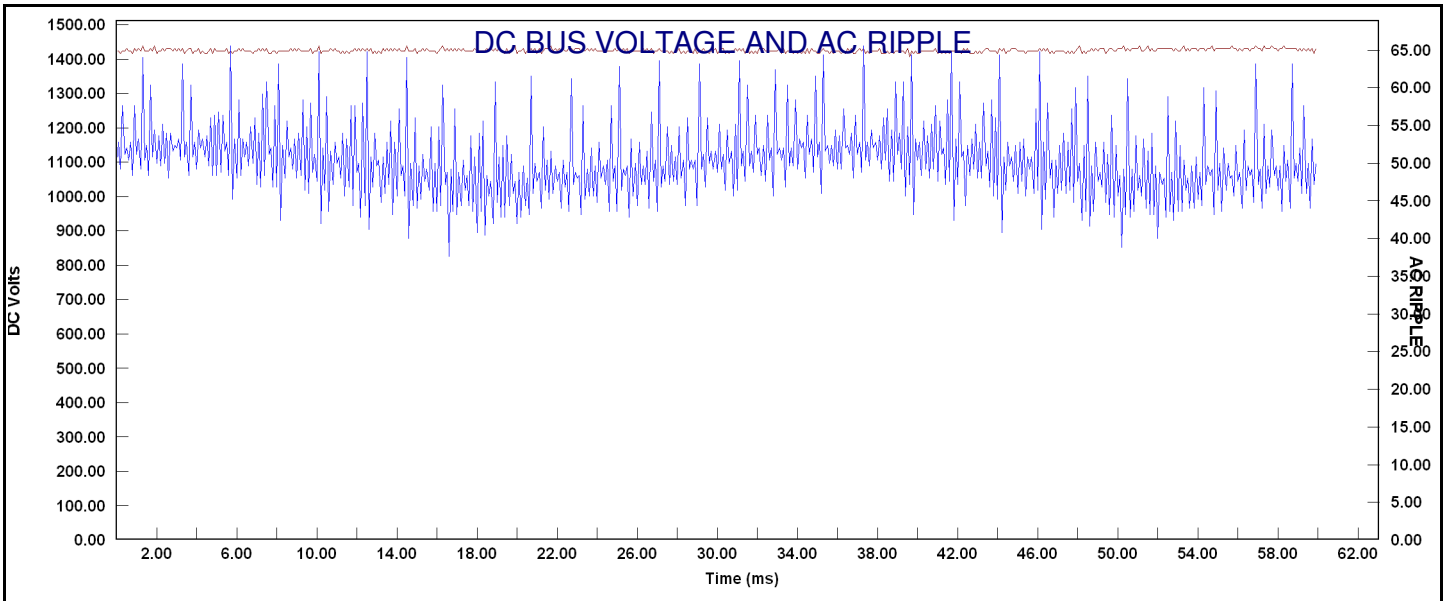
EQPT. INVENTORY NO. _____ TESTED BY: _____



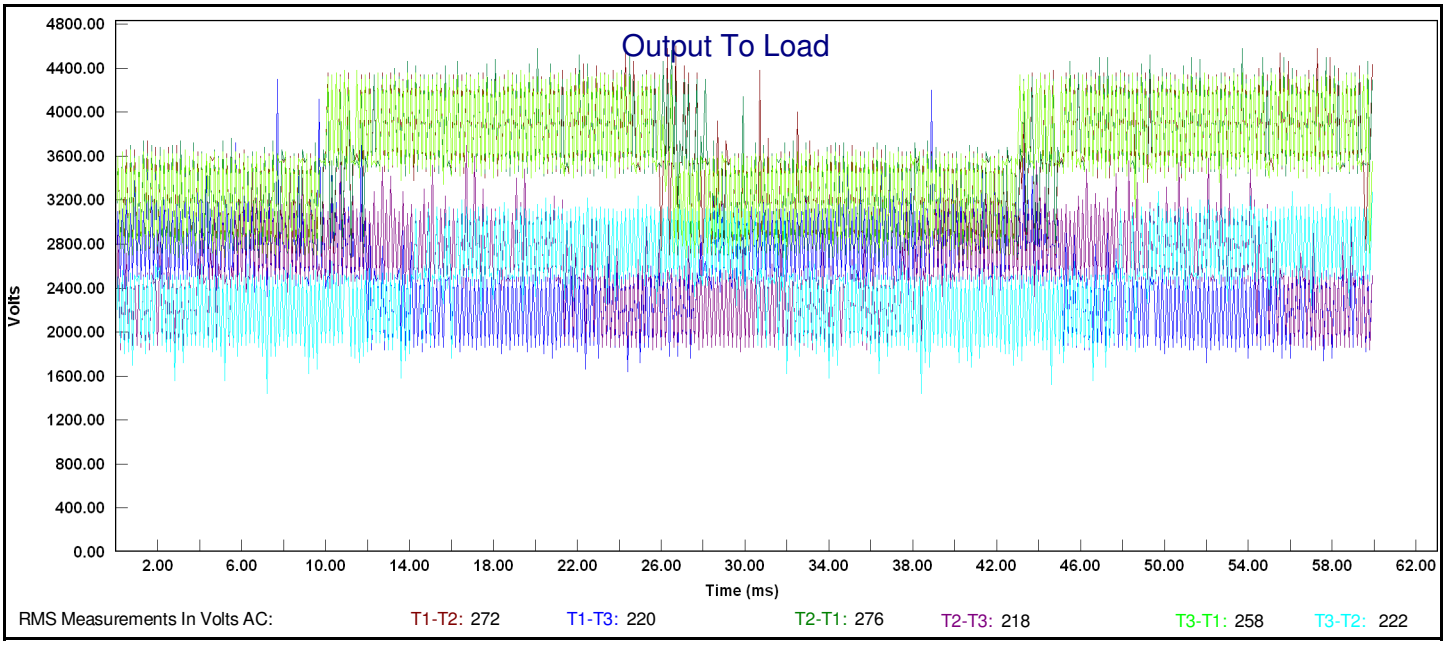
RMS Measurements In Volts AC: L1-G: 267 L2-G: 266 L3-G: 267



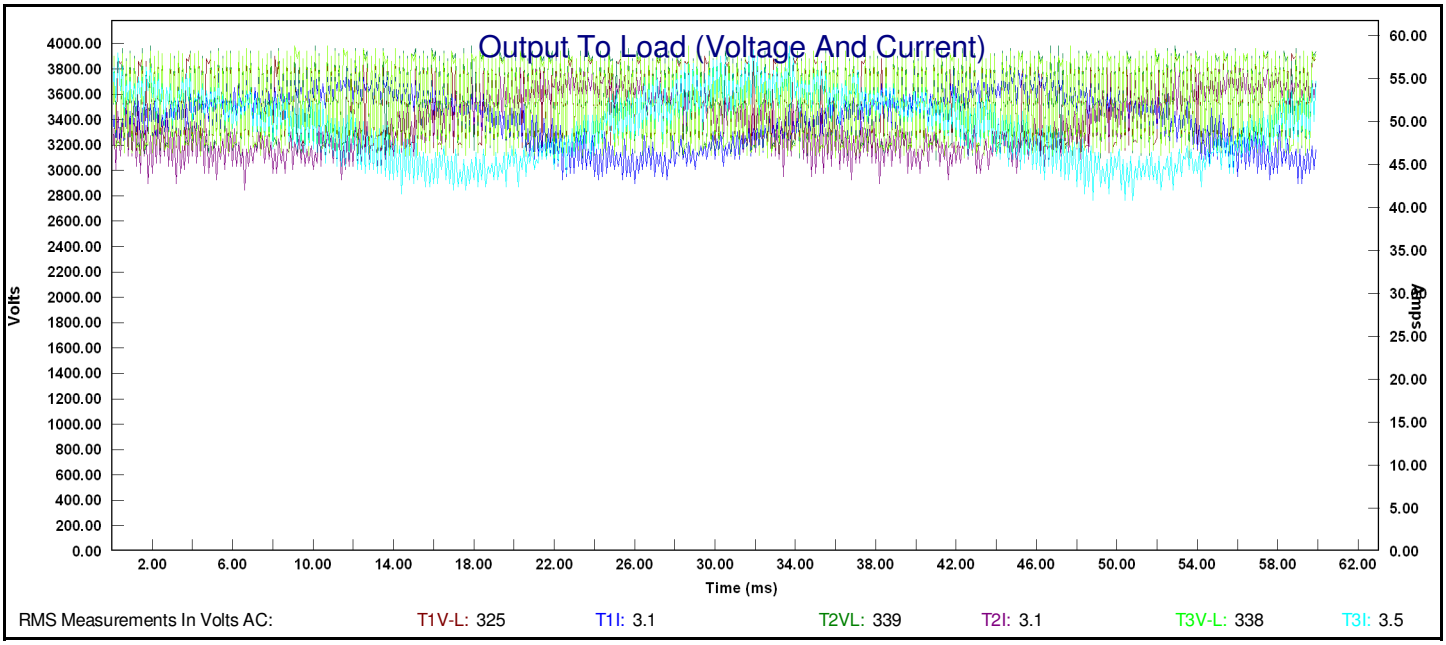
RMS AC Measurements: VL1-BUS: 273 IL1: 1.9 VL2-BUS: 273 IL2: 0.4 L3-BUS: 274 IL3: 1.9



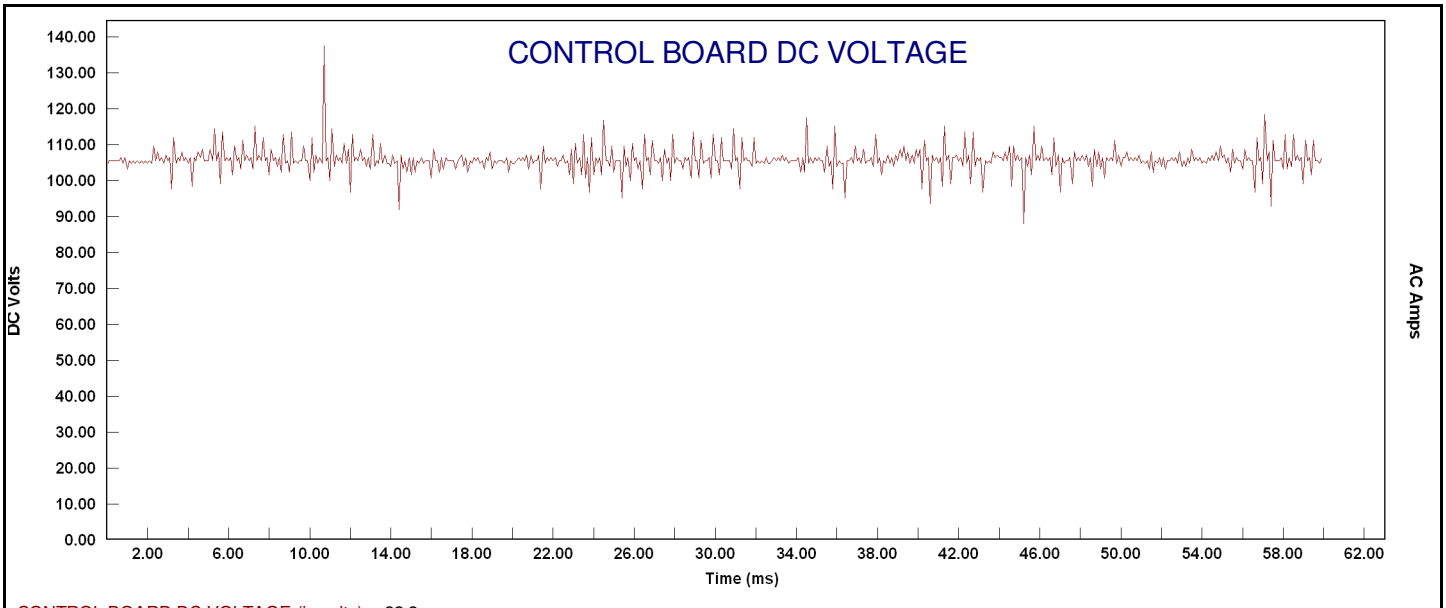
DC BUS VOLTAGE (in volts): 646 DC BUS AC RIPPLE (in volts): 1.8



RMS Measurements In Volts AC: T1-T2: 272 T1-T3: 220 T2-T1: 276 T2-T3: 218 T3-T1: 258 T3-T2: 222



RMS Measurements In Volts AC: T1V-L: 325 T1I: 3.1 T2VL: 339 T2I: 3.1 T3V-L: 338 T3I: 3.5



CONTROL BOARD DC VOLTAGE (in volts): 22.2

CURRENT TRASFORMER RATIO AND EXCITATION TEST

SECONDARY INJECTION - VOLTAGE

Your Company Logo

CUSTOMER	County Co-op	PAGE	4 of 37
ADDRESS	7833 West Road; Midland TX	JOB #	DEMO-JOB
USER	Hometown Utility; 789 Elm Street; Bryan TX 77840		
OWNER REPRESENTATIVE	Ed Smith	TELEPHONE	
DATE	2/6/2008	TEMPERATURE	70 °F
HUMIDITY	80 %	EQPT. LOCATION	3 FLOOR WEST
SUBSTATION	A-123	POSITION	MAIN

NAMEPLATE DATA

MANUFACTURER	ABB Inc	VOLTAGE RATING	600 V	RELAY ACC. CLASS	C400
TYPE	BYM	BASIC IMPULSE LVL	95 kV	METER ACC. CLASS	0.3
CATALOG NO.	123456789	FREQUENCY	60 Hz	BURDEN RATING	B-4
MODEL NO.	123456789	MAX RATIO	1200:5	CURVE SHEET NO.	72-280-269-464
PART/STYLE NO.	123456789	AVAILABLE RATIOS	1200:5		

TRANSFORMER IDENTIFICATION AND CONNECTIONS

PHASE 1	BCT-1Y	PHASE 2	BCT-3Y	PHASE 3	BCT-5Y	◯ LINE SIDE	◯ LOAD SIDE
SERIAL #	123456789	SERIAL #	987654321	SERIAL #	5465456789	CONSTRUCTION TYPE	

TAP X1-X5 RATIO 1200:5 CONFIGURATION ◯ WYE ◯ DELTA CONNECTED BURDEN SEL-311 LINE CURRENT LINE CURRENT DIFFERENTIAL

VISUAL AND MECHANICAL INSPECTION

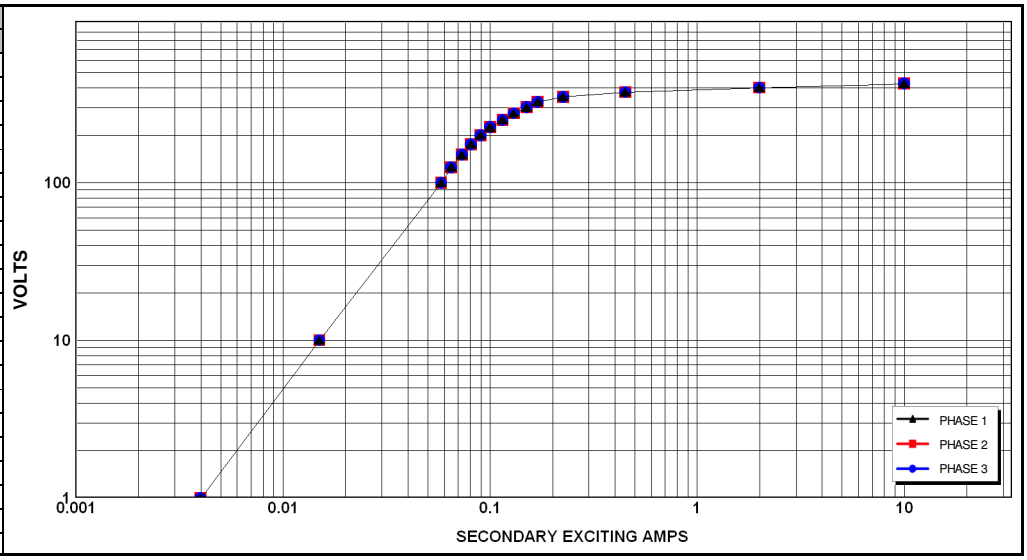
DESCRIPTION	INSPECTED	CONDITION	DESCRIPTION	INSPECTED	CONDITION
EQUIPMENT NAMEPLATE DATA			OVERALL CLEANLINESS		
PHYSICAL CONDITION			BOLTED ELECTRICAL CONNECTIONS		
CORRECT CONNECTION			GROUNDING AND SHORTING CONNECTIONS		
ADEQUATE CLEARANCES			CKTS GROUNDED AND ONE GROUNDING POINT		

ELECTRICAL TESTS

Insulation Resistance	PHASE 1 BCT-1Y		PHASE 2 BCT-3Y		PHASE 3 BCT-5Y	
TEST VOLTAGE 1,000 VDC	READING MΩ	20ºC MΩ	READING MΩ	20ºC MΩ	READING MΩ	20ºC MΩ
WDG-TO-WDG	100,000	105,556	100,000	105,556	100,000	105,556
'H' WDG-TO-GND	100,000	105,556	100,000	105,556	100,000	105,556
'X' WDG-TO-GND	100,000	105,556	100,000	105,556	100,000	105,556

Ratio Verification		PHASE 1 BCT-1Y				PHASE 2 BCT-3Y				PHASE 3 BCT-5Y			
SECONDARY TAPS	TURN RATIO	APPLIED SEC VOLTAGE	INDUCED PRI VOLTAGE	MEASURED RATIO	% ERROR	APPLIED SEC VOLTAGE	INDUCED PRI VOLTAGE	MEASURED RATIO	% ERROR	APPLIED SEC VOLTAGE	INDUCED PRI VOLTAGE	MEASURED RATIO	% ERROR
X1 - X2	40	40.000	0.998	40.080	0.20 %	40.000	1.001	39.960	-0.10 %	40.000	0.994	40.241	0.60 %
X1 - X3	60	60.000	0.998	60.120	0.20 %	60.000	1.001	59.940	-0.10 %	60.000	0.997	60.181	0.30 %
X1 - X4	160	160.000	0.997	160.481	0.30 %	160.000	1.000	160.000	0.00 %	160.000	0.998	160.321	0.20 %
X1 - X5	240	240.000	0.999	240.240	0.10 %	240.000	1.006	238.569	-0.60 %	240.000	0.999	240.240	0.10 %
					%				%				%
Polarity	H1 - X1	◯ AGREE	◯ DISAGREE	◯ N/T		◯ AGREE	◯ DISAGREE	◯ N/T		◯ AGREE	◯ DISAGREE	◯ N/T	

Excitation	TAP X1 - X5		
VOLTS INJECTED	AMPERES MEASURED		
	PHASE 1	PHASE 2	PHASE 3
1	0.004	0.004	0.004
10	0.015	0.015	0.015
100	0.058	0.058	0.058
125	0.065	0.065	0.065
150	0.073	0.073	0.073
175	0.081	0.081	0.081
200	0.090	0.090	0.090
225	0.100	0.100	0.100
250	0.115	0.115	0.115
275	0.130	0.130	0.130
300	0.150	0.150	0.150
325	0.170	0.170	0.170
350	0.225	0.225	0.225
375	0.450	0.450	0.450
400	2.000	2.000	2.000
425	10.000	10.000	10.000



COMMENTS:

DEFICIENCIES:

EQPT. INVENTORY NO. TESTED BY:

SEL 351
DIRECTIONAL OVERCURRENT RELAY

Your Company Logo

CUSTOMER County Co-op | PAGE 5 of 37

ADDRESS 7833 West Road; Midland TX | JOB # DEMO-JOB

USER Hometown Utility; 789 Elm Street; Bryan TX 77840

OWNER REPRESENTATIVE Ed Smith | TELEPHONE

DATE 2/6/2008 | TEMPERATURE 70 °F | HUMIDITY 80 % | EQPT. LOCATION 3 FLOOR WEST

SUBSTATION A-123 | POSITION MAIN

Unit	Pickup (amps)					Timing						
	Theo Current	Min Current	Max Current	As Found Current	As Left Current	Multiple	Value Current	Theo Seconds	As Found Sec	As Found Error	As Left Sec	As Left Error
51P Phase A-N	5	4.75	5.25			3	15					
						5	15					
						7	15					
51P Phase B-N	5	4.75	5.25			3	15					
						5	25					
						7	35					
51P Phase C-N	5	4.75	5.25			3	15					
						5	25					
						7	35					
51A						3						
						5						
						7						
51B						3						
						5						
						7						
51C						3						
						5						
						7						
51G						3						
						5						
						7						
51Q						3						
						5						
						7						
51N						3						
						5						
						7						

Unit	Pickup (amps)								
	Theo Current	Min Current	Max Current	A - N		B - N		C - N	
				As Found	As Left	As Found	As Left	As Found	As Left
50P1									
50P2									
50P3									
50P4									
50P5									
50P6									

COMMENTS:

DEFICIENCIES:

EQPT. INVENTORY NO. | TESTED BY:

SEL 351
DIRECTIONAL OVERCURRENT RELAY

Under - Over Voltage Phase Pickups (volts)										
	Theo	Min	Max	A Phase Volts		B Phase Volts		C Phase Volts	
Unit	Volts	Volts	Volts	As Found	As Left	As Found	As Left	As Found	As Left
27P1P UV	5	3.75	6.25						
27P2P UV									
59P1P OV									
59P2P OV									

Under - Over Voltage Phase To Phase Pickups									
	Theo	Min	Max	Phase A-B Volts		Phase B-C Volts		Phase C-A Volts	
Unit	Volts	Volts	Volts	As Found	As Left	As Found	As Left	As Found	As Left
27PP UV									
59PP OV									

Phase To Phase Instantaneous Pickups (amps)									
	Theo	Min	Max	Phase A-B Current		Phase B-C Current		Phase C-A Current	
Unit	Current	Current	Current	As Found	As Left	As Found	As Left	As Found	As Left
50PP1									
50PP2									
50PP3									
50PP4									

Voltage Pickups					
	Theo	Min	Max	Volts	
Unit	Volts	Volts	Volts	As Found	As Left
27P1P 3PH	5	3.75	6.25		
59P1P 3PH					
59N1P OV					
59N2P OV					
59QP OV					
59V1P OV					
27B81P					
27SP					
59S1P					
59S2P					
25VLO					
25VHI					

Current Pickups (amps)					
	Theo	Min	Max	Current	
Unit	Current	Current	Current	As Found	As Left
50PP1					
50PP2					
50PP3					
50PP4					
50G1					
50G2					
50G3					
50G4					
50G5					
50G6					
50Q1					
50Q2					
50Q3					
50Q4					
50Q5					
50Q6					
50QR					
50QF					
50N1					
50N2					
50N3					
50N4					
50N5					
50N6					

Sync Angle (degrees)					
UNIT	Angle	Min	Max	As Found	As Left
25ANG1	LEADING:				
	LAGGING:				
25ANG2	LEADING:				
	LAGGING:				

Slip Frequency						
	Min	Max	Pickup Hz		Drop Out Hz	
Unit	Hz	Hz	As Found	As Left	As Found	As Left
25						

COMMENTS:

DEFICIENCIES:

Frequency Pickup						Frequency Time				
	Theo	Min	Max	Hz		Applied	Seconds		Seconds	
Unit	Hz	Hz	Hz	As Found	As Left	Hz.	Min	Max	As Found	As Left
81D1										
81D2										
81D3										
81D4										
81D5										
81D6										

Reach								
			Current (amps)		Impedance (ohms)		Error	
Unit	Angle	Voltage	As Found	As Left	As Found	As Left	As Found	As Left
Z2R								
Z2F								

Timer						
			Min	Max	Seconds	
Unit	Multiple	Value	Seconds	Seconds	As Found	As Left
67P1						
67P2						
67P3						
67P4						
67G1						
67G2						
67G3						
67G4						
67Q1						
67Q2						
67Q3						
67Q4						
67N1						
67N2						
67N3						
67N4						

SEL 351
DIRECTIONAL OVERCURRENT RELAY

Identifier Labels
RID =
TID =

Current And Potential Transformer Ratios
CTR = PTR =
CTRN = PTRS =
VNOM =

Line Settings
Z1MAG = Z1ANG =
Z0MAG = Z0ANG =
Z0SMAG = Z0SANG =
LL =

Other Enable
E32 ESV ESOTF EVOLT
E79 EDEM E25 ELOAD
E81 ELOP EFLOC ESSI
EPWR ECOMM

Load-Encroachment Elements
ZLF = ZLR =
PLAF = NLAF =
PLAR = NLAR =

Directional Elements
DIR1 = DIR2 =
DIR3 = DIR4 =
ORDER = 50P32P =
Z2F = Z2R =
50QFP = 50QRP =
a2 = k2 =
50GFP = 50GRP =
a0 = Z0F =
Z0R = 50NFP =
50NRP = a0N =

Reclosing Relay
79OI1 = 79OI2 =
79OI3 = 79OI4 =
79RSD = 79RSLD =
79CLSD =

Additional DCUB Trip Scheme Settings
GARD1D = UBDURD =
UBEND =

Other Settings
TDURD = CFD =
3POD = 50LP =

Wattmetric Element Settings
59RES = 32WFP =
32WRP = 32WD =

Synchronism Check Elements
25VLO = 25VHI =
25SF = 25ANG1 =
25ANG2 = SYNCP =
TCLOSD =

Voltage Sag / Swell / Interrupt
VINT = VSAG =
VSWELL =

DCB Trip Scheme Settings
Z3XPU = Z3XD =
BTXD = 67P2SD =
67N2SD = 67G2SD =
67Q2SD =

POTT Trip Scheme Settings
Z3RBD = EBLKD =
ETDPU = EDURD =
EWFC

Instantaneous Overcurrent Elements

Unit	PkUp(50x1P)	PkUp(50x2P)	PkUp(50x3P)	PkUp(50x4P)	PkUp(50x5P)	PkUp(50x6P)	Enable(E50x)
Ph-Ph(PP)							
Phase(P)							
Neutral(N)							
Res. Gnd.(G)							
Neg. Seq.(Q)							

Definite Time Overcurrent Elements

Unit	Time Delay (67x1D)	Time Delay (67x2D)	Time Delay (67x3D)	Time Delay (67x4D)
Phase(P)				
Neutral(N)				
Res. Gnd.(G)				
Neg. Seq.(Q)				

Time Overcurrent Elements

Unit	Pickup (51xP)	Curve (51xC)	Time Dial (51xTD)	EM Reset (51xRS)	Enable(E51x)
A Phase(A)					
B Phase(B)					
C Phase(C)					
Ph-Ph(P)	5				
Neutral(N)					
Res. Gnd.(G)					
Neg. Seq.(Q)					

Power Elements

#	PhPkUp (PWRxP)	3PhPkUp (3PWRxP)	Type (PWRxT)	Time Delay (PWRxD)
1				
2				
3				
4				

SELogic Control Equation Variable Timers

#	Pickup (SVxPU)	Dropout (SVxDO)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

Frequency Elements

#	Pickup (81DxP)	Dropout (81DxD)
1		
2		
3		
4		
5		
6		

Voltage Elements

UNIT	PkUp (xxxxP)	PkUp (xxx2P)
Phase Over V (59P1)		
VS Over V (59S)		
NegSeq Over V (59Q)		
ZeroSeq Over V (59N)		
PosSeq Over V (59V1)		
Ph-Ph Over V (59P)		
Ph-Ph Under V (27P)		
VS Under V (27S)		
Phase Under V (27P1)	5	
Ph UV Block (27B81)		

Switch-Onto-Fault
CLOEND = 52AEND =
SOTFD =

Demand Metering Settings
DMTC = PDEMP =
NDEMP = GDEMP =
QDEMP =

Reclosing Relay Equations
79RI =
79RIS =
79DTL =
79DLS =
79SKP =
79STL =
79BRS =
79SEQ =
79CLS =

Trip Logic Equations
TR =
TRCOMM =
TRSOTF =
DTT =
ULTR =

Close Logic Equations
52A =
CL =
ULCL =

Communications-Assisted Trip Scheme Input Equations
PT1 =
LOG1 =
PT2 =
LOG2 =
BT =

SEL 351
DIRECTIONAL OVERCURRENT RELAY

Torque Control Equations for Time Overcurrent

51ATC =
51BTC =
51CTC =
51PTC =
51NTC =
51GTC =
51QTC =

Torque Control Equations for Inst./Def. Time Overcur

67P1TC =
67P2TC =
67P3TC =
67P4TC =
67N1TC =
67N2TC =
67N3TC =
67N4TC =
67G1TC =
67G2TC =
67G3TC =
67G4TC =
67Q1TC =
67Q2TC =
67Q3TC =
67Q4TC =

Setting Group Selection Equations

SS1 =
SS2 =
SS3 =
SS4 =
SS5 =
SS6 =

Output Contact Equations

OUT101 =
OUT102 =
OUT103 =
OUT104 =
OUT105 =
OUT106 =
OUT107 =
OUT201 =
OUT202 =
OUT203 =
OUT204 =
OUT205 =
OUT206 =
OUT207 =
OUT208 =
OUT209 =
OUT210 =
OUT211 =
OUT212 =

SELogic Control Equation Variable Timer Input

SV1 =
SV2 =
SV3 =
SV4 =
SV5 =
SV6 =
SV7 =
SV8 =
SV9 =
SV10 =
SV11 =
SV12 =
SV13 =
SV14 =
SV15 =

Front-Panel Display Operation

FP_TO = SCROLD =
FPNGD =

Latch Bits Set / Reset Equations

#	Set Latch Bit (SETx)	Reset Latch Bit (RSTx)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

Mirrored Bits Transmit Equations

#	Channel A (TMBxA)	Channel B (TMBxB)
1		
2		
3		
4		
5		
6		
7		
8		

Display Points

#	Equation (DPx)	On Label (DPx_1)	Off Label (DPx_0)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

Load Profile Settings

LDLIST = LDAR =

Power System Config & Date Format

NFREQ = PHROT =
DATE_F =

Station DC Battery Monitor

DCLOP = DCHIP =

Settings Group Change Delay

TGR =

Event Parameters

LER = PRE =

Optoisolated Input Timers

IN101D = IN102D =
IN103D = IN104D =
IN105D = IN106D =
IN201D = IN202D =
IN203D = IN204D =
IN205D = IN206D =
IN207D = IN208D =

Breaker Monitor Settings

COSP1 = COSP2 =
COSP3 = KASP1 =
KASP2 = KASP3 =
EBMON = ☐

Other Equations

ER =
FAULT =
BSYNCH =
CLMON =
BKMON =
E32IV =

Sequential Events Recorder Triggers

SER1 =
SER2 =
SER3 =

Voltage Input Configuration

PTCONN = VSCONN =

Reclosing Relay Labels

79LL = _____ 79SL = _____

Protocol Settings

PROTO = _____ PREFIX = _____

ADDR = _____ SETTLE = _____

Communication Settings

SPEED = _____ BITS = _____

PARITY = _____ STOP = _____

Other Port Settings

T_OUT = _____ AUTO = _____

RTSCTS = _____ FASTOP = ☐

Local Bit Labels

#	Local Bit (NLBx)	Clear Local Bit (CLBx)	Set Local Bit (SLBx)	Pulse Local Bit (PLBx)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

CEY51A RELAY

CUSTOMER	County Co-op	PAGE	11 of 37
ADDRESS	7833 West Road; Midland TX	JOB #	DEMO-JOB
USER	Hometown Utility; 789 Elm Street; Bryan TX 77840		
OWNER REPRESENTATIVE	Ed Smith	TELEPHONE	
DATE	2/6/2008	TEMPERATURE	70 °F
HUMIDITY	85 %	EQPT. LOCATION	3 FLOOR WEST
SUBSTATION	A-123	POSITION	MAIN

RELAY SETTINGS

MANUFACTURER	General Electric	TYPE	CEY	MODEL	
CT RATIO	60	PT RATIO	30	VOLTAGE CLASS	138
SEC. OHMIC REACH	0.75 ohms	BMR	.75 ohms	PERCENT TAP	100 %
MAX TORQUE ANG.	60 degrees	SEAL IN	2.0 amps	ALLOWED ERROR	3.00 %
				MTA ALLOWED ERROR	2.00 degrees

REACH TESTS

Angle	Impedance In Ohms			A - B				B - C				C - A			
(degrees)	Calc.	Min.	Max	Volts	Amps	Ohms	Pass / Fail	Volts	Amps	Ohms	Pass / Fail	Volts	Amps	Ohms	Pass / Fail
60	0.75	0.73	0.79	10.00	6.60	0.76	PASS	10.00	6.60	0.76	PASS	10.00	6.60	0.76	PASS

MAX TORQUE ANGLE TEST

Min. Angle (degrees)	Max. Angle (degrees)	Test Ohms	Test Amps	A - B				B - C				C - A			
				CW Ang. (degrees)	CCW Ang. (degrees)	MTA (degrees)	Pass / Fail	CW Ang. (degrees)	CCW Ang. (degrees)	MTA (degrees)	Pass / Fail	CW Angle (degrees)	CCW Ang. (degrees)	MTA (degrees)	Pass / Fail
58.00	62.00	0.60	8.33	27.90	90.50	59.20	PASS	27.50	90.70	59.10	PASS	28.40	90.60	59.50	PASS

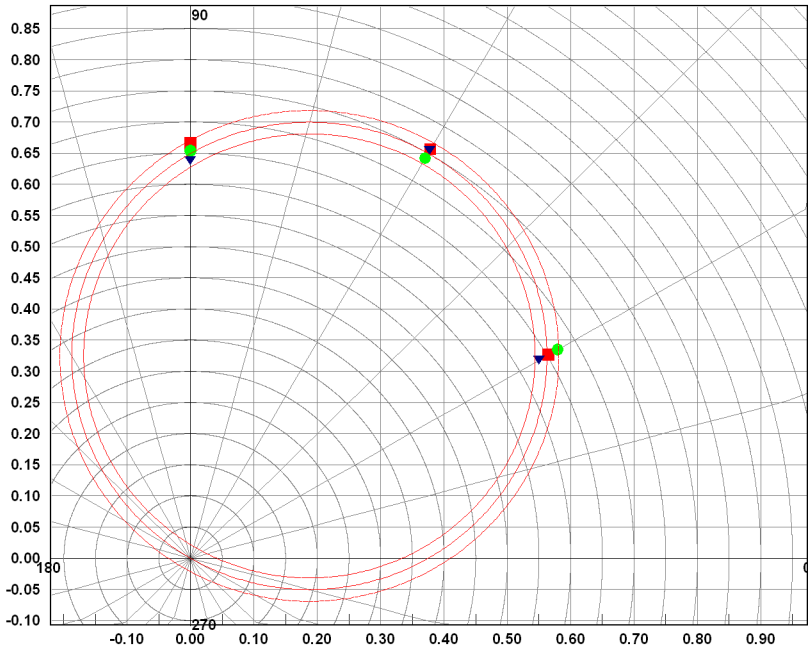
CHARACTERISTIC TESTS

Angle	Impedance In Ohms			A - B				B - C				C - A			
(degrees)	Calc.	Min.	Max	Volts	Amps	Ohms	Pass / Fail	Volts	Amps	Ohms	Pass / Fail	Volts	Amps	Ohms	Pass / Fail
30	0.65	0.63	0.67	10.00	7.66	0.65	PASS	10.00	7.47	0.67	PASS	10.00	7.87	0.64	PASS
60	0.75	0.73	0.77	10.00	6.60	0.76	PASS	10.00	6.75	0.74	PASS	10.00	6.62	0.76	PASS
90	0.65	0.63	0.67	10.00	7.51	0.67	PASS	10.00	7.65	0.65	PASS	10.00	7.84	0.64	PASS

Phase A-B: Red Squares

Phase B-C: Green Circles

Phase C-A: Blue Triangles



COMMENTS:

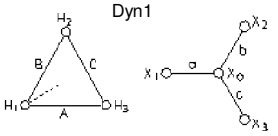
DEFICIENCIES:

EQPT. INVENTORY NO. _____ TESTED BY: _____

TRANSFORMER TURNS RATIO TEST

CUSTOMER	County Co-op	PAGE	12 of 37
ADDRESS	7833 West Road; Midland TX	JOB #	DEMO-JOB
USER	Hometown Utility; 789 Elm Street; Bryan TX 77840		
OWNER REPRESENTATIVE	Ed Smith	TELEPHONE	
DATE	2/7/2008	TEMPERATURE	76 °F
HUMIDITY	60 %	EQPT. LOCATION	YARD
SUBSTATION	A-123	POSITION	MAIN

NAMEPLATE DATA



MFR	Ferranti Packard	YEAR	1958
SER NO	9911222	WEATHER	Cloudy
WEIGHT	724000 LB	OIL TEMP	24 °C
TYPE	SEALED	BIL	550 kV
CLASS	ONAN/OFAF	PHASES	3
COOLANT	OIL	WDG MATERIAL	Cu
REASON	Routine	ALLOWED ERR	0.5 %
OIL VOLUME	11870 UG		

Test Voltage 80 V

	VOLTAGE (kV)	mVA	RATED I	# TAPS	NOMINAL	CHANGER	TAP SETTING
PRIMARY:	345	47	236	5	3	Off Load	
SECOND:	12.5 / 7.22	47	6,513	1			

BUSHING NAMEPLATE						
DSG	SERIAL NUM	MFR.	TYPE/CLASS	kV	AMPS	YEAR
H1						
H2						
H3						
H0						
X1						
X2						
X3						
X0						

TRANSFORMER TURNS RATIO TESTS

Test #	PRIMARY TAP	SEC. TAP	HIGH SIDE VOLTAGE	LOW SIDE VOLTAGE	CALC RATIO	$H_1 H_3 / X_1 X_0$				$H_2 H_1 / X_2 X_0$				$H_3 H_2 / X_3 X_0$			
						Ratio	Error	Iexc	Ph(min)	Ratio	Error	Iexc	Ph(min)	Ratio	Error	Iexc	Ph(min)
1	R2 (1)	Nominal	362,250	12,500	50.1948	26.8531	-46.50	0.1	-0.2	26.9234	-46.36	0.1	-0.3	26.9832	-46.24	0.1	-0.3
2	R1 (2)	Nominal	353,625	12,500	48.9997	48.9360	-0.13	0.1	-0.0	48.8822	-0.24	0.1	-0.2	48.7774	-0.45	0.2	-0.2
3	Nominal	Nominal	345,000	12,500	47.8046	47.3636	-0.92	0.1	0.0	47.4111	-0.82	0.2	-0.2	47.6559	-0.31	0.1	-0.3
4	L1 (4)	Nominal	336,375	12,500	46.6095	30.5679	-34.42	0.2	-0.1	30.9844	-33.52	0.2	-0.1	32.6448	-29.96	0.1	-0.2
5	L2 (5)	Nominal	327,750	12,500	45.4144	45.4662	0.11	0.1	-0.1	45.4963	0.18	0.1	-0.2	45.4977	0.18	0.1	-0.1

COMMENTS:

DEFICIENCIES: Tests 1,3,4 Failed

EQPT. INVENTORY NO. _____ TESTED BY: _____

OIL CIRCUIT BREAKERS
CAPACITANCE AND POWER FACTOR TESTS

Your Company Logo

CUSTOMER	County Co-op	PAGE	13 of 37
ADDRESS	7833 West Road; Midland TX	JOB #	DEMO-JOB
USER	Hometown Utility; 789 Elm Street; Bryan TX 77840		
OWNER REPRESENTATIVE	Ed Smith	TELEPHONE	
DATE	2/7/2008	TEMPERATURE	62.6 °F
HUMIDITY	1 %	EQPT. LOCATION	COH Fed. Rd.
SUBSTATION	A-123	POSITION	MAIN

SERIAL NO.	27805	SPECIAL ID	C110
CIRCUIT	C110	AMPS.	2000
MFR	Mc-Ed	kV	145
MFR YEAR	1958 LOC.	BIL	650
TYPE	ALP-60	INT. RATING	63.0 kA
MEC. TYPE	OA-4	INT. MEDIUM	
MEC. DESIGN		WEIGHT	lbs
REASON	BUSHING REPL	WEATHER	PTCLDY
TANKS 3	CONTROL VOLTS 120	OIL TEMP	18 °C
OIL TYPE	CONVENTIONAL	COUNTERS	,,

PHASE NAMES ,,
CLASS
LAYOUT

BUSHING NAMEPLATE

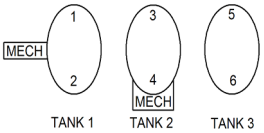
DSG	SERIAL NUM	MFR.	TYPE/CLASS	kV	AMPS	YEAR
1	E74505	Mc-Ed	NONE	145	2000	1985
2	E74506	Mc-Ed	NONE	145	2000	1985
3	E74504	Mc-Ed	NONE	145	2000	1985
4	E74509	Mc-Ed	NONE	145	2000	1985
5	E74508	Mc-Ed	NONE	145	2000	1985
6	E74507	Mc-Ed	NONE	145	2000	1985

CIRCUIT BREAKER OVERALL TESTS

CB	TEST NO	INSULATION TESTED	Ph.	TEST MODE	BUSHINGS CONNECTIONS ENG	BUS FT	INS #	TLI	TEST kV	CAP. (PF)	% POWER FACTOR MEAS.	20° C	CORR.	EQUIV mA	WATTS	IR
OPEN	1	C_{1G}	A	GST GND	1				10.00		0.59	0.59	1.000	2.003	0.1190	I /
	2	C_{2G}		GST GND	2				10.00		0.41	0.41	1.000	2.059	0.0850	I /
	3	C_{3G}	B	GST GND	3				10.00		0.59	0.59	1.000	2.005	0.1190	I /
	4	C_{4G}		GST GND	4				10.00		0.59	0.59	1.000	1.974	0.1160	I /
	5	C_{5G}	C	GST GND	5				10.00		0.59	0.59	1.000	2.000	0.1170	I /
	6	C_{6G}		GST GND	6				10.00		0.65	0.65	1.000	2.005	0.1300	I /
CLOSED	7	$C_{1G} + C_{2G}$		GST GND	1&2			-0.044	10.00		0.40	0.40	1.000	3.971	0.1600	I /
	8	$C_{3G} + C_{4G}$		GST GND	3&4			-0.044	10.00		0.49	0.49	1.000	3.878	0.1910	I /
	9	$C_{5G} + C_{6G}$		GST GND	5&6			-0.050	10.00		0.50	0.50	1.000	3.903	0.1970	I /

BUSHING AND OIL TESTS

	TEST NO.	NO.	NAMEPLATE SERIAL #	% PF	CAP.	Dsg	Test Mode	TEST kV	CAP. (PF)	% POWER FACTOR MEAS.	20° C	CORR.	mA	WATTS	IR
C1 TESTS	10	1	E74505	0.50	420.00	L1	UST	10.00	410.34	0.55	0.55	1.000	1.547	0.0850	I /
	11	2	E74506	0.49	420.00	L2	UST	10.00	438.87	0.34	0.34	1.000	1.655	0.0560	G /
	12	3	E74504	0.50	421.00	L3	UST	10.00	411.38	0.54	0.54	1.000	1.551	0.0830	I /
	13	4	E74509	0.47	412.00	L4	UST	10.00	403.28	0.52	0.52	1.000	1.520	0.0790	I /
	14	5	E74508	0.50	420.00	L5	UST	10.00	410.72	0.54	0.54	1.000	1.548	0.0840	I /
	15	6	E74507	0.54	421.00	L6	UST	10.00	412.48	0.56	0.56	1.000	1.555	0.0870	I /
C2 TESTS	16	1	E74505		3,630.00	L1	UST	1.00	3,638.50	0.55	0.55	1.000	13.717	0.7550	I /
	17	2	E74506		3,710.00	L2	UST	1.00	3,801.30	0.31	0.31	1.000	14.331	0.4510	G /
	18	3	E74504		3,599.00	L3	UST	1.00	3,605.80	0.56	0.56	1.000	13.594	0.7660	I /
	19	4	E74509		3,558.00	L4	UST	1.00	3,540.20	0.52	0.52	1.000	13.346	0.6960	I /
	20	5	E74508		3,510.00	L5	UST	1.00	3,548.90	0.69	0.69	1.000	13.379	0.9270	I /
	21	6	E74507		3,839.00	L6	UST	1.00	3,644.40	0.53	0.53	1.000	13.740	0.7340	I /
OIL	22		TANK 1 OIL				UST								
	23		TANK 2 OIL				UST								
	24		TANK 3 OIL				UST								



INSULATION RATING: G=GOOD; D=DETERIORATED; I=INVESTIGATE; B=BAD; Q=QUESTIONABLE

NOTE: No. in ENG column is bushing energized, all other bushings must be floating.

TANK LOSS INDEX

TANK 1 = $W_7 - (W_1 + W_2) =$
TANK 2 = $W_8 - (W_3 + W_4) =$
TANK 3 = $W_9 - (W_5 + W_6) =$

Note: Subscripts are test no.s. Index may be positive or negative.

COMMENTS:
DEFICIENCIES:

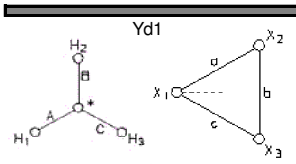
EQPT. INVENTORY NO.

TESTED BY: jrrivadeneyra

INSULATION TESTS
TWO-WINDING TRANSFORMERS

Your Company Logo

CUSTOMER: County Co-op | PAGE: 14 of 37
ADDRESS: 7833 West Road; Midland TX | JOB #: DEMO-JOB
USER: Hometown Utility; 789 Elm Street; Bryan TX 77840
OWNER REPRESENTATIVE: Ed Smith | TELEPHONE:
DATE: 2/7/2008 | TEMPERATURE: 82.4 °F | HUMIDITY: 0 % | EQPT. LOCATION: WA PARISH
SUBSTATION: A-123 | POSITION: MAIN



MFR	W	YEAR	1967
SER NO	7000786	WEATHER	SUNNY
WEIGHT	724000 LB	OIL TEMP	24 °C
TYPE	SEALED	BIL	550 kV
CLASS	FOA	PHASES	3
COOLANT	OIL	WDG MATERIAL	Cu
REASON	RETEST		
OIL VOLUME	11870 UG		

	VOLTAGE (kV)	MVA	RATED I	# TAPS	NOMINAL	CHANGER	TAP SETTING
PRIMARY:	150.4 / 86.83	600	7	5			
SECOND:	22	672	53	3	3		

BUSHING NAMEPLATE

DSG	SERIAL NUM	MFR.	TYPE/CLASS	kV	AMPS	YEAR
H1	1	W	O	138	3000	1967
H2	2	W	O	138	3000	1967
H3	3	W	O	138	3000	1967
HN	1-4	W	OS		3000	1974
L1						
L2						
L3						
LN						

TRANSFORMER OVERALL TESTS

TEST NO	INSULATION TESTED	TEST MODE	TEST CONNECTIONS (WINDINGS) ENG	GND	GAR	UST	TEST kV	CAPACITANCE C (pF)	% POWER FACTOR MEASURED	20 C %PF	CORR FACTOR	EQUIV mA	EQUIV WATTS	INDUCT-ANCE (H)	IR Auto/Man
1	C_{HG} + C_{HL}	GST GND	H	L			10.01	37,501.5			0.980	141.380	6.0150	187.77	/
2	C_{HG}	GST	H		L		10.00	12,197.4	0.46	0.45	0.980	45.984	2.1150	576.96	G /
3	C_{HL}	UST	H			L	10.00	25,321.2	0.41	0.40	0.980	95.460	3.9370	277.93	G /
4	C_{HL}		TEST 1 MINUS TEST 2					25,304.1	0.41	0.40	0.980	95.396	3.9000	0.00	OK
5	C_{LG} + C_{HL}	GST GND	L	H			9.01	71,954.2			0.980	271.270	11.8800	88.07	/
6	C_{LG}	GST	L		H		9.00	46,643.6	0.45	0.44	0.980	175.850	7.8560	135.77	G /
7	C_{HL}	UST	L			H	9.00	25,319.3	0.42	0.41	0.980	95.453	4.0070	250.16	G /
8	C_{HL}		TEST 5 MINUS TEST 6					25,310.6	0.42	0.41	0.980	95.420	4.0240		OK
9	C_{HG}'		C_{HG} MINUS HIGH BUSH.					10,924.6	0.46	0.45	0.980	45.984	2.1150		/
10	C_{LG}'		C_{LG} MINUS LOW BUSH.						0.45	0.44	0.980	175.850	7.8560		/

BUSHING C1 TESTS

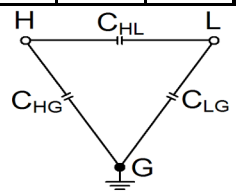
TEST NO.	BUSHING NO.	BUSHING SERIAL #		NAMEPLATE POWER FACTOR	NAMEPLATE CAPACITANCE (pF)	TEST kV	CAPACITANCE C (pF)	MEASURED	20 C %PF	CORR FACTOR	mA	WATTS	
11	H1	1	UST	0.46	432.00	10.00	423.32	0.48	0.50	1.040	1.596	0.0770	G /
12	H2	2	UST	0.44	436.00	10.01	427.66	0.48	0.50	1.040	1.612	0.0780	G /
13	H3	3	UST	0.43	431.00	10.01	421.74	0.46	0.48	1.040	1.590	0.0730	G /
14	H0	1-4	UST	0.65	468.00	10.01	533.84	0.69	0.61	0.880	2.013	0.1390	G /
15			UST										
16			UST										
17			UST										
18			UST										
19	OIL TEST												

NOTE: SHORT EACH WINDING ON ITSELF

INSULATION RATING KEY
- G = GOOD
- D = DETERIORATED
- I = INVESTIGATE
- B = BAD
- Q = QUESTIONABLE

- H = HIGH VOLTAGE WINDING
- L = LOW VOLTAGE WINDING
- G = GROUND
- N = NEUTRAL BUSHING

EQUIVALENT CIRCUIT



COMMENTS: PF Startup Test Satisfactory

DEFICIENCIES:

EQPT. INVENTORY NO. M4K | TESTED BY: MJ/FS

INSULATION TESTS
TWO-WINDING TRANSFORMERS

SURGE ARRESTERS

	LOCATION	SERIAL #	MFR	OVERALL CATALOG	UNIT CATALOG	TYPE	RATED kV	ORDER	TEST MODE	TEST kV	mA	WATTS	IR Auto/Man
20	H1 Top	88BS015-2	Jos	8110D0001J108		ZS	42		GND RB	10			/
21	H1 Bot.	88BS015-1	Jos	8110D0001J108		ZS	42		GND RB	10			/
22	H2 Top	88BS014-2	Jos	8110D0001J108		ZS	42		GND RB	10			/
23	H2 Bot.	88BS014-1	Jos	8110D0001J108		ZS	42		GND RB	10			/
24	H3 Top	88BS013-2	Jos	8110D0001J108		ZS	42		GND RB	10			/
25	H3 Bot.	88BS013-1	Jos	8110D0001J108		ZS	42		GND RB	10			/
26													/
27													/
28													/

BUSHING C2 TESTS

TEST NO.		BUSHING NO.	BUSHING SERIAL #		NAMEPLATE POWER FACTOR	NAMEPLATE CAPACITANCE (pF)	TEST kV	CAPACITANCE C (pF)	% POWER FACTOR MEASURED	% POWER FACTOR 20 C	% POWER FACTOR CORR FACTOR	EQUIV mA	EQUIV WATTS	IR Auto/Man
	29	H1	1	GRD		4,150.00	1.00	4,145.30	0.52	0.52	1.000	15.628	0.8120	I /
	30	H2	2	GRD		3,890.00	1.00	3,884.60	0.51	0.51	1.000	14.645	0.7460	I /
	31	H3	3	GRD		4,040.00	1.00	4,031.90	0.50	0.50	1.000	15.200	0.7600	I /
	32	H0	1-4	GRD			0.50	837.35	0.86	0.86	1.000	3.157	0.2710	I /
	33			GRD										
	34			GRD										
	35			GRD										
	36			GRD										

HOT COLLAR TESTS

	SERIAL #	DSG	TEST MODE	SKIRT #	TEST kV	mA	WATTS	IR Auto/Man
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								

TURNS RATIO TEST

					PHASE A					PHASE B					PHASE C				
		kV	STANDARD CAP. (pF)	CALC. RATIO		kV	CAP. (pF)	TURNS RATIO	% ERROR		kV	CAP. (pF)	TURNS RATIO	% ERROR		kV	CAP. (pF)	TURNS RATIO	% ERROR
47	H			6.8364	48					49					50				

COMMENTS:

DEFICIENCIES:

INSULATION TESTS
TWO-WINDING TRANSFORMERS

EXCITING CURRENT TESTS									
		MFR.	TYPE	STEPS	BOOST %	BUCK %	POSITION FOUND	POSITION LEFT	OIL VOLUME
51	De-Energized Tap Changer								
52	On-Load Tap Changer								

EXCITING CURRENT TESTS

			CONNECTIONS:	H1 - H0			H2 - H0			H3 - H0			
	DETC	LTC	TEST kV	mA	WATTS	X	mA	WATTS	X	mA	WATTS	X	IR Auto/Man
54				484.09	3007.8		410.11	2532.0		482.38	3008.2		
55													
56													

COMMENTS:

DEFICIENCIES:

LOW VOLTAGE POWER CIRCUIT BREAKER TEST

Your Company Logo

CUSTOMER: County Co-op | PAGE: 17 of 37
ADDRESS: 7833 West Road; Midland TX | JOB #: DEMO-JOB
USER: Hometown Utility; 789 Elm Street; Bryan TX 77840
OWNER REPRESENTATIVE: Ed Smith | TELEPHONE:
DATE: 2/7/2008 | TEMPERATURE: 57 °F | HUMIDITY: 32 % | EQPT. LOCATION: 2ND FLOOR
SUBSTATION: B-456 | POSITION: PP-2

MANUFACTURER	CUTLER-HAMMER	SN / SO NO.	413568	FRAME SIZE(F)	3200
BREAKER TYPE	MAGNUM DS 632	SENSOR TAPS	3200	MOUNTING	○ B.I. ◉ D.O.
FUSE CAT. NO.	NA	CUBICLE CODE	NA	THERMAL MEMORY	○ ON ◉ OFF
TRIP UNIT TYPE	DIGITRIP 1150	CATALOG NO.	11LSIG	ZONE INTLK ☑	TARGETS ☑

DESCRIPTION	INSPECTED	CONDITION	CLEAN/LUBE
CUBICLE AND RACKING DEVICES	☑	Good	
CONTACT FINGERS	☐	N/A	
LOADING AND ARCING CONTACTS	☐	N/A	
OVERCURRENT DEV. BATTERY	☑	Good	

DESCRIPTION	INSPECTED	CONDITION	CLEAN/LUBE
ARC CHUTES	☐	N/A	
AUXILIARY DEVICES	☐	N/A	
GROUND CONNECTION	☑	Good	
LOAD CONDUCTOR NO. 0	Size	CU ○ AL ○	

SETTINGS AS FOUND

RATING PLUG(R)	3200	LONG TIME PU	1	x	3200	A =	3200	A	DELAY	4		
SENSOR TAP	3,200	SHORT TIME PU	3X	=	9600	A			DELAY	0.3	I²T	○ IN ◉ OUT ○ N/A
GRD. FLT.	○ 3W ◉ 4W	INST. PU	OFF	=		A	○ ON ◉ OFF					
		GRD. FLT. PU	0.5	=	1200	A	◉ ON ○ OFF		DELAY	0.3	I²T	○ IN ◉ OUT ○ N/A

SETTINGS AS LEFT

RATING PLUG(R)	3200	LONG TIME PU	1	x	3200	A =	3200	A	DELAY	4		
SENSOR TAP	3,200	SHORT TIME PU	4X	=	12800	A			DELAY	0.5	I²T	◉ IN ○ OUT ○ N/A
GRD. FLT.	○ 3W ◉ 4W	INST. PU	OFF	=		A	○ ON ◉ OFF					
		GRD. FLT. PU	0.37	=	1184	A	◉ ON ○ OFF		DELAY	0.5	I²T	◉ IN ○ OUT ○ N/A

TCC NO. 70C1034

FUNCTION	TEST AMPERES	CURRENT MULTIPLE	TIME BAND MINIMUM	TIME BAND MAXIMUM	POLE 1 AS FOUND (seconds)	POLE 1 AS LEFT (seconds)	POLE 2 AS FOUND (seconds)	POLE 2 AS LEFT (seconds)	POLE 3 AS FOUND (seconds)	POLE 3 AS LEFT (seconds)
INSTANTANEOUS	NA									
	IPU									
SHORT TIME	19200	6	0.6	0.9	0.7680	0.7680	0.7784	0.7784	0.7584	0.7584
	STPU				13,634	13,634	13,634	13,634	13,626	13,626
LONG TIME	9600	3	15	38	14,263	14,263	14,498	14,498	14,055	14,055
	LTPU				3,558	3,558	3,579	3,579	3,543	3,543
	VOLTAGE DROP @ LONG TIME TEST CURRENT				1.50		1.51		1.53	
GROUND FAULT	4800	1.5	0.42	0.5	0.4636	0.4636	0.4680	0.4680	0.4756	0.4756
	GFPU				1,202	1,202	1,203	1,203	1,205	1,205

EQUIPMENT TEMPERATURE: 14 °C | TEMPERATURE CORRECTION FACTOR TO 20°C, TCF: 0.774

INSULATION RESISTANCE

	POLE 1 MΩ (P1-P2) READING	POLE 1 MΩ (P1-P2) 20°C	POLE 2 MΩ (P2-P3) READING	POLE 2 MΩ (P2-P3) 20°C	POLE 3 MΩ (P3-P4) READING	POLE 3 MΩ (P3-P4) 20°C
POLE TO POLE	2,000	1,548.00	2,000	1,548.00	2,000	1,548.00
POLE TO FRAME	2,000	1,548.00	2,000	1,548.00	2,000	1,548.00
LINE TO LOAD	2,000	1,548.00	2,000	1,548.00	2,000	1,548.00

POLE RESISTANCE - MICRO-OHMS READING		
POLE 1	POLE 2	POLE 3
10	12	13

CONTROL WIRING				COUNTER READING BEG/END	
READING	NT	20°C		0054	0092

COMMENTS: CONTROL WIRING INSULATION NOT TESTED DUE TO SOLID STATE TRIP UNIT. SHOP TEST GROUND CONNECTION/CUBICLE & RACKING DEVICES NOT INSPECTED. INSTANTANEOUS FUNCTION TURNED OFF; NOT TESTED.

DEFICIENCIES: THE BREAKER INTERMITTENTLY WOULD NOT CHARGE PROPERLY. INCIDENT OCCURRED TWICE. RACKING THE BREAKER OUT AND BACK WOULD CORRECT THE PROBLEM. BREAKER CLOSING ON CHARGING CYCLE.

EQPT. INVENTORY NO. 558879 | TESTED BY: JOE TESTER

OVERCURRENT RELAY

Your Company Logo

CUSTOMER: County Co-op | PAGE: 18 of 37
ADDRESS: 7833 West Road; Midland TX | JOB #: DEMO-JOB
USER: Hometown Utility; 789 Elm Street; Bryan TX 77840
OWNER REPRESENTATIVE: Ed Smith | TELEPHONE:
DATE: 2/8/2008 | TEMPERATURE: 57 °F | HUMIDITY: 32 % | EQPT. LOCATION: 2ND FLOOR
SUBSTATION: B-456 | POSITION: PP-2

NAMEPLATE DATA

MANUFACTURER: CUTLER-HAMMER | TYPE: DIGITRIP / 3000 | MODEL / STYLE NO.: 66D2005-01 /
LONG TIME RANGE: SEE INST. / | SEAL-IN RANGE: SEE INST. | INSTANTANEOUS RANGE: NA /
INSTRUCTION BOOKLET: 17555 / | TCC. NO.: SC6686 / 96 (PHASE RELAYS / NEUTRAL RELAY)
DEVICES OPERATED: 52 | CT RATIO: 600 :5

VISUAL INSPECTION

	phA	phB	phC	phN
COVER GASKET OK	☑	☐	☑	☐
GLASS CONDITION OK	☑	☐	☐	☑
NO FOREIGN MATERIAL	☑	☑	☑	☐
NO MOISTURE PRESENT	☑	☐	☐	☐
SPIRAL SPRING OK	☑	☑	☑	☐
BEARING ENDPLAY OK	☐	☑	☑	☐
BEARING CONDITION OK	☑	☐	☐	☑
DISC CLEARANCE OK	☑	☑	☑	☑
NO RUST PRESENT	☑	☐	☑	☑

ROUTINE MAINTENANCE

	phA	phB	phC	phN
GLASS CLEANED	☑	☐	☑	☐
CASE CLEANED	☑	☐	☑	☑
RELAY CLEANED	☑	☑	☐	☐
CONNECTION TIGHTENED	☐	☑	☑	☐
TAPS TIGHTENED	☑	☑	☑	☑
CONTACTS CLEANED	☑	☑	☑	☑
TRIP CIRCUIT TESTED	☐	☐	☐	☐
INSULATION RESISTANCE	☐	☐	☐	☐
CT SHORTING BAR REMOVED	☐	☐	☐	☐

RELAY SETTINGS

	TAP / TIME DIAL			SEAL - IN			INSTANTANEOUS		
	AS FOUND	SPECIFIED	AS LEFT	AS FOUND	SPECIFIED	AS LEFT	AS FOUND	SPECIFIED	AS LEFT
PHASE RELAYS	0.3 A/ 0.3	0.85 A/ 0.3	0.85 A/ 0.3	ADC	ADC	ADC	A	A	A
NEUTRAL RELAYS	0.1 A/ 0.4	0.1 A/ 0.9	0.1 A/ 0.9	ADC	ADC	ADC	A	A	A

PICKUP TESTS

PHASE	TIMING UNIT		SEAL - IN UNIT		INSTANTANEOUS UNIT	
	AS FOUND	AS LEFT	AS FOUND	AS LEFT	AS FOUND	AS LEFT
phA	4.257 A	4.257 A	NA ADC	NA ADC	OFF A	OFF A
phB	4.228 A	4.228 A	NA ADC	NA ADC	OFF A	OFF A
phC	4.241 A	4.241 A	NA ADC	NA ADC	OFF A	OFF A
phN	A	A	NA ADC	NA ADC	OFF A	OFF A

TIMING TESTS

PHASE	AS FOUND		SPECIFIED		AS LEFT		AS FOUND		SPECIFIED		AS LEFT		AS FOUND		SPECIFIED		AS LEFT	
	AMPS	SEC.	AMPS	SEC.	AMPS	SEC.	AMPS	SEC.	AMPS	SEC.	AMPS	SEC.	AMPS	SEC.	AMPS	SEC.	AMPS	SEC.
phA	0.45	2.09	1.275	2.10	1.275	2.09	0.9	0.519	2.55	0.52	2.55	0.519	1.5		4.25		4.25	
phB	0.45	2.07	1.275	2.10	1.275	2.07	0.9	0.488	2.55	0.52	2.55	0.488	1.5		4.25		4.25	
phC	0.45	2.05	1.275	2.1	1.275	2.05	0.9	0.508	2.55	0.52	2.55	0.508	1.5		4.25		4.25	
phN	0.15		0.15	5.90	0.15		0.3		0.3	1.60	0.3		0.5		0.5		0.5	

COMMENTS: NEUTRAL PICKUP : A: 0.465 B: 0.474 C: 0.477
TIMING A: 5.98/1.58 B: 5.93/1.58 C: 6.00/1.55

DEFICIENCIES:

EQPT. INVENTORY NO. 97972 | TESTED BY: JOE TESTER

ROTATING MACHINERY INSULATION TEST
STEP VOLTAGE TEST

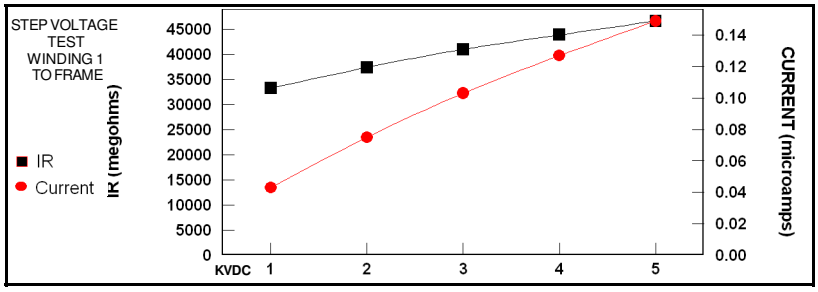
CUSTOMER	County Co-op	PAGE	19 of 37
ADDRESS	7833 West Road; Midland TX	JOB #	DEMO-JOB
USER	Hometown Utility; 789 Elm Street; Bryan TX 77840		
OWNER REPRESENTATIVE	Ed Smith	TELEPHONE	
DATE	2/7/2008	TEMPERATURE	95 °F
HUMIDITY	80 %	EQPT. LOCATION	YARD
SUBSTATION	B-456	POSITION	PP-2

SERIAL NO.	1-5-9280566	MACHINE		EXCITER MFR	
SPECIAL ID		TYPE		EXCITER S/N	
CIRCUIT		INS TYPE		EXCITER DESIGN	
MFR	WESTINGHOUSE	COOLING		EXCITER VOLTS	
MFR YEAR		INS NAME		EXCITER AMPS	
REASON	Routine	kVA 1	11000	EXCITER kW	
WEATHER	CLOUDY	kVA 2		EXCITER DRWG	
TANK TEMP	26 °C	hp/kw		EXCITER rpm	
YR RWND		SPEED/rpm	3600	EXCITER TYPE	
YR SERVICE		PWR FACTOR		RES S/N	
STATOR kV	11.5 L-L	CREW SIZE		SEMI-CON COAT	
FREQ Hz	60	STA AMP 1		VOLT GRADING APPLIED	
TYPE	Y - Y 3 PH	STA AMP 2		GLOBAL VPI	
VOLTS		POLES		H2 PRESS	
AMPS				H2 PRESS	
CONFIGURATION					

TEMPERATURE 26 °C TEMP. CORR. FACTOR (TCF) TO 20°C 1.38 MAX. TEST VOLTAGE 5 KVDC TEST TIME 5 minutes

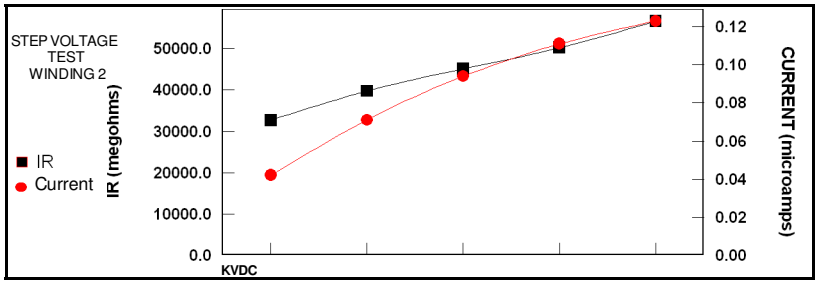
WINDING 1 TO FRAME

TIME (minutes)	STEP VOLT. (kVDC)	IR (megohms)	IR 20°C (megohms)	CURRENT (microamps)
1.0	1.00	24,100	33,258	0.043
2.0	2.00	27,100	37,398	0.075
3.0	3.00	29,700	40,986	0.103
4.0	4.00	31,800	43,884	0.127
5.0	5.00	33,800	46,644	0.149



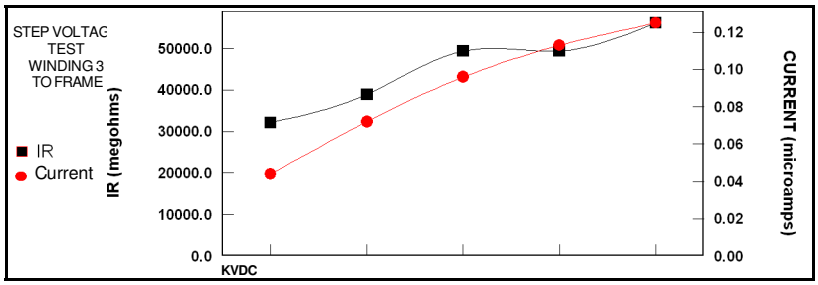
WINDING 2 TO FRAME

TIME (minutes)	STEP VOLT. (kVDC)	IR (megohms)	IR 20°C (megohms)	CURRENT (microamps)
1.0	1.00	23,700	32,706	0.042
2.0	2.00	28,800	39,744	0.071
3.0	3.00	32,700	45,126	0.094
4.0	4.00	36,400	50,232	0.111
5.0	5.00	41,100	56,718	0.123



WINDING 3 TO FRAME

TIME (minutes)	STEP VOLT. (kVDC)	IR (megohms)	IR 20°C (megohms)	CURRENT (microamps)
1.0	1.00	23,300	32,154	0.044
2.0	2.00	28,200	38,916	0.072
3.0	3.00	35,800	49,404	0.096
4.0	4.00	35,800	49,404	0.113
5.0	5.00	40,700	56,166	0.125



COMMENTS: INSIDE 2ND FLOOR POWER HOUSE TG #2
PHASES ISOLATED TEST SET MODEL MEGGER S1-552

DEFICIENCIES: DUST AND DEBRIS - CLEANED AND REMOVED

EQPT. INVENTORY NO. TESTED BY:

CABLE POLARIZATION INDEX (PI)TEST

Your Company Logo

CUSTOMER: County Co-op | PAGE: 20 of 37
ADDRESS: 7833 West Road; Midland TX | JOB #: DEMO-JOB
USER: Hometown Utility; 789 Elm Street; Bryan TX 77840
OWNER REPRESENTATIVE: Ed Smith | TELEPHONE:
DATE: 2/7/2008 | TEMPERATURE: 70 °F | HUMIDITY: 80 % | EQPT. LOCATION: 3 FLOOR WEST
SUBSTATION: C-985 | POSITION: PP-22

CABLE SOURCE: T1 TRANSFORMER | CABLE TERMINATION POINT: BREAKER B2
OPERATING VOLTAGE: 14400 kV | INSTALLED IN: CONDUIT | LENGTH: 3,000 FT
MANUFACTURER: ALCATEL | INSULATION TYPE: XLP | INSULATION THICKNESS: 220 MILS
SIZE: 500 KCMIL | NO. OF CONDUCTORS: 3CX3 | CONDUCTOR MATERIAL: ALUMINUM
RATED VOLTAGE: 15 kV | ○ GROUNDED | ◉ UNGROUNDED | ◉ BELTED | ○ SHIELDED | AGE: 1976
PHASE IDENTIFICATION: PHASE A: RED | PHASE B: YELLOW | PHASE C: BLUE

CONNECTED EQUIPMENT: | CABLE TEMPERATURE: 25 °C
TEST VOLTAGE: 10 kVDC | TEST VOLTAGE MULTIPLIER, K1: 1.00 | K2 = (K1)(TCF)
TEMPERATURE CORRECTION FACTOR TO 20°C, TCF: 2.3598 | TEST CONDUCTED ◉ BEFORE ○ AFTER HIGH POTENTIAL TEST
K = INSULATION RESISTANCE CONSTANT IN MEGOHMS: 20,000 | d = INSIDE DIAMETER OF INSULATION: 0.780
D = OUTSIDE DIAMETER OF INSULATION: 1.220 | $R = [\,K \log_{10} (\frac{D}{d})\,] (\frac{1000}{L_{(ft)}})$

MINUTES	PHASE A MEGOHMS				PHASE B MEGOHMS				PHASE C MEGOHMS			
	RDG	RANGE MULT	K2	20°C	RDG	RANGE MULT	K2	20°C	RDG	RANGE MULT	K2	20°C
0.25	201.0	1	2.3598	474.3	198.0	1	2.3598	467.2	105.0	1	2.3598	247.8
0.50	253.0	1	2.3598	597.0	242.0	1	2.3598	571.1	138.0	1	2.3598	325.7
0.75	319.0	1	2.3598	752.8	305.0	1	2.3598	719.7	178.0	1	2.3598	420.0
1.00	385.0	1	2.3598	908.5	375.0	1	2.3598	884.9	222.0	1	2.3598	523.9
1.25	471.0	1	2.3598	1,111.5	490.0	1	2.3598	1,156.3	296.0	1	2.3598	698.5
1.50	551.0	1	2.3598	1,300.2	575.0	1	2.3598	1,356.9	305.0	1	2.3598	719.7
1.75	631.0	1	2.3598	1,489.0	646.0	1	2.3598	1,524.4	310.0	1	2.3598	731.5
2.00	681.0	1	2.3598	1,607.0	710.0	1	2.3598	1,675.5	315.0	1	2.3598	743.3
2.50	797.0	1	2.3598	1,880.8	815.0	1	2.3598	1,923.2	317.0	1	2.3598	748.1
3.00	882.0	1	2.3598	2,081.3	912.0	1	2.3598	2,152.1	320.0	1	2.3598	755.1
4.00	968.0	1	2.3598	2,284.3	999.0	1	2.3598	2,357.4	320.0	1	2.3598	755.1
5.00	998.0	1	2.3598	2,355.1	1,025.0	1	2.3598	2,418.8	321.0	1	2.3598	757.5
6.00	1,010.0	1	2.3598	2,383.4	1,030.0	1	2.3598	2,430.6	322.0	1	2.3598	759.9
7.00	1,010.0	1	2.3598	2,383.4	1,035.0	1	2.3598	2,442.4	323.0	1	2.3598	762.2
8.00	1,010.0	1	2.3598	2,383.4	1,036.0	1	2.3598	2,444.8	323.0	1	2.3598	762.2
9.00	1,010.0	1	2.3598	2,383.4	1,036.0	1	2.3598	2,444.8	325.0	1	2.3598	766.9
10.00	1,010.0	1	2.3598	2,383.4	1,040.0	1	2.3598	2,454.2	326.0	1	2.3598	769.3
P.I. NO.*	0.381188				2.77333				1.46847			

* POLARIZATION INDEX = 10 MINUTE READING / 1 MINUTE READING

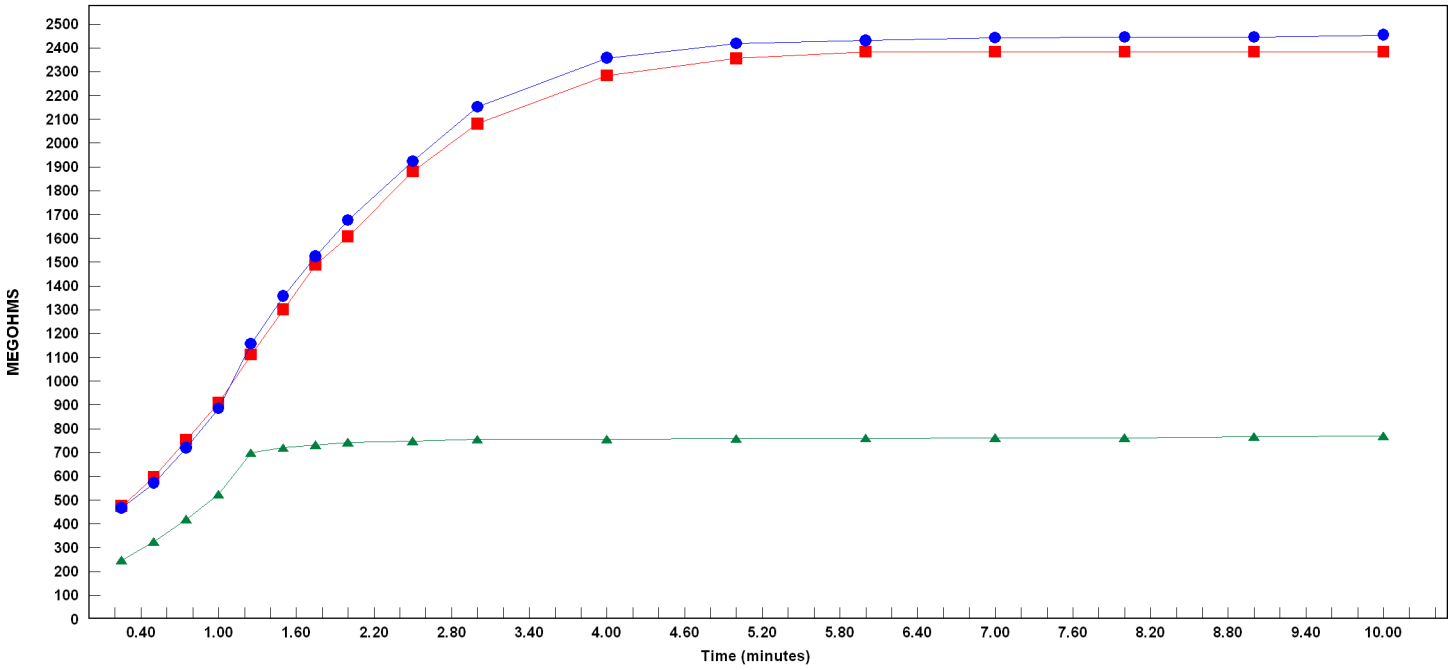
MINIMUM DESIGN INSULATION RESISTANCE, R = 1,295.10 MEGOHMS

COMMENTS:

DEFICIENCIES:

EQPT. INVENTORY NO. | TESTED BY:

POLARIZATION CURVE



Phase A: Red Square
Phase B: Blue Circle
Phase C: Green Triangle

CABLE HIGH POTENTIAL TEST

Your Company Logo

CUSTOMER: County Co-op | PAGE: 22 of 37

ADDRESS: 7833 West Road; Midland TX | JOB #: DEMO-JOB

USER: Hometown Utility; 789 Elm Street; Bryan TX 77840

OWNER REPRESENTATIVE: Ed Smith | TELEPHONE:

DATE: 2/8/2008 | TEMPERATURE: 57 °F | HUMIDITY: 32 % | EQPT. LOCATION: 3 FLOOR WEST

SUBSTATION: C-985 | POSITION: PP-22

CABLE SOURCE: SUBSTATION H | CABLE TERMINATION POINT: SUBSTATION L

OPERATING VOLTAGE: 13.2 KV kV | INSTALLED IN: CONDUIT | LENGTH: 100 FT

MANUFACTURER: PIRELLI CABLE | INSULATION TYPE: EPR | INSULATION THICKNESS: 220 MILS

SIZE: 4/0 KCMIL | NO. OF CONDUCTORS: 1C | CONDUCTOR MATERIAL: CU

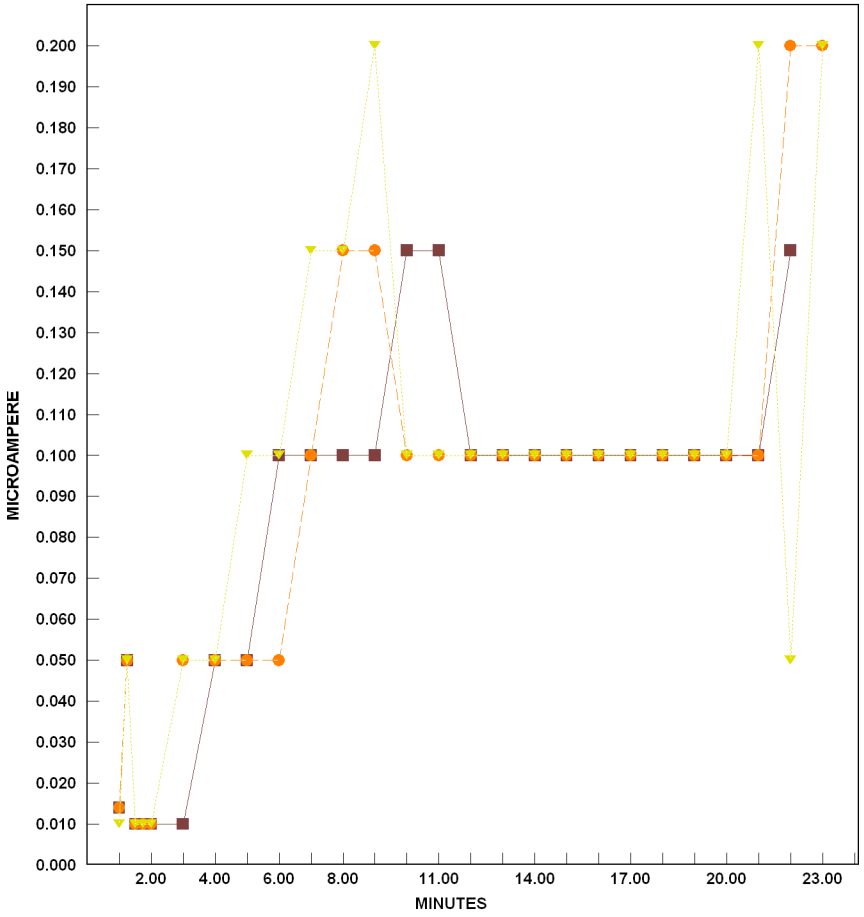
RATED VOLTAGE: 15 kV | (●) GROUNDED ( ) UNGROUNDED | ( ) BELTED (●) SHIELDED | AGE: NA

CONNECTED EQUIPMENT:

TIME MINUTES	TEST VOLTAGE	PHASE A µA	PHASE B µA	PHASE C µA
0.25	7.5	0.01	0.01	0.05
0.50	7.5	0.01	0.01	0.01
0.75	7.5	0.01	0.01	0.01
1.00	7.5	0.01	0.01	0.01
1.25	15	0.05	0.05	0.05
1.50	15	0.01	0.01	0.01
1.75	15	0.01	0.01	0.01
2.00	15	0.01	0.01	0.01
3.00	22.5	0.01	0.05	0.05
4.00	30	0.05	0.05	0.05
5.00	37.5	0.05	0.05	0.10
6.00	45	0.10	0.05	0.10
7.00	52.5	0.10	0.10	0.15
8.00	60	0.10	0.15	0.15
9.00	65	0.10	0.15	0.20
10.00	65	0.15	0.10	0.10
11.00	65	0.15	0.10	0.10
12.00	65	0.10	0.10	0.10
13.00	65	0.10	0.10	0.10
14.00	65	0.10	0.10	0.10
15.00	65	0.10	0.10	0.10
16.00	65	0.10	0.10	0.10
17.00	65	0.10	0.10	0.10
18.00	65	0.10	0.10	0.10
19.00	65	0.10	0.10	0.10
20.00	65	0.10	0.10	0.10
21.00	65	0.10	0.10	0.20
22.00	65	0.15	0.20	0.05
23.00			0.20	0.20
24.00				
25.00				
DECAY TO 5kV; SECS		7.55	7.45	8.22
SHIELD RESIST.- OHMS		0.7	0.4	.04

PHASE IDENTIFICATION

PHASE A: BROWN PHASE B: ORANGE PHASE C: YELLOW



COMMENTS:

DEFICIENCIES:

EQPT. INVENTORY NO. 96018 | TESTED BY: JOE TESTER

TJ | H2b ANALYTICAL SERVICES INCORPORATED

DISSOLVED GAS ANALYSIS

Report Date:
Report Number:

Job Number: DEMO-JOB
PO Number: 123456

COUNTY CO-OP
7833 WEST ROAD
MIDLAND, TX 79701

ATTN: ED SMITH

Location: MAINTENANCE YARD
Bank & Phase: BK1 PH 55
Serial Number: PFG3693
Manufacturer: STD
Equipment Type: TRANSFORMER
Model: L55

Year of Mfg.: 1998
kV Rating: 69
Breathing: N2 BLANKET
Cooling: OA/FA
Fluid Type: MINERAL OIL
Fluid Volume: 4567

Substation: C-985 Position: PP-22

Sample Date:	2/8/2008	10/24/2007	12/1/2006	3/15/2005	12/1/2004
Laboratory No.:					
Container No.:	439				
Temperature:	30	30	34	31	32
Hydrogen (ppm):	18	18	21	18	20
Methane (ppm):	13	13	18	14	15
Ethane (ppm):	3	3	5	4	4
Ethylene (ppm):	17	17	18	14	19
Acetylene (ppm):	10	10	11	12	8
Carbon Monoxide (ppm):	1,050	1,050	1,077	1,081	1,080
Carbon Dioxide (ppm):	10,106	10,106	10,205	10,145	10,200
Nitrogen (ppm):	87,586	87,586	88,789	88,001	88,866
Oxygen (ppm):	3,042	3,042	3,188	3,278	3,186
Total (ppm):	101,844	101,844	103,332	102,567	103,348
TDCG (ppm):	1,111	1,111	1,187	1,232	1,555
TDCG Rate (ppm/day):	0	0	0.01	0.2	0.1
TDCG (gallons):	0	0	0	0	0
TDHHG (ppm):	32	32	33	34	34
ETCG (% in blanket):	0.88	0.88	0.89	0.86	0.92
CH4 / H2:	0.722222	0.722222	0.857143	0.777778	0.75
C2H2 / C2H4:	0.588235	0.588235	0.611111	0.857143	0.421053
C2H2 / CH4:	0.769231	0.769231	0.611111	0.857143	0.533333
C2H6 / C2H2:	0.3	0.3	0.454545	0.333333	0.5
C2H4 / C2H6:	5.66667	5.66667	3.6	3.5	4.75
CO2 / CO:	9.62476				

Dissolved Gas Diagnostics

Key Gas Method:	
Doernenburg Ratios:	
Rodgers Ratios (3):	
Rodgers Ratios (4):	
CO2 / CO:	
Heat Index:	

IEEE Std. C57.104 - 1991

Condition: TDCG Level (ppm): TDCG Rate (ppm/day):

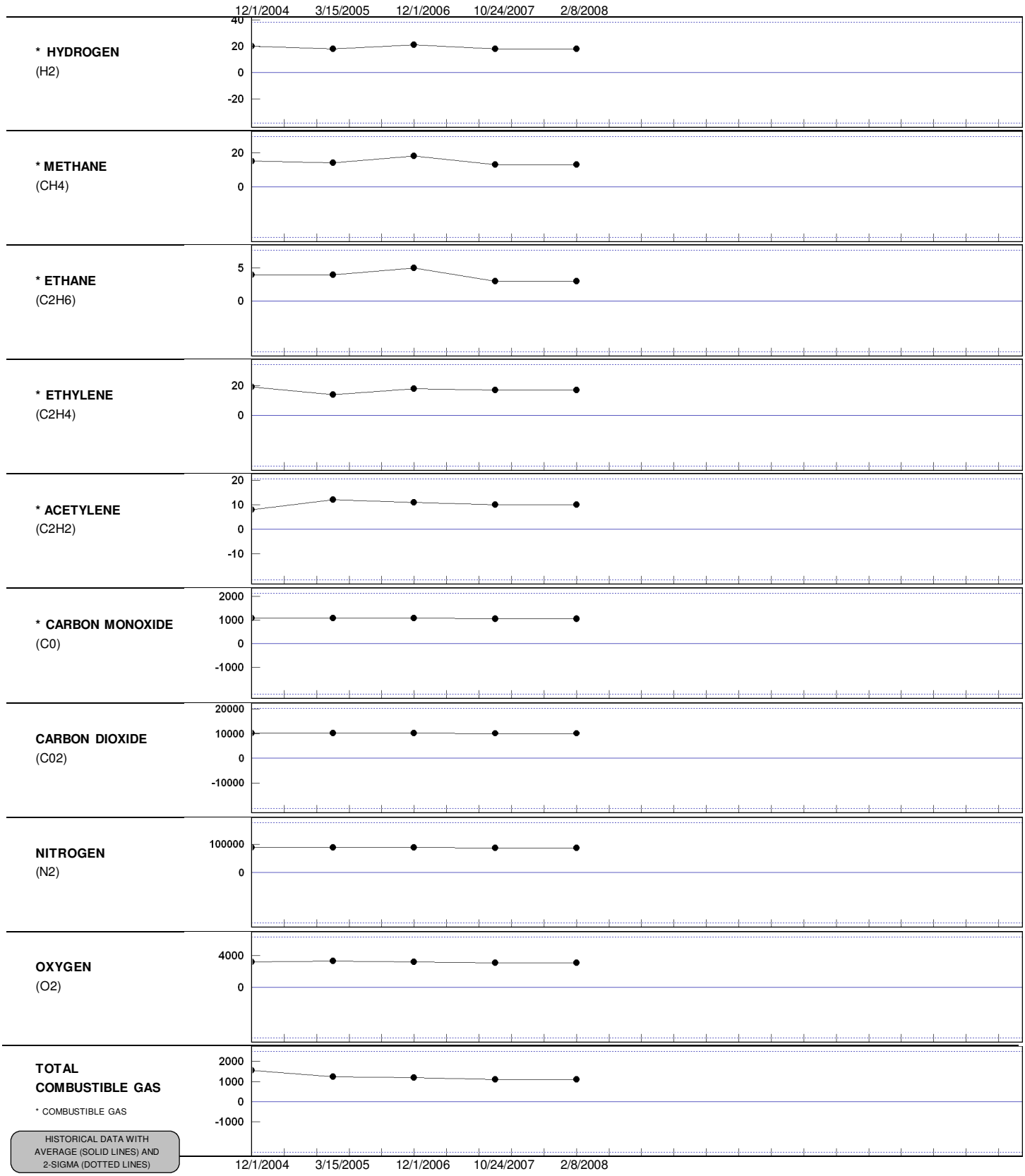
Sampling Interval:

Operating Procedure:

Comments:

- 3123 Fite Circle, Sacrmento, CA 95827, (916) 361-7177
- 1000 Riverbend Blvd: Suite O, St. Rose, LA 70087, (604) 468-8837
- 3098 Happy Valley Road, Sun Prairie, WI 53590, (608) 825-2022
- 204 Gale Lane, Kennett Square, PA 19348, (610) 925-0688

DISSOLVED GAS ANALYSIS



- 3123 Fite Circle
  Sacrmento, CA 95827
  (916) 361-7177
- 1000 Riverbend Blvd: Suite O
  St. Rose, LA 70087
  (604) 468-8837
- 3098 Happy Valley Road
  Sun Prairie, WI 53590
  (608) 825-2022
- 204 Gale Lane
  Kennett Square, PA 19348
  (610) 925-0688

DISSOLVED GAS ANALYSIS

WEIDMANN-ACTI INC.
222 FANNIN WAY
HOUSTON, TX
www.weidmann–acti.com

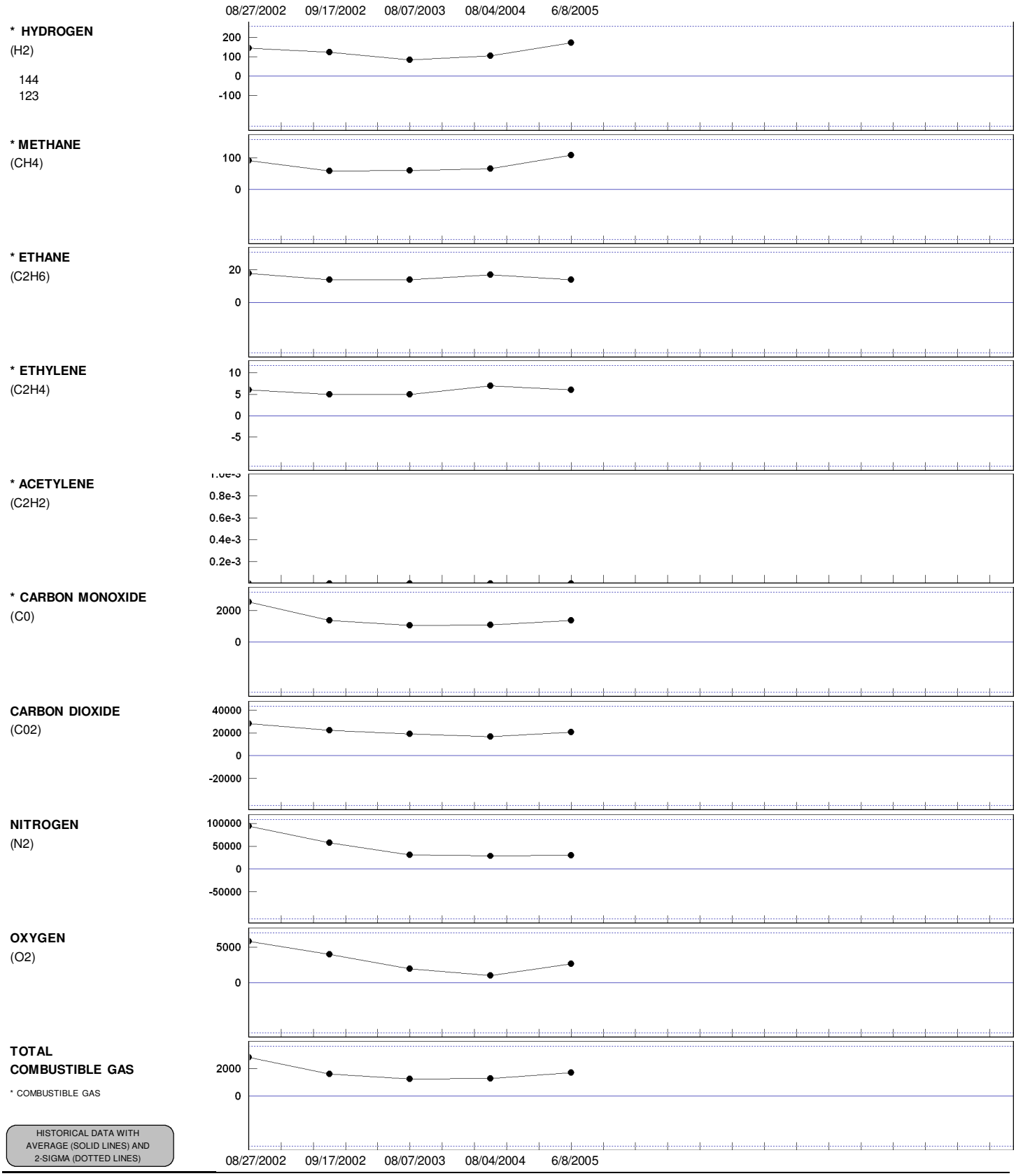
COUNTY CO-OP		SERIAL #	HCT05360201	MFR.	WEST	ACCOUNT	
7833 WEST ROAD		BANK/PH		KV		REPORT #	
MIDLAND, TX 79701		TANK	TRANSFORMER	KVA		CONTROL #	142878
		BREATHING	SEAL	% IMP. (% Z)	8.21	RECEIVED	6/10/2005
ATTN		FLUID	OIL	CONTAINER	S413	REPORTED	6/17/2005
P. O. #	7768-CASCADES	GALLONS	OILTRN	PROJECT ID		CUSTOMER ID	1124
LOCATION	CASCADES MA	SUBSTATION	C-985	POSITION	PP-22		

DISSOLVED GAS ANALYSIS	ASTM D-3612	LAB CONTROL NUMBER	142878				
	REPORT UNITS: PPM	DATE SAMPLED	6/8/2005	08/04/2004	08/07/2003	09/17/2002	08/27/2002
		ACTI REPORT NUMBER		127011		43720	30316
		OIL TEMP (C)	45	45	55	53	45
		HYDROGEN (H2)	172	104	84	123	144
		METHANE (CH4)	108	66	60	59	91
		ETHANE (C2H6)	14	17	14	14	18
		ETHYLENE (C2H4)	6	7	5	5	6
		ACETYLENE (C2H2)	0	0	0	0	0
		CARBON MONOXIDE (CO)	1386	1094	1069	1392	2544
		CARBON DIOXIDE (CO2)	20860	16911	19265	22377	28162
		NITROGEN (N2)	29662	28566	31351	57265	93767
		OXYGEN (O2)	2652	1029	1929	3967	5774
		TOTAL GAS	54860	47794	53777	85202	130506
		TOTAL COMBUSTIBLE GAS	1686	1288	1232	1593	2803
		EQUIVALENT TCG PERCENT	3.8971	3.8971	2.6831	1.9845	2.0944
OIL SCREEN	D-1533B	MOISTURE IN OIL (ppm)	6	6	37	5	28
		% SATURATION AT TOP OIL TEMP	4	4	19	3	18
	D-971	INTERFACIAL TENSION (dynes/cm)					
	D-974	ACID NUMBER (mg KOH/g)					
	D-1500	COLOR NUMBER (RELATIVE)					
	D-1524	VISUAL EXAM (RELATIVE)					
	D-1524	SEDIMENT EXAM (RELATIVE)					
	D-877	DIELECTRIC BREAKDOWN (kV)					
	D-1816	DIELECTRIC BREAKDOWN (kV mm-C)					
	D-924	POWER FACTOR-25 (%)					
	D-924	POWER FACTOR-100C (%)					
	D-1298	SPECIFIC GRAVITY (RELATIVE)					

DIAGNOSTICS	DGA KEY GAS / INTERPRETIVE METHOD (Most Recent Sample)	HYDROGEN WITHIN NORMAL LIMITS (500 PPM) (0.05%) ETHANE >=100 (0.01%): SPARKING, GENERAL OVERHEATING OR OTHER MINOR FAULTS. ACETYLENE WITHIN NORMAL LIMITS (1 PPM) (0.0001%) CARBON MONOXIDE >=1000 (0.1%): GENERAL CONDUCTOR OVERHEATING. CARBON DIOXIDE >=10000 (1%): GENERAL CONDUCTOR OVERHEATING. OXYGEN WITHIN NORMAL LIMITS (20000 PPM) (2%)
	DGA ROGERS RATIO METHOD	0-0-0: Normal operation.
	DGA CELLULOSE (PAPER) INSULATION	CO2/CO >= 7: Ratio indicates general overheating or aged insulation.
	DGA IEEE/ANSI (C57.104-1991) (Two most recent samples)	B-Retest Quarterly, 2-Exercise caution: analyze gas space and DGA, and load dependence.
	MOISTURE IN OIL	Moisture content acceptable for continued use (35 max@<=69kV (In Service))
	INTERFACIAL TENSION	
	ACID NUMBER	
	COLOR NUMBER, VISUAL, AND SEDIMENT	
	DIELECTRIC BREAKDOWN	
	POWER FACTOR	

DISSOLVED GAS ANALYSIS

USER	Hometown Utility; 789 Elm Street; Bryan TX 77840			PAGE	26 of 37
SUBSTATION	C-985	POSITION	PP-22	JOB #	DEMO-JOB
SERIAL NO.	HCT05360201				



FULL FALL OF POTENTIAL

CUSTOMER	County Co-op	PAGE	27 of 37
ADDRESS	7833 West Road; Midland TX	JOB #	DEMO-JOB
USER	Hometown Utility; 789 Elm Street; Bryan TX 77840		
OWNER REPRESENTATIVE	Ed Smith	TELEPHONE	
DATE	2/7/2008	TEMPERATURE	76 °F
HUMIDITY	60 %	EQPT. LOCATION	YARD
SUBSTATION	DEMO EAST SUB	POSITION	BANK 1

TYPE OF GROUND ROD	COPPERCLAD	NUMBER OF GROUND RODS	3
DIAMETER OF GROUND ROD	.625 cm	LENGTH OF GROUND RODS	10 METERS
SOIL TYPE	SANDY GLACIAL TILL WITH COBBLES	SOIL CONDITION:	○ DRY ◉ DAMP ○ WET
CONNECTING CONDUCTOR SIZE	#2 SOLID AWG	CONNECTING CONDUCTOR	◉ BARE ○ INSULATED
DIAGONAL MEASUREMENT OF GROUND GRID	14 METERS	GROUND TESTER MAKE/MODEL	MEGGER DET4TC
GROUND TESTER SERIAL NUMBER		LAST CALIBRATION DATE	

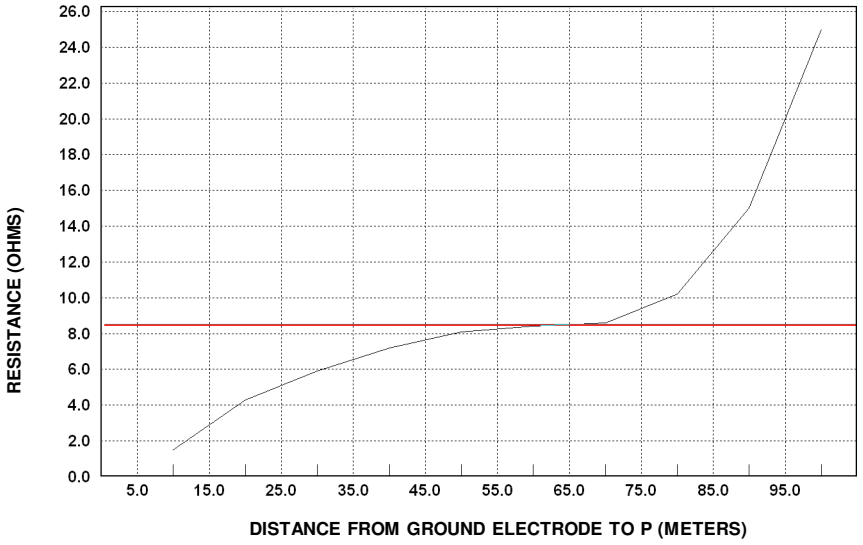
PROBE PLACEMENT DIRECTION: NE

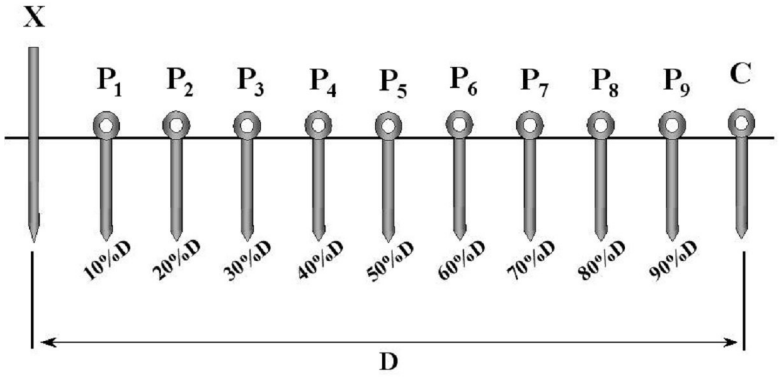
100 DISTANCE FROM GROUND ELECTRODE TO C IN METERS

DISTANCE IN METERS (GROUND ELECTRODE TO P)	PERCENT OF OVERALL DISTANCE	RESISTANCE READING (Ohms)
10	10.0 %	1.50 Ω
20	20.0 %	4.30 Ω
30	30.0 %	5.90 Ω
40	40.0 %	7.20 Ω
50	50.0 %	8.10 Ω
60	60.0 %	8.40 Ω
70	70.0 %	8.60 Ω
80	80.0 %	10.20 Ω
90	90.0 %	15.00 Ω
100	100.0 %	25.00 Ω
	%	Ω
	%	Ω
	%	Ω
	%	Ω
	%	Ω

RESULT: 8.47 OHMS

EARTH RESISTANCE CURVE





COMMENTS: Based on equipment manufacturer and customer requirements of 10.0 ohms or less, this site passed.
Suggest due to the value and importance of the equipment that the site be tested yearly.

DEFICIENCIES: None noted.

EQPT. INVENTORY NO. N/A

TESTED BY: Burt Brooks

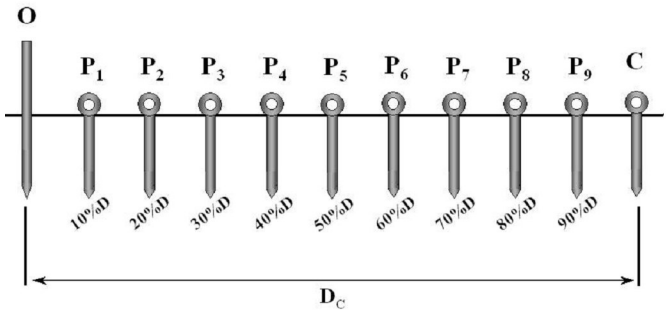
INTERSECTING CURVES

CUSTOMER	County Co-op	PAGE	28 of 37
ADDRESS	7833 West Road; Midland TX	JOB #	DEMO-JOB
USER	Hometown Utility; 789 Elm Street; Bryan TX 77840		
OWNER REPRESENTATIVE	Ed Smith	TELEPHONE	
DATE	2/8/2008	TEMPERATURE	76 °F
HUMIDITY	60 %	EQPT. LOCATION	YARD
SUBSTATION	DEMO EAST SUB	POSITION	BANK 1

TYPE OF GROUND ROD	COPPERCLAD	NUMBER OF GROUND RODS	3
DIAMETER OF GROUND ROD	.625 cm	LENGTH OF GROUND RODS	10 METERS
SOIL TYPE	SANDY GLACIAL TILL WITH COBBLES	SOIL CONDITION:	○ DRY ◉ DAMP ○ WET
CONNECTING CONDUCTOR SIZE	#2 SOLID AWG	CONNECTING CONDUCTOR	◉ BARE ○ INSULATED
DIAGONAL MEASUREMENT OF GROUND GRID	14 METERS	GROUND TESTER MAKE/MODEL	MEGGER DET4TC
GROUND TESTER SERIAL NUMBER		LAST CALIBRATION DATE	

PROBE PLACEMENT DIRECTION: NW

	DISTANCE FROM C TO O					
	1,000		800		600	
	TEST 1		TEST 2		TEST 3	
	DISTANCE IN METERS (P)	RESISTANCE (OHMS)	DISTANCE IN METERS (P)	RESISTANCE (OHMS)	DISTANCE IN METERS (P)	RESISTANCE (OHMS)
1	0	1.0	0	2.5	0	3.5
2	100	5.2	100	7.1	50	7.0
3	200	7.5	200	10.0	100	8.5
4	300	10.1	300	12.0	150	11.1
5	400	12.9	400	16.3	200	14.0
6	500	12.5	500	17.5	250	15.3
7	600	17.1	600	25.0	300	17.5
8	700	16.8	700	31.8	350	23.2
9	800	22.0			400	23.2
10	900	27.5			450	28.7



Measurement process is repeated with three different values for D_C

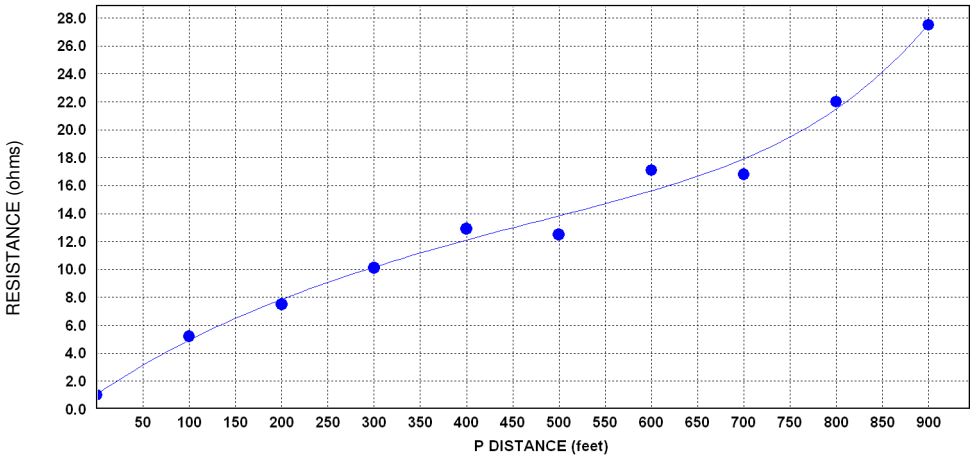
COMMENTS:

DEFICIENCIES:

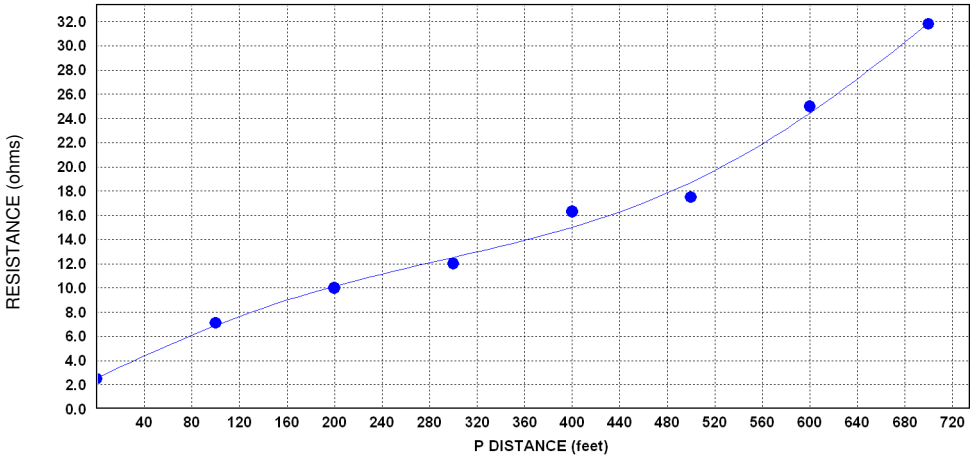
EQPT. INVENTORY NO. _____ TESTED BY: _____

INTERSECTING CURVES

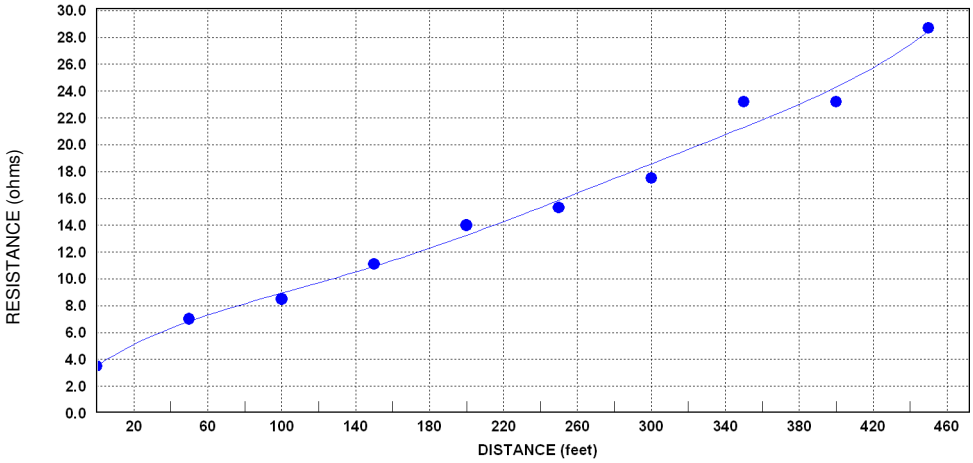
FALL OF POTENTIAL CURVE: O TO C = 1,000 METERS



FALL OF POTENTIAL CURVE: O TO C = 800 METERS



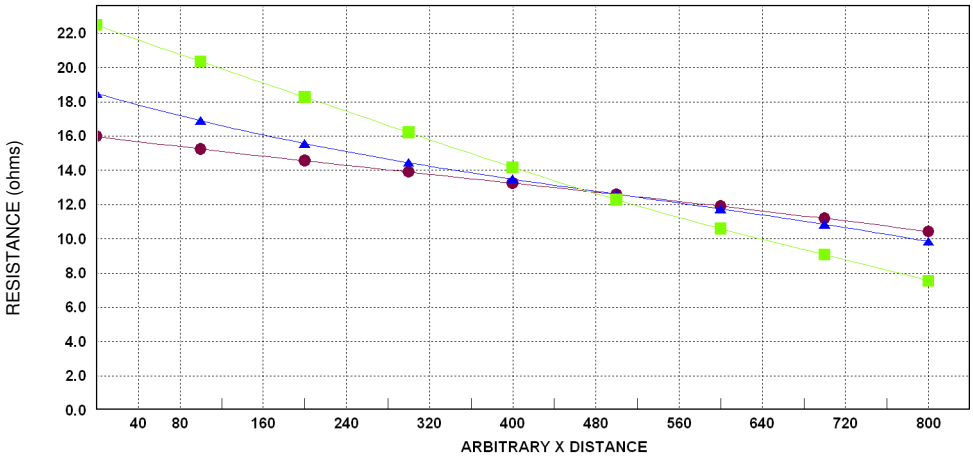
FALL OF POTENTIAL CURVE: O TO C = 600 METERS



INTERSECTING CURVES

ARBITRARY X DISTANCE	TEST 1 1000METERS		TEST 2 800METERS		TEST 3 600METERS	
	D p	RESISTANCE	D p	RESISTANCE	D p	RESISTANCE
0	618.0	16.0	494.4	18.5	370.8	22.5
100	579.8	15.2	456.2	16.9	332.6	20.3
200	541.6	14.6	418.0	15.6	294.4	18.3
300	503.4	13.9	379.8	14.4	256.2	16.2
400	465.2	13.2	341.6	13.5	218.0	14.2
500	427.0	12.6	303.4	12.6	179.8	12.3
600	388.8	11.9	265.2	11.7	141.6	10.6
700	350.6	11.2	227.0	10.8	103.4	9.1
800	312.4	10.4	188.8	9.8	65.2	7.5

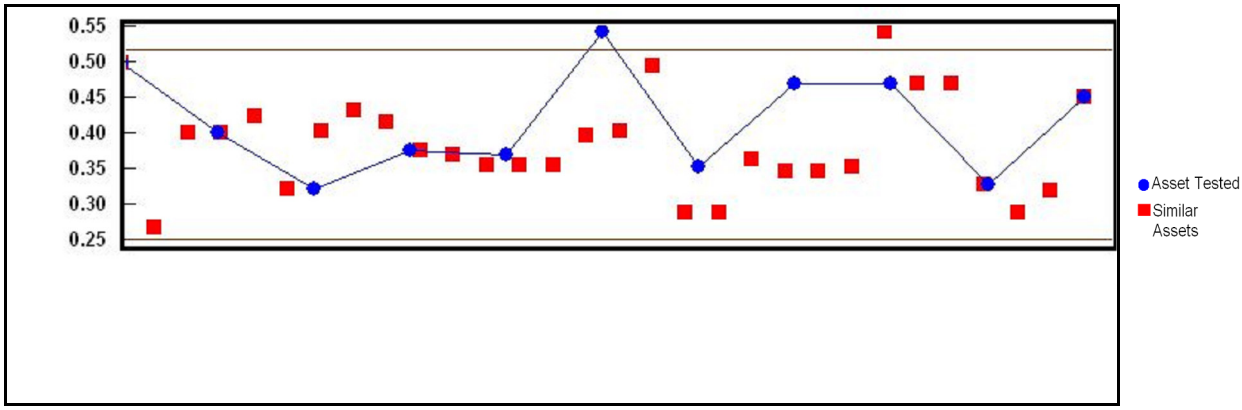
RESISTANCE VERSUS X DISTANCES (O to C = 600, 800and 1000METERS)



RESISTANCE RESULT: 12.7 OHMS

TRENDING

CUSTOMER	County Co-op	PAGE	31 of 37
ADDRESS	7833 West Road; Midland TX	JOB #	DEMO-JOB
USER	Hometown Utility; 789 Elm Street; Bryan TX 77840		
OWNER REPRESENTATIVE	Ed Smith	TELEPHONE	
DATE	4/1/2008	TEMPERATURE	82.4 °F
HUMIDITY	0 %	EQPT. LOCATION	WA PARISH
SUBSTATION	DEMO EAST SUB	POSITION	BANK 1



ASSET DESCRIPTION: Two Winding Transformer

TEST POINT: Test 2 Corrected Reading

NOTES:

COMMENTS:

DEFICIENCIES:

EQPT. INVENTORY NO.

TESTED BY:

BATTERY TEST

Your Company Logo

CUSTOMER County Co-op | PAGE 32 of 37

ADDRESS 7833 West Road; Midland TX | JOB # DEMO-JOB

USER Hometown Utility; 789 Elm Street; Bryan TX 77840

OWNER REPRESENTATIVE Ed Smith | TELEPHONE

DATE 2/6/2008 | TEMPERATURE 75 °F | HUMIDITY % | EQPT. LOCATION 2800 W. Raymond Street

SUBSTATION MAYWOOD | POSITION CONTROL_SCADA

STRING NAME: Control _ Scada | VOLTS PER CELL: | NOMINAL: | DUTY CYCLE: 0 Amps

INSTALLATION DATE: 8/14/06 | HYDROMETER. START/SKIP CELLS 1 / 1 | LOW LIMIT: | for 0 Minutes

NUMBER OF CELLS: 60 | NUMBER OF STRAPS: 59 | HIGH LIMIT: | to 0 VPC

CHARGER MANUFACTURER: ALCAD | EQUALIZATION VOLTAGE: Volts

MODEL: 1SCF-130-030-E | VOLTAGE: Volts

Min. Voltage: 2.210 Max. Voltage: 2.253

CELL #	IMPEDANCE (ohms)					VOLTAGE (volts)	SPECIFIC GRAVITY	TEMPERATURE °F	TIME	MODEL
	NOTES	VALUE	% VARIANCE (Baseline)	% DEVIATION (String)	% CHANGE (Last)					
1		0.464696	-88.4	-0.8	-4.2	2.23	1.213	81.8	13:49	NSB10FT/4/24
2		0.462068	-88.4	-1.4	-4.2	2.22	1.209	82.5	13:49	NSB10FT/4/24
3		0.467019	-88.3	-0.3	-4.7	2.23	1.206	82.5	13:50	NSB10FT/4/24
4		0.45994	-88.5	-1.8	-4.2	2.23	1.211	83.1	13:50	NSB10FT/4/24
5		0.46134	-88.5	-1.5	-4.7	2.23	1.214	83.1	13:51	NSB10FT/4/24
6		0.451939	-88.7	-3.6	-6.6	2.22	1.205	83.1	13:51	NSB10FT/4/24
7		0.462263	-88.4	-1.3	-4.9	2.23	1.217	83.1	13:52	NSB10FT/4/24
8		0.47099	-88.2	0.5	-5.7	2.22	1.213	83.5	13:52	NSB10FT/4/24
9		0.457694	-88.6	-2.3	-6.4	2.22	1.211	83.6	13:52	NSB10FT/4/24
10		0.457725	-88.6	-2.3	-6.1	2.23	1.213	83.7	13:53	NSB10FT/4/24
11		0.465601	-88.4	-0.6	-4.2	2.23	1.206	84.1	13:53	NSB10FT/4/24
12		0.457904	-88.6	-2.3	-6	2.22	1.207	84.2	13:54	NSB10FT/4/24
13		0.4569	-88.6	-2.5	-4.6	2.22	1.212	84.4	13:54	NSB10FT/4/24
14		0.45952	-88.5	-1.9	-7.8	2.23	1.21	84.4	13:55	NSB10FT/4/24
15		0.451728	-88.7	-3.6	-4.8	2.21	1.206	83.7	13:55	NSB10FT/4/24
16		0.468707	-88.3	0.0	-6.3	2.22	1.207	83.8	13:56	NSB10FT/4/24
17		0.467272	-88.3	-0.3	-4	2.22	1.211	83.8	13:56	NSB10FT/4/24
18		0.458781	-88.5	-2.1	-5.6	2.22	1.201	83.8	13:57	NSB10FT/4/24
19		0.464563	-88.4	-0.9	-3.6	2.24	1.207	83.7	13:57	NSB10FT/4/24
20		0.454724	-88.6	-3.0	-4.9	2.22	1.209	83.9	13:57	NSB10FT/4/24
21		0.463299	-88.4	-1.1	-4	2.23	1.216	83.8	13:58	NSB10FT/4/24
22		0.461805	-88.5	-1.4	-6.2	2.23	1.213	83.9	13:59	NSB10FT/4/24
23		0.471069	-88.2	0.5	-5.1	2.23	1.213	84.1	13:59	NSB10FT/4/24
24		0.460238	-88.5	-1.8	-5.1	2.22	1.208	84.1	13:59	NSB10FT/4/24
25		0.467951	-88.3	-0.1	-3.8	2.23	1.21	84.3	14:00	NSB10FT/4/24
26		0.458692	-88.5	-2.1	-5	2.23	1.212	84.3	14:00	NSB10FT/4/24
27		0.465874	-88.4	-0.6	-3.5	2.22	1.21	84.5	14:01	NSB10FT/4/24
28		0.462802	-88.4	-1.2	-4.1	2.23	1.217	84.6	14:01	NSB10FT/4/24
29		0.470774	-88.2	0.5	-5.1	2.23	1.212	84.5	14:02	NSB10FT/4/24
30		0.471452	-88.2	0.6	-5.6	2.22	1.208	85.1	14:02	NSB10FT/4/24
31		0.478638	-88.0	2.1	-2.6	2.24	1.21	80.3	14:03	NSB10FT/4/24
32		0.478477	-88.0	2.1	-4.1	2.25	1.21	80.5	14:03	NSB10FT/4/24
33		0.485109	-87.9	3.5	-3.5	2.24	1.21	80.3	14:04	NSB10FT/4/24
34		0.475337	-88.1	1.4	-4.3	2.24	1.211	80.1	14:04	NSB10FT/4/24
35		0.478076	-88.0	2.0	-3.7	2.25	1.209	80	14:04	NSB10FT/4/24
36		0.479314	-88.0	2.3	-5.1	2.25	1.209	79.9	14:05	NSB10FT/4/24
37		0.475962	-88.1	1.6	-3.9	2.24	1.209	79.8	14:05	NSB10FT/4/24
38		0.473448	-88.2	1.0	-5	2.24	1.208	79.8	14:06	NSB10FT/4/24
39		0.474373	-88.1	1.2	-3.7	2.25	1.209	79.9	14:06	NSB10FT/4/24
40		0.475076	-88.1	1.4	-3.7	2.25	1.21	79.8	14:07	NSB10FT/4/24
41		0.485593	-87.9	3.6	-4.1	2.25	1.213	79.7	14:07	NSB10FT/4/24
42		0.473033	-88.2	0.9	-3.6	2.25	1.215	79.6	14:07	NSB10FT/4/24
43		0.465909	-88.4	-0.6	-3.2	2.24	1.211	79.5	14:08	NSB10FT/4/24
44		0.473496	-88.2	1.0	-4.7	2.24	1.207	79.4	14:08	NSB10FT/4/24
45		0.476557	-88.1	1.7	-4.7	2.24	1.208	79.4	14:09	NSB10FT/4/24

EQPT. INVENTORY NO. | TESTED BY:

BATTERY TEST

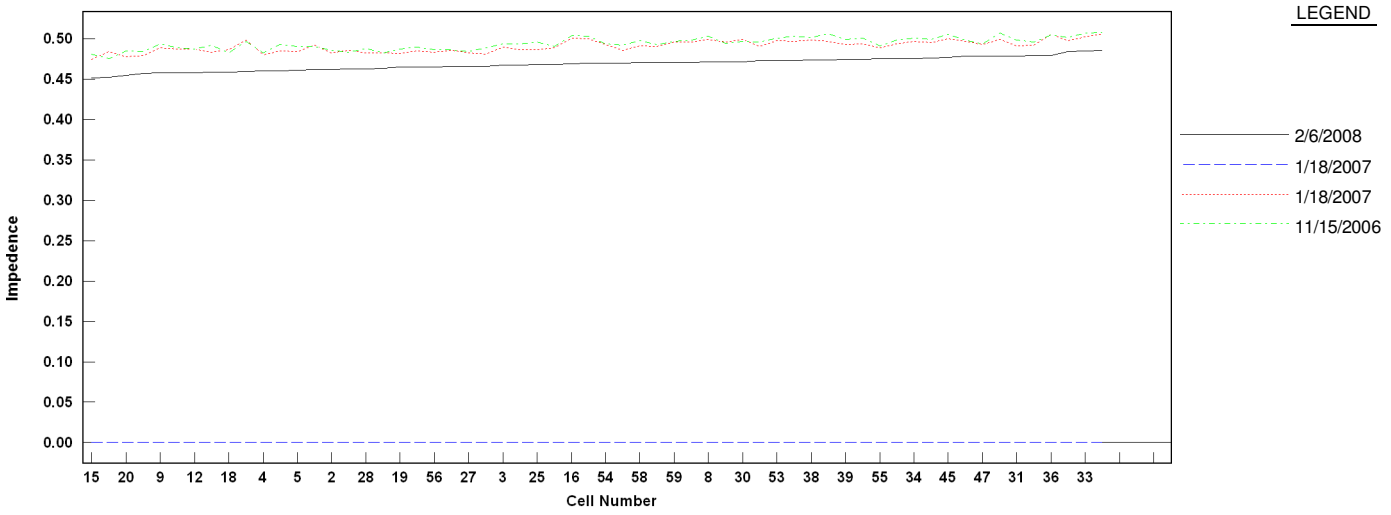
Min. Voltage: 2.210 Max. Voltage: 2.253

CELL #	IMPEDANCE (ohms)					VOLTAGE (volts)	SPECIFIC GRAVITY	TEMPERATURE °F	TIME	MODEL
	NOTES	VALUE	% VARIANCE (Baseline)	% DEVIATION (String)	% CHANGE (Last)					
46		0.474378	-88.1	1.2	-4	2.25	1.21	79.3	14:09	NSB10FT/4/24
47		0.478227	-88.0	2.1	-3	2.24	1.211	79.3	14:10	NSB10FT/4/24
48		0.468348	-88.3	-0.1	-4.2	2.24	1.208	79.3	14:10	NSB10FT/4/24
49		0.470059	-88.2	0.3	-3.2	2.25	1.212	79.2	14:11	NSB10FT/4/24
50		0.46972	-88.3	0.2	-6	2.24	1.211	79	14:11	NSB10FT/4/24
51		0.470199	-88.2	0.3	-4.1	2.24	1.212	79	14:11	NSB10FT/4/24
52		0.473073	-88.2	1.0	-4.7	2.25	1.213	79	14:12	NSB10FT/4/24
53		0.473057	-88.2	1.0	-5	2.24	1.213	79	14:12	NSB10FT/4/24
54		0.469963	-88.3	0.3	-4.6	2.24	1.213	78.9	14:13	NSB10FT/4/24
55		0.475059	-88.1	1.4	-2.9	2.23	1.204	79	14:13	NSB10FT/4/24
56		0.464946	-88.4	-0.8	-3.7	2.23	1.209	78.9	14:14	NSB10FT/4/24
57		0.479272	-88.0	2.3	-2.7	2.24	1.21	79	14:14	NSB10FT/4/24
58		0.470142	-88.2	0.3	-4.3	2.24	1.205	78.9	14:15	NSB10FT/4/24
59		0.470735	-88.2	0.5	-5.1	2.24	1.209	78.6	14:15	NSB10FT/4/24
60		0.484094	-87.9	3.3	-2.6	2.25	1.215	77.9	14:16	NSB10FT/4/24

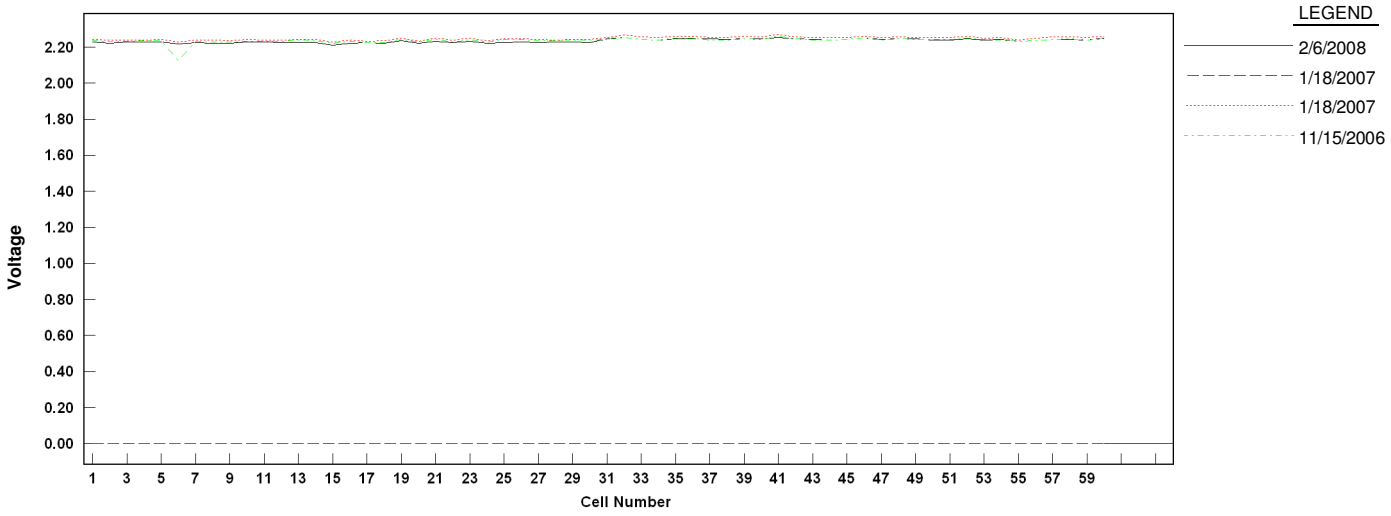
STRAP #	RESISTANCE (ohms)	MEASUREMENT TIME	CELL CONNECTED TO	TYPE
1	0.040156	13:49	1	Inter-cell
2	0.037924	13:50	2	Inter-cell
3	0.040775	13:50	3	Inter-cell
4	0.040288	13:50	4	Inter-cell
5	0.041841	13:51	5	Inter-cell
6	0.037286	13:51	6	Inter-cell
7	0.041701	13:52	7	Inter-cell
8	0.036146	13:52	8	Inter-cell
9	0.038501	13:53	9	Inter-cell
10	0.043643	13:53	10	Inter-cell
11	0.040107	13:53	11	Inter-cell
12	0.036633	13:54	12	Inter-cell
13	0.038861	13:54	13	Inter-cell
14	0.038839	13:55	14	Inter-cell
15	0.039865	13:55	15	Inter-cell
16	0.036083	13:56	16	Inter-cell
17	0.042411	13:56	17	Inter-cell
18	0.038519	13:57	18	Inter-cell
19	0.0424	13:57	19	Inter-cell
20	0.037375	13:58	20	Inter-cell
21	0.04016	13:58	21	Inter-cell
22	0.036475	13:59	22	Inter-cell
23	0.041808	13:59	23	Inter-cell
24	0.037783	14:00	24	Inter-cell
25	0.044957	14:00	25	Inter-cell
26	0.04078	14:00	26	Inter-cell
27	0.041839	14:01	27	Inter-cell
28	0.036021	14:01	28	Inter-cell
29	0.039425	14:02	29	Inter-cell
30	0.491282	14:02	30	Inter-cell
31	0.049664	14:03	31	Inter-cell
32	0.038251	14:03	32	Inter-cell
33	0.044601	14:04	33	Inter-cell
34	0.037821	14:04	34	Inter-cell
35	0.04267	14:05	35	Inter-cell
36	0.037816	14:05	36	Inter-cell
37	0.046753	14:05	37	Inter-cell
38	0.03733	14:06	38	Inter-cell
39	0.040249	14:06	39	Inter-cell
40	0.039775	14:07	40	Inter-cell
41	0.044522	14:07	41	Inter-cell
42	0.035492	14:08	42	Inter-cell
43	0.040368	14:08	43	Inter-cell
44	0.03947	14:08	44	Inter-cell
45	0.042956	14:09	45	Inter-cell
46	0.037748	14:09	46	Inter-cell
47	0.03906	14:10	47	Inter-cell
48	0.036214	14:10	48	Inter-cell
49	0.041493	14:11	49	Inter-cell

STRAP #	RESISTANCE (ohms)	MEASUREMENT TIME	CELL CONNECTED TO	TYPE
50	0.036366	14:11	50	Inter-cell
51	0.041034	14:12	51	Inter-cell
52	0.037359	14:12	52	Inter-cell
53	0.040341	14:12	53	Inter-cell
54	0.037467	14:13	54	Inter-cell
55	0.043348	14:13	55	Inter-cell
56	0.040415	14:14	56	Inter-cell
57	0.03975	14:14	57	Inter-cell
58	0.036793	14:15	58	Inter-cell
59	0.041297	14:16	59	Inter-cell

ASCENDING IMPEDANCE GRAPH

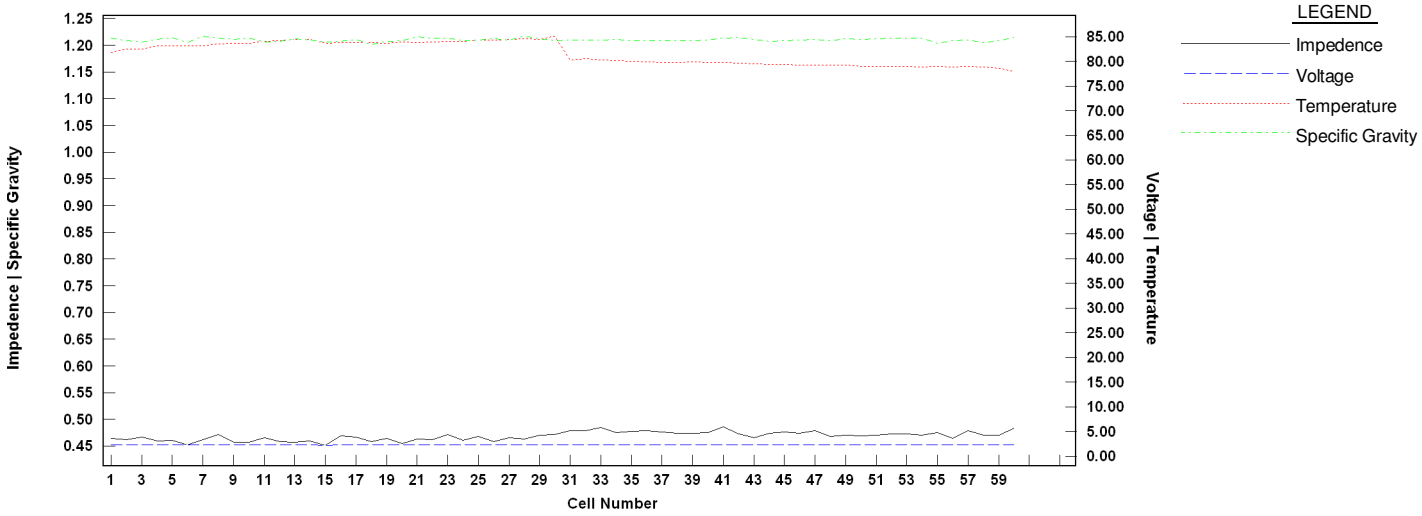


ALL TESTS GRAPH

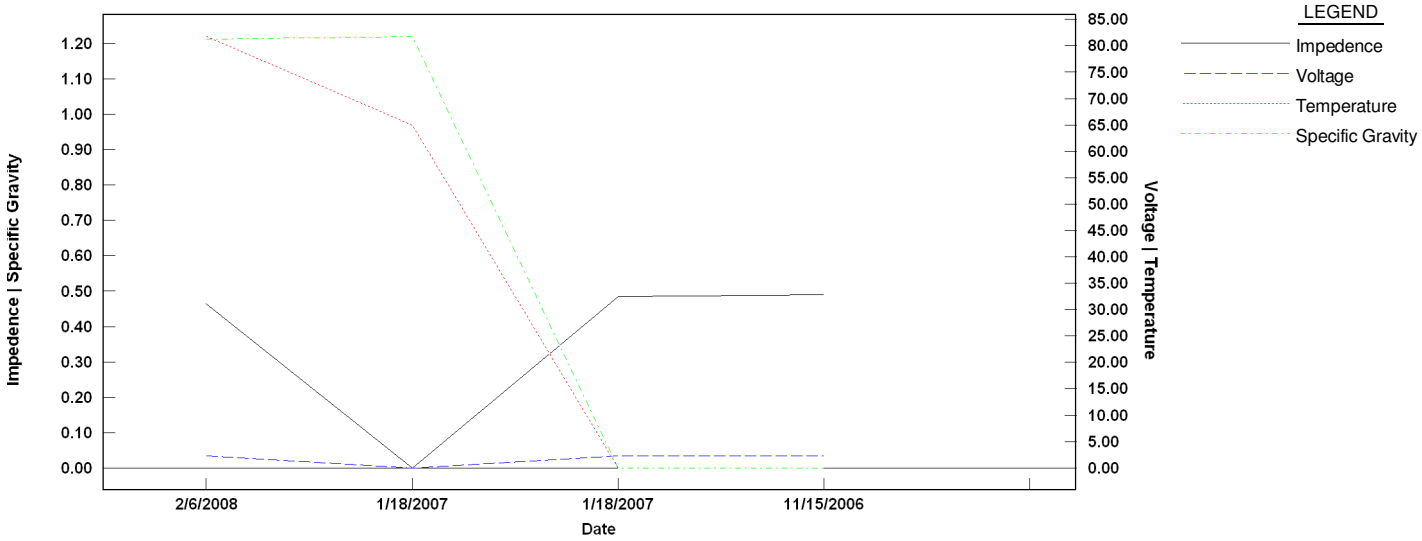


BATTERY TEST

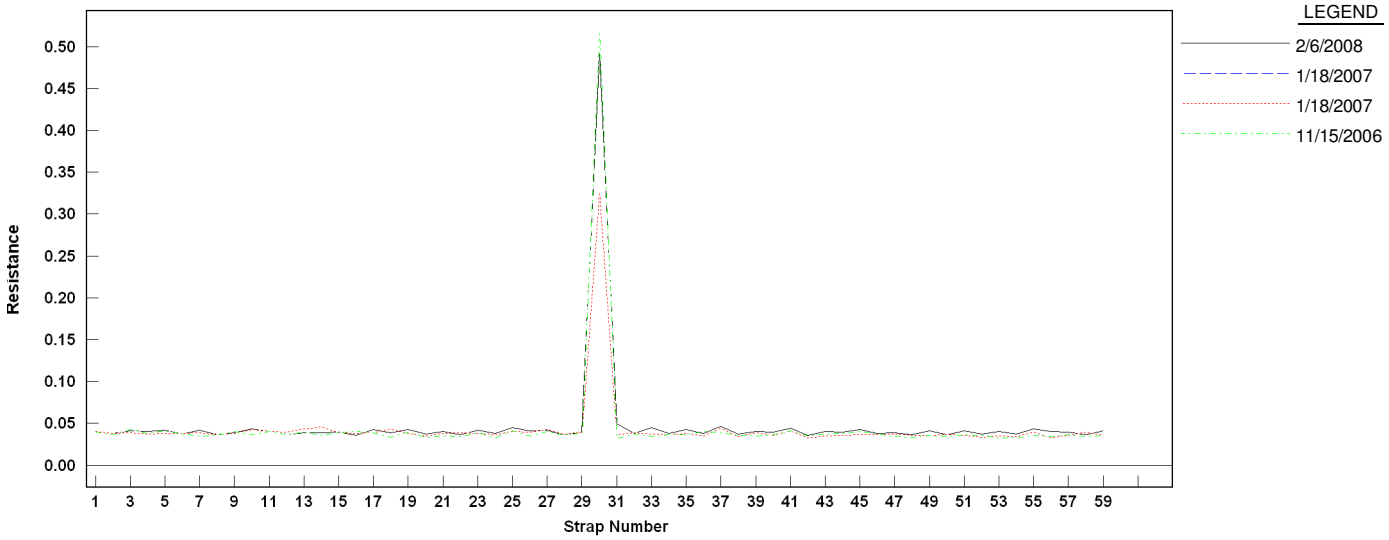
SELECTED TEST GRAPH



CELL MEASUREMENTS GRAPH CELL # 1

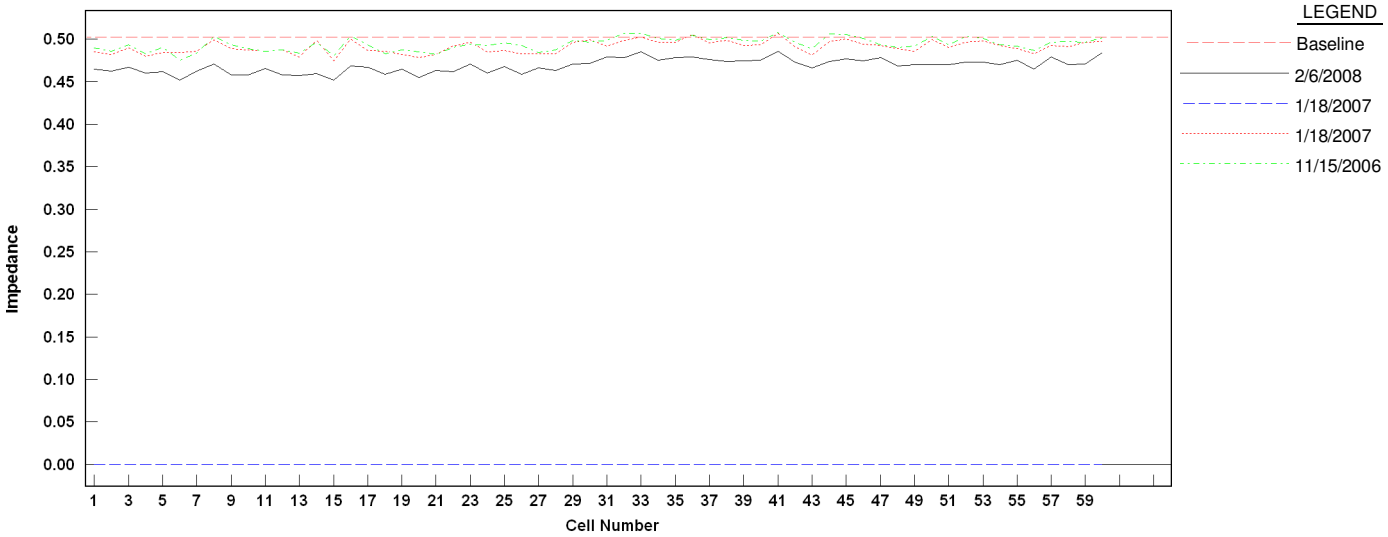


STRAP RESISTANCES GRAPH

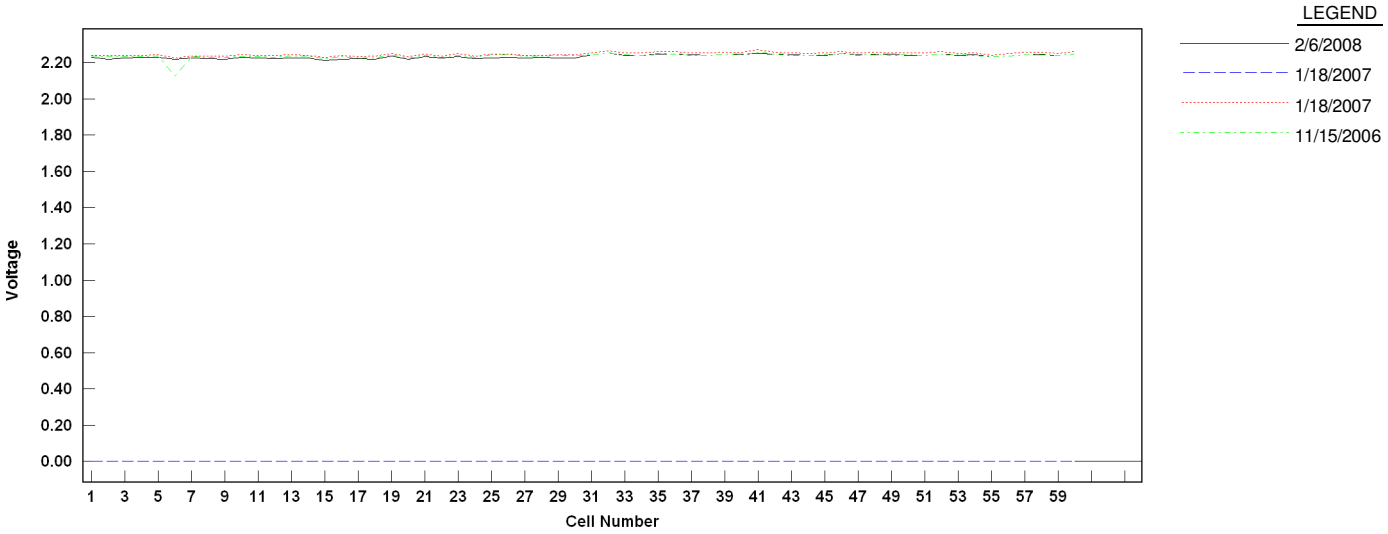


BATTERY TEST

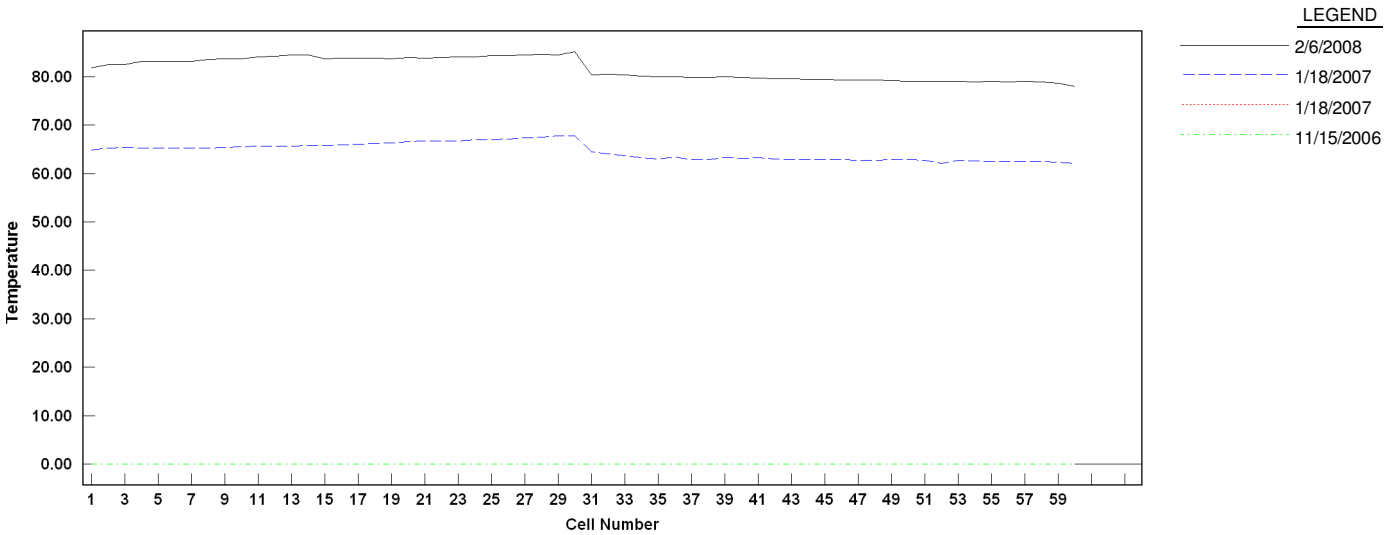
ALL TESTS IMPEDENCE GRAPH



ALL TESTS VOLTAGE GRAPH

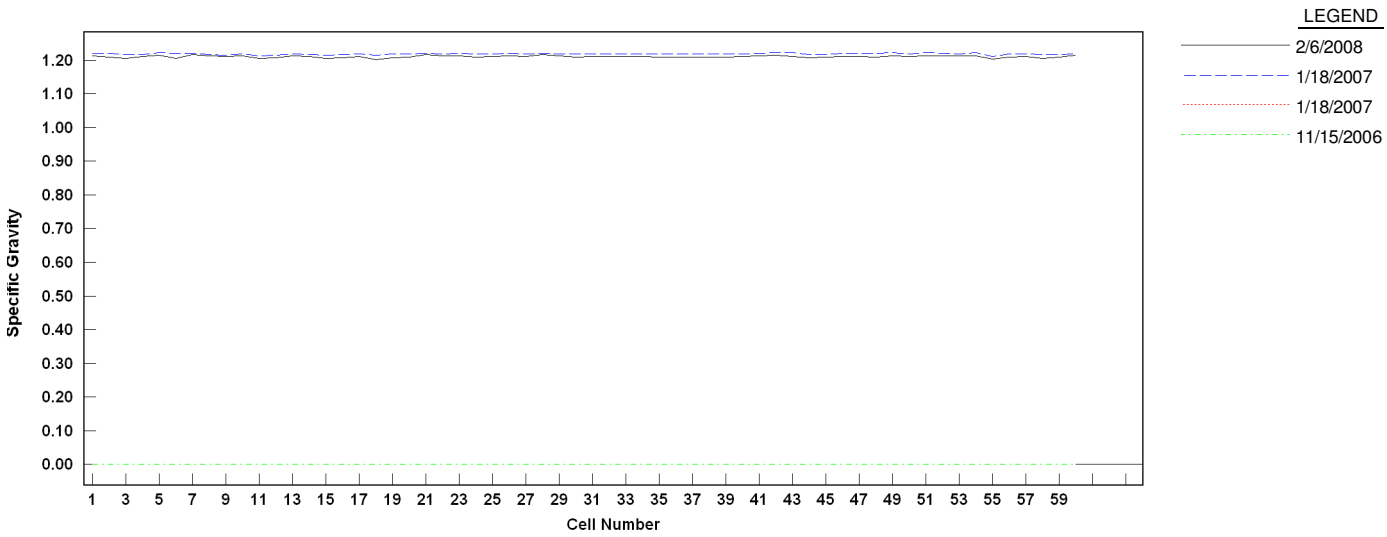


ALL TESTS TEMPERATURE GRAPH



BATTERY TEST

ALL TESTS SPECIFIC GRAVITY GRAPH



COMMENTS:

DEFICIENCIES:

Comment Summary
Job #DEMO-JOB

Customer County Co-op
User Hometown Utility

Plant: <None> Page: 14
Substation: A-123 Date: 2/7/2008
Position: MAIN
Equipment: 93500 - PF TWO-WINDING TRANSFORMERS

Comments: PF Startup Test Satisfactory

Plant: <None> Page: 17
Substation: B-456 Date: 2/7/2008
Position: PP-2
Equipment: 15000 - LOW VOLT. PWR. CKT. BKR. TEST

Comments: CONTROL WIRING INSULATION NOT TESTED DUE TO SOLID STATE TRIP UNIT. SHOP TEST GROUND CONNECTION/CUBICLE & RACKING DEVICES NOT INSPECTED. INSTANTANEOUS FUNCTION TURNED OFF; NOT TESTED.

Plant: <None> Page: 18
Substation: B-456 Date: 2/8/2008
Position: PP-2
Equipment: 45000 - OVERCURRENT RELAY

Comments: NEUTRAL PICKUP : A: 0.465 B: 0.474 C: 0.477
TIMING A: 5.98/1.58 B: 5.93/1.58 C: 6.00/1.55

Plant: <None> Page: 19
Substation: B-456 Date: 2/7/2008
Position: PP-2
Equipment: 98500 - ROTATING MACHINERY STEP VOLTAGE

Comments: INSIDE 2ND FLOOR POWER HOUSE TG #2
PHASES ISOLATED TEST SET MODEL MEGGER S1-552

Comment Summary
Job #DEMO-JOB

Plant: <None>
Substation: DEMO EAST SUB
Position: BANK 1
Equipment: 24400 - FULL FALL OF POTENTIAL

Page: 27
Date: 2/7/2008

Comments: Based on equipment manufacturer and customer requirements of 10.0 ohms or less, this site passed.

Suggest due to the value and importance of the equipment that the site be tested yearly.

Deficiency Summary
Job #DEMO-JOB

Customer County Co-op
User Hometown Utility

Plant: <None> Page: 12
Substation: A-123 Date: 2/7/2008
Position: MAIN
Equipment: 56360 - 3PH TTR WITH TAP CHANGER

Deficiencies: Tests 1,3,4 Failed

Plant: <None> Page: 17
Substation: B-456 Date: 2/7/2008
Position: PP-2
Equipment: 15000 - LOW VOLT. PWR. CKT. BKR. TEST

Deficiencies: THE BREAKER INTERMITTENTLY WOULD NOT CHARGE PROPERLY. INCIDENT OCCURRED TWICE. RACKING THE BREAKER OUT AND BACK WOULD CORRECT THE PROBLEM. BREAKER CLOSING ON CHARGING CYCLE.

Plant: <None> Page: 19
Substation: B-456 Date: 2/7/2008
Position: PP-2
Equipment: 98500 - ROTATING MACHINERY STEP VOLTAGE

Deficiencies: DUST AND DEBRIS - CLEANED AND REMOVED

Plant: <None> Page: 27
Substation: DEMO EAST SUB Date: 2/7/2008
Position: BANK 1
Equipment: 24400 - FULL FALL OF POTENTIAL

Deficiencies: None noted.